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EFFECTS OF WORKING CAPITAL MANAGEMENT ON THE PROFITABILITY OF PORTUGUESE MANUFACTURING FIRMS

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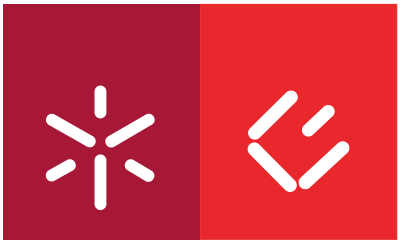

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EFFECTS OF WORKING CAPITAL MANAGEMENT ON THE PROFITABILITY OF PORTUGUESE MANUFACTURING FIRMS

ABSTRACT

The purpose of this study is to provide empirical evidence about the effects of working capital management on the profitability of Portuguese manufacturing firms. In accordance to this purpose, profitability was measured by the return-on-assets ratio and the efficiency of the working capital management was measured by the aggregate summary indicator: net trade cycle. A longitudinal database covering the period 1996-2006, collected from *Instituto Nacional de Estatística* (Portuguese Statistical Office), was analyzed under panel data methodology.

In line with previous research, the empirical findings of this study provide evidence that there is a negative linear relationship between profitability and net trade cycle. Moreover, a reduction in the average number of days of accounts receivable and in the average number of days of inventories leads to an increase in firm´s profitability. Also a decrease in the average number of days of accounts payable tends to increase profitability.

In addition, our study is the first one to test a non-linear relation between profitability and working capital management for a sample of Portuguese firms. Our results suggest a non-linear (concave) relationship between these two variables, which indicates there is an optimum net trade cycle level that maximizes firm's profitability.

EFEITOS DA GESTÃO DO FUNDO DE MANEIO NA RENDIBILIDADE DAS EMPRESAS DA INDÚSTRIA MANUFACTUREIRA PORTUGUESA

RESUMO

O objectivo deste estudo é evidenciar, através de uma análise empírica, os efeitos da gestão do fundo de maneio na rendibilidade das empresas da indústria manufactureira Portuguesa. De acordo com este objectivo, a rendibilidade foi medida pelo rácio rendibilidade dos activos e a eficiência da gestão de fundo de maneio foi medida pelo indicador agregado: ciclo financeiro de exploração. Para este efeito foram recolhidos, junto do Instituto Nacional de Estatística, dados longitudinais durante o período 1996-2006. Na análise dos dados foi aplicada a metodologia de dados em painel.

De acordo com pesquisas anteriores, os resultados empíricos deste estudo fornecem evidências da existência de uma relação linear negativa entre a rendibilidade e o ciclo financeiro de exploração. Além disso, uma redução do número médio de dias de contas a receber e do número médio de dias de inventários conduz a um aumento na rendibilidade das empresas. Também uma diminuição do número médio de dias de contas a pagar tende a aumentar a rendibilidade.

Adicionalmente, o nosso estudo é o primeiro a testar uma relação não linear entre a rendibilidade e o ciclo financeiro de exploração para uma amostra de empresas Portuguesas. Os nossos resultados sugerem uma relação não linear (côncava) entre a rendibilidade e o ciclo financeiro de exploração, o que indica a existência de um nível óptimo do ciclo financeiro de exploração que maximiza a rendibilidade das empresas.

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LIST OF ABBREVIATIONS

AP	Accounts Payable
AR	Accounts Receivable
CA	Current Assets Ratio
CAE	*Código Actividade Económica* (Code of Business Activities)
CCC	Cash conversion cycle
CL	Current Liabilities Ratio
EBIT	Earnings before interest and taxes
FE	Fixed Effects
FFA	Fixed financial assets ratio
GDP	Gross Domestic Product
GLS	Generalized Least Squares
INE	*Instituto Nacional de Estatística* (Portuguese Statistical Office)
INV	Inventories
IV	Instrumental variables
LSE´s	Large Scale Enterprises
NTC	Net trade cycle
OLS	Ordinary Least Squares
RE	Random Effects
ROA	Return-on-Assets
SG	Sales Growth
SME´s	Small and Medium Enterprises
U.S.	United States
WCCC	Weighted cash conversion cycle
WCM	Working capital management

1. INTRODUCTION

Most of the studies in corporate finance have focused on long-term financial decisions. However, short-run financial decisions, namely, working capital management (WCM) decisions (how much to invest in inventories and how much trade credit extend to customers or accept from suppliers) take up most of the time of financial managers (Richards and Laughlin, 1980). As noted by Gentry (1988), the working capital[1] is the connection, although sometimes neglected, between short-term financial management and strategic financial management decisions. As it is well known, the operating cycle is the main source of a firm´s cash inflows, which combines three basic activities — production, distribution and collection from customers (Richards and Laughlin, 1980). This suggests that a significant part of firm´s balance sheet is current assets and current liabilities. In this line, Fazzari and Petersen (1993) point out that firm´s investment in currents assets are of the same order of magnitude as fixed assets and, in manufacturing firms, working capital is more than half as large as the fixed assets. Also García-Teruel and Martínez-Solano (2007) stand out that current assets of small and medium-size enterprises (SME´s) in Spain represent, in average, more than half of its total assets.

If most firms have a large amount of cash invested in working capital, it can be expected that the way that working capital is managed will have a significant impact on firm´s profitability, mainly on industrial firms with long operating cycles (Deloof, 2003). Indeed, WCM may be crucial for the survival and growth, especially of small firms, and an inappropriate evaluation of a firm's working capital needs may increase the risk of default (Richards and Laughlin, 1980; Grablowsky, 1984). Thereby, the main goal of WCM is to improve financial performance while minimizing the risk associated with the reduction of the investment in current assets[2]. This can be achieved by identifying the main drivers of working capital, which are accounts receivable, inventories and accounts payable, commonly called working capital accounts. In this line, Gitman (2006:512) suggests that the main point of WCM is to manage the tradeoff between profitability and risk, which will depend on the working capital policies that

[1] Working capital represents the net investment in current assets. According to Gitman (2006:511), working capital represents the portion of investment that circulates in one form to another, i.e., from cash to inventory to receivables back to cash, in order to drive the operating cycle.

[2] Horne and Wachowicz (2005:212) point out that reducing the investment in current assets may increase risk in the following ways: reducing the number of days of receivables could lead firms to lose sales and customers, reducing inventory levels increases the probability of a stock-out and also lost of sales and, for last, decreasing cash reduces the firm´s capacity to meet its financial obligations.

firms adopt. According to Ross *et al.* (2008:752), those working capital policies will be reflected, at least, on two operating performance indicators: the size of firm´s investment in current assets and the financing of those current assets as the proportion of short-term debt to long-term debt. Conservative working capital policies mean a higher investment in working capital accounts, which will lead to a higher ratio of current assets to total assets and a lower ratio of short-term debt to total debt. This kind of short-term financial strategy means a decrease in risk but may also indicate a decrease in profitability. Differently, aggressive working capital policies mean a lower investment in working capital accounts and will be reflected in a lower ratio of current assets to total assets and a higher ratio of short-term debt to long-term debt. This type of working capital policies may indicate an increase in profitability but also an increase in risk.

Some empirical studies on this subject support the argument that aggressive working capital policies benefit profitability and others disagree on this. In fact, several previous studies found evidence that aggressive working capital policies tend to enhance profitability (Jose *et al.*, 1996; Shin and Soenen, 1998; Wang, 2002; Deloof, 2003; Valadas, 2005; García-Teruel and Martínez-Solano, 2007). However, some authors argue that adopting some strategies of conservative working capital policies may increase sales and that tends to increase profitability (Czyzewski and Hicks, 1992; Long *et al*., 1993; Deloof and Jeggers, 1996; among others). Although most of these previous studies discuss the possibility that firms may have an optimum working capital level (that maximizes firm´s profitability), empirical analysis assumes almost always a linear relationship between profitability and WCM measure.

Most recently, Baños-Caballero *et al*. (2011) provide evidence of a non-linear relation between profitability and WCM, which indicates that firms have an optimum working capital level that maximizes corporate profitability.

In this context, the main purpose of this study is to provide empirical evidence about the effects of WCM on the profitability of Portuguese manufacturing firms. According to this aim, we collected from *Instituto Nacional de Estatística* (INE) a longitudinal database covering the period 1996-2006. Our empirical findings provide evidence that there is a negative linear relationship between the profitability, measured by the return-on-assets ratio (ROA), and the WCM, measured by the aggregate indicator: net trade

cycle (NTC)[3]. Moreover, a reduction of the investment in current assets, namely a reduction in the average number of days of accounts receivable and in the average number of days of inventories, increases profitability. Also a decrease in the average number of days of accounts payable increases profitability and this result is opposite to what might be expected, although consistent with some previous studies (Jose *et al.*, 1996; Shin and Soenen, 1998; Wang, 2002; Deloof, 2003; Valadas, 2005).

This study is the first one to provide evidence of a non-linear relation between profitability and WCM for a sample of Portuguese firms. Such evidence suggests a non-linear (concave) relationship between these two variables, which indicates there is an optimum net trade cycle level that maximizes firm's profitability.

The remaining of this study is organized as follows. Section 2 provides a review of WCM literature, particularly in what concerns to working capital determinants, trade credit theories and market imperfections. Section 3 presents the hypotheses and methodology applied. Section 4 describes the sample and the variables used in this study. Section 5 reports and discusses empirical results. Finally, section 6 presents the main conclusions.

[3] NTC measures the working capital needs, relatively to firm's sales, expressed in days and called as days-sales (NTC=[((Accounts Receivable + Inventory - Accounts Payable)/Sales)*365]).

2. LITERATURE REVIEW

Several empirical studies found evidence of a significant impact of WCM on firm's profitability and this is a result of how working capital is managed. The corporate managers must take into account that working capital investments are not transformed into liquidity at the same time. Thereby, the management´s aim must be to assure the necessary amount of available funds to match firm's liquidity needs (Richards and Laughlin, 1980).

Liquidity ratios, such as current ratio[4], quick ratio[5] or even net working capital[6], are generally accepted as having limitations in measuring the efficiency of the firm's WCM because of their static nature. In this line, Richards and Laughlin (1980) point out that a liquidity analysis based on static balance sheet ratios can induce managers to misinterpret firm's liquidity position. They argue that liquidity, for the on-going firm, has to be analyzed under a dynamic approach that is based on the operating cash flow generated by current assets.

Given the need to find a performance indicator of WCM, Gitman (1974) developed the aggregate summary indicator: cash conversion cycle (CCC)[7]. The CCC is a performance indicator of WCM´s efficiency, which measures the number of days that funds are committed to inventories and accounts receivable minus the number of days that payment to suppliers is deferred. Indeed, the CCC combines data from balance sheet and income statement into a dynamic measure. Nevertheless, Gentry *et al.* (1990) suggest a weighted cash conversion cycle (WCCC) by arguing that it must be taking into account both the timing and the amount of funds used in each segment of the operating cycle. This approach is given in terms of dollar-days and it provides an aggregate summary measure of the amount of funds invested in working capital accounts. However, as noted by Shin and Soenen (1998), it is hard to use the WCCC because not all the required information is always available[8].

Later, Soenen (1993) introduces the NTC concept, a simpler and efficient WCM measure. He points out that the CCC is an additive measure whose denominators for the three components of working capital accounts are all different, making addition not

[4] Current ratio=Current Assets/Current Liabilities.
[5] Quick ratio=(Current Assets – Inventories)/Current Liabilities.
[6] Net working capital is defined as the difference between the firm´s current assets and its current liabilities.
[7] CCC=((Accounts Receivable/Sales) + (Inventories/Purchases) – (Accounts Payable/Purchases))*365.
[8] Also Deloof (2003) points out the same limitations of the WCCC measure.

useful. The NTC measure provides an estimator for working capital financing needs, expressed as a function of the projection of sales growth (Shin and Soenen, 1998).

At another level, the discussion of the pros and cons of investing in working capital involves a tradeoff between profitability and risk, i.e., decisions that tend to maximize profitability probably do not boost the chances of adequate liquidity (Smith, 1980). On the other hand, having only the focus at maximizing liquidity will tend to reduce the potential firm´s profitability. As mentioned before, the tradeoff between profitability and risk will depend on working capital policies adopted by firms, differentiated as conservative or aggressive.

Conservative working capital policies imply a larger CCC, which means a higher investment in working capital accounts, such as higher levels of inventories, extending more trade credit to customers and reducing supplier´s financing. Petersen and Rajan (1997) argue that conservative working capital policies may result in higher sales and, consequently, higher profitability. In this line, Blinder and Maccini (1991) and also Carpenter *et al.* (1994) argue that maintaining high inventories levels can prevent interruptions in operating cycle process and a reduction of the supply costs. They also point out that keeping a high inventory level reduces both the risk of losing customers due to the product´s scarcity and the risk of price fluctuations among business cycles.

Moreover, adopting conservative working capital policies may tend to increase profitability because trade credit allows customers to check if their purchases are as agreed in quantity and quality terms (Long *et al.*, 1993; Deloof and Jegers, 1996). In fact, trade credit may help improve financial performance of customers of smaller firms and of customers of high-tech firms with larger operating cycles (Long *et al.*, 1993)[9]. As noted by Emery (1987), trade credit also helps firms to increase sales in periods of low demand and to reduce transactions costs. According to Smith (1987), extend trade credit to customers helps to ensure that the services contracted have been carried out and it is an investment by the seller to get repeated sales from the customer.

Finally, adopting conservative working capital policies reflects a reduction on the supplier´s financing[10], which means taking advantage of prompt payment discount due to early payments. Shortening supplier´s financing also indicates a reduction of the cost of external financing (Ng *et al.*, 1999; Wilner, 2000; Baños-Caballero *et al.*, 2010).

[9] Long *et al.* (1993) point out that is reasonable that customers from firms, which produce high-tech products (such as computers or electronic goods), require a longer time period to check quality. On the other hand, buyers of perishable goods, where quality is observable (such as food, beverages or tobacco), require a shorter time to check quality.

[10] This trade credit is also known in the literature as spontaneous credit (Richards and Laughlin, 1980).

According to Czyzewski and Hicks (1992), firms which hold high cash and marketable securities balances tend to have a higher ROA ratio. However, their study was restricted to the use of static liquidity ratios. Baños-Caballero *et al.* (2010) argue that the CCC length is longer for older firms and for firms with greater cash flows, while being shorter for firms with more growth opportunities and for firms with higher leverage and larger investment in fixed assets, which suggests that the cost of financing has a negative impact on firm´s CCC.

One basic principle in finance is to collect receivables as soon as possible and postpone payments to suppliers as long as possible without damage the firm´s reputation (Gentry *et al.*, 1990). If the cost of a large CCC increases more than its benefits profitability will decrease because money is locked up, as the result of extending trade credit and maintaining high levels of inventories (Deloof, 2003). In fact, keeping a large CCC may also have an opportunity cost if the firm forgoes other more productive investments to maintain that investment level. In this line, Soenen (1993) argues that a large CCC might be a primary reason why firms go bankrupt. Also Gentry (1988), points out that liquidity weight and its effects on firm´s profitability is a primary concern of short-run financial management and that means the shorter the CCC the more liquid the firm. According to Hager (1976), firms that keep low cash balances usually have better operating performance, because cash is a low return investment.

Several previous empirical studies support the evidence that decreasing CCC, with the adoption of aggressive working capital policies, tends to increase profitability. Aggressive working capital policies indicate lower levels of investment in inventories, shortening trade credit and postponing payments to suppliers. Some of those studies used CCC to measure WCM efficiency. Jose *et al.* (1996), for a United States (U.S.) sample during the period 1974-1993, provide evidence of an inverse relationship between CCC and profitability. Consequently, firms which keep a shorter CCC tend to be more profitable because they tend to minimize the cost of holding unproductive assets (such as cash and marketable securities). They also find evidence that reducing the dependency of external financing preserves the firm´s debt capacity since less short-term borrowing is required to provide liquidity. Further, those results fit better to larger firms. Also Wang (2002), for a sample of public Japanese and Taiwanese firms from 1985 to 1996, has found evidence that the relationship between the CCC and profitability, measured by ROA, is negative. Furthermore, these findings indicate that the relation between CCC and ROA is sensitive to industry factors, such as competitive

forces, production processes and channels of marketing. Deloof (2003), for a sample of large non-financial Belgian firms during the period 1991-1996, has found evidence that corporate managers can create value by reducing the number of days of accounts receivable and inventories. This research suggests that there is a certain level of working capital requirement which potentially maximizes return. In addition, Deloof (2003) explains the negative relationship between profitability and payables arguing that less profitable firms need more time to pay their bills. Similar results were also obtained by García-Teruel and Martínez-Solano (2007), for a sample of Spanish SME´s, representing all sectors of activity during the period 1996-2002. This study differs from previous ones because authors have found no statistically significant impact on firm´s profitability when payment to suppliers is deferred.

Other empirical studies provide similar results but using NTC as a WCM performance measure. Soenen (1993) has found, for a sample of U.S. firms across industries, a significant negative relationship between NTC and profitability. Also Shin and Soenen (1998) provide, for a sample of non-financial U.S. firms during the period 1975-1994, evidence of a strong negative impact of the NTC on firm´s profitability. They argue that a shorter NTC reflects more efficient WCM and that means lower needs for external financing. Valadas (2005) has conducted a similar study for a sample of non-financial Portuguese firms, from various sectors of activity during the period 1996-2002. The author has found that when it comes to analyzing the impact of WCM on firm´s profitability, an increase in profitability will be caused, mainly, by the reduction of the inventories in percentage of sales.

Those previous empirical results provide evidence that both the NTC and the CCC are negatively correlated with profitability measures. In this line, Kamath (1989) has found evidence, for a sample of U.S. large retail firms, that NTC provides the same information as CCC and both measures are negatively correlated with profitability measures and with quick and current liquidity ratios.

In order to investigate the effects of WCM on firm´s value, Kieschnick *et al.* (2006) point out that U.S. firms overinvest in working capital. They also found that industry practices, firm size and future sales growth have a significantly influence on the WCM efficiency. Indeed, industry practices have a strong influence on working capital policies adopted by the firms. Hawawini *et al.* (1986), using a sample of U.S. firms during the period 1960-1979, have found evidence that there is a substantial industry effect on working capital policies, which is stable over time. They also provide evidence

of the existence of industries benchmarks to which firms adhere when implementing their working capital policies. Also Weinraub and Visscher (1998), using a U.S. sample of ten different industry groups during ten years, provided evidence that industries follow significantly different aggressive or conservative working capital policies. They found the existence of a strong trend that a more aggressive/conservative policy in one working capital account is balanced by a more conservative/aggressive policy in other working capital account. On the other hand, Baños-Caballero *et al*. (2010) suggest that firms have a target CCC to which they attempt to converge, which maximizes their profitability. They also found evidence that when firms are far from their CCC target the adjustment is quick, which might be explained by the fact that significant implicit costs occur during this unbalance, due to financial constraints under which firms operate.

As noted, most studies provide evidence that a decrease in working capital investment tends to increase profitability. However, it also increases the risk. In fact, the optimum working capital investment level is a tradeoff between profitability and risk. Most recently, Baños-Caballero *et al.* (2011), for a sample of Spanish SME´s, provide evidence that the relationship between profitability and CCC is non-linear (concave). Such evidence means that the relationship between profitability and CCC is positive for low levels of investment in working capital accounts, while being negative for higher levels of investment in working capital accounts. This finding indicates that there is an optimum working capital level that balances benefits and costs of investing in working capital and maximizes corporate profitability. According to Chiou *et al.* (2006), the optimum level of investment in working capital accounts is, mainly, determined by firms own characteristics. In this respect, also other outside factors, such as bargaining power with its suppliers and customers, availability of internal financing and cost of external financing, may affect the optimum working capital level (Baños-Caballero *et al.*, 2009)[11]. These outside factors are quite important because most firms have a large amount of cash invested in accounts receivable and trade credit is also a major source of financing through accounts payable (Deloof and Jegers, 1996; Petersen and Rajan, 1997; Wilner, 2000). Moreover, those outside factors are extremely important in small firms (Peel and Wilson, 1996).

La Porta *et al.* (1997) states out that most of Roman Law countries have a bank-based financial system and a less-developed capital market with lower investor

[11] According to Baños-Caballero *et al.* (2009), firms with more bargaining power have a shorter NTC.

protection and ownership concentration. In this line, the main sources of firm´s financing are net cash flows and spontaneous credit extended by suppliers (Whited, 1992; Fazzari and Petersen, 1993). Petersen and Rajan (1997) point out that supplier´s financing is the biggest and a very important source of short-term external finance and it can be an optimal source of financing when firms face adverse selection (Brennan *et al.*, 1988). In this line, Schwartz (1974) argues that firms able to obtain funds at lower costs will extend trade credit to firms facing higher financing costs. As noted by Long *et al.* (1993), financial theory suggests a positive correlation between trade credit and size, which means that larger firms extend more trade credit to customers. The main reason for suppliers to extend credit to customers that face adverse selection is because, in a repeated relationship with a buyer, the supplier has an implicit equity investment (Ng *et al.*, 1999)[12]. As pointed out by Emery (1984), extend trade credit to customers could be a more profitable short-term investment than marketable securities.

According to Danielson and Scott (2000), previous research about trade credit theories implicitly assumes that the use of trade credit is, at least partially, the result of credit rationing. Accepting trade credit from suppliers is a very expensive source of funds when discounts for early payment are not taken (Ng *et al*., 1999; Wilner, 2000; Niskanen and Niskanen, 2006). Petersen and Rajan (1997) point out that creditworthy customers will find the trade credit overpriced and repay it as soon as possible and, on the other hand, risky customers will find it worthwhile to borrow because trade credit may still be cheaper than others sources of external financing. In this line, Baños-Caballero *et al.* (2010) have found evidence that, in Spain, smaller firms use more trade credit from their suppliers, which can be explained because such firms operate under financial constraints. Also Silva and Carreira (2010), for a sample[13] of Portuguese firms across a wide range of industries, have found evidence that firms (mainly smaller firms) are financially constrained, as they have too many difficulties in accessing to external financing[14]. In that case, supplier financing is cheaper because of information asymmetry problems faced by firms when attempting to access to external financing. Indeed, firms extend trade credit because they may have a comparative advantage in

[12] An implicit equity investment could be, for instance, invest in employee's training to offer expertise assistance to customer´s business.

[13] Authors also collected data from INE.

[14] Also the European Commission, in the Annual Report of Small and Medium Enterprises of 2009, states that access to financing is a huge problem for SME´s that operate in the European Union. This analysis was conducted based on a survey to corporate managers.

assuring, by informal channels, that customers will pay (Demirguc-Kunt and Maksimovic, 2001).

Summarizing the state of art of WCM literature, most of previous studies provide evidence that adopting aggressive working capital policies enhances profitability. However, the empirical analysis in those studies was restricted to a linear relation between profitability and WCM efficiency measure. Most recently, Baños-Caballero *et al.* (2011) provide evidence that the relationship between those two variables is non-linear (concave), which indicates there is an optimum working capital level that maximizes corporate profitability.

On the other hand, accessing to external financing determines the working capital policies that firms will adopt, because it affects trade credit and may be a huge problem when firms face agency costs due to asymmetric information. All these issues affect the optimum working capital level that maximizes firm`s profitability.

3. HYPOTHESES AND METHODOLOGY

Given the fact that most firms have a large amount of cash invested in working capital accounts it can therefore be expected that WCM will have a significant impact on firm's profitability. The effects of such impact will depend on working capital policies adopted by firms, which are sensitive to industry factors and also to financial constraints. In sum, the aim of WCM is to achieve an optimum level of working capital investment that maximizes corporate profitability.

The purpose of this study is to provide empirical evidence about the effects of WCM on the profitability of Portuguese manufacturing firms. In order to achieve that aim, we will test empirically some hypotheses.

3.1 Hypotheses

In line with the previous empirical studies on WCM subject, we will start the empirical analysis testing hypotheses based on linear relationships. Thus, the first hypothesis concerns the impact of WCM efficiency on profitability. The following hypotheses concern the relationship between profitability and working capital accounts.

- *Hypothesis 1*: There is a negative relationship between firm´s profitability and the NTC length.
- *Hypothesis 2*: A reduction of the average number of days of accounts receivable will have a positive impact on profitability.
- *Hypothesis 3*: A reduction of the average number of days of inventories will have a positive impact on profitability.
- *Hypothesis 4*: An increase in the average number of days of accounts payable increases profitability.

We will also examine the existence of a non-linear (concave) relationship between profitability and WCM efficiency.

- *Hypothesis 5*: There is an optimum NTC level that maximizes corporate profitability.

3.2 Methodology applied

In order to test the effects of WCM on profitability we conduct two different kinds of analysis. Firstly, we conduct a univariate analysis in function of the profitability measure ROA. Secondly, we carry on a multivariate analysis based on multiple regression analysis to test the relationship between dependent, independent and control variables.

The first methodology, univariate analysis, is adopted as a preliminary study of the relationship between average values of dependent, independent and control variables in function of ROA quartiles. The aim is to test the statistical significance of the differences between the most profitable firms (represented in the fourth quartile of the ROA variable) and the less profitable firms (represented in the first quartile of the ROA variable).

The second methodology applied in this study is multivariate analysis, based on multiple regression analysis. This kind of analysis involves more lengthy and complex procedures than the first one. Being this an empirical longitudinal study, data is analyzed under panel data methodology. According to Brooks (2008:488-9), this kind of methodology presents important benefits: (i) gives access to more information by combining time-series (over time) and cross-sectional (across different entities)[15], which allows to address more complex issues than would be possible with time-series or cross-sectional data; (ii) allows the use of a larger number of observations, which will ensure the asymptotic properties of the estimators and will increase the degrees of freedom and that means more robust and meaningful *t* test and *F* test; (iii) reduces the risk of multicollinearity, since the data between entities have different structures; (iv) increases the efficiency and stability of the estimators by conducting adequate regression methods and hypotheses tests that allow a safe choice between different methods[16]; (v) allows to introduce dynamic adjustments. As pointed out by Baum (2006:219), panel data also allows controlling for unobserved cross section heterogeneity, making it possible to exclude biases derived from the existence of individual effects. That is possible because it confines the heterogeneity to the intercept term of the relationship.

The identification and estimation of the panel data models requires a previous test to identify the correct method (Wooldridge, 2002:288-9). Such method implies, firstly, analyzing the data considering Pooled Ordinary Least Squares (OLS), in order to test if

[15] In this study the entities represent the firms that compose our dataset.
[16] The Hausman test is a good example of such benefit, as it will be seen ahead.

there are unobserved heterogeneity effects across entities (in this case, across firms). The Pooled OLS estimation provides an *F* Statistic test under a null hypothesis that the constant terms are equal across entities. If the null hypothesis is rejected it means there are unobservable individual effects that have to be properly treated. The Hausman test is then used to determine if the unobservable heterogeneity term[17] is uncorrelated or not with the regressors (explanatory variables), while continuing to assume that the regressors are uncorrelated with the disturbance term in each time period. The null hypothesis of this test is that the unobservable heterogeneity term is uncorrelated with regressors. If the null hypothesis is not rejected, there will be random effects (RE) and the model is then estimated by Generalized Least Squares (GLS). If the null hypothesis is rejected, the effects are considered to be fixed and the model is then estimated by fixed-effects (FE). The FE method implies that data pass through a time-demeaning process to get "rid" of individual effects and then coefficients are estimated by OLS (Wooldridge, 2002:267). This estimation method assumes that the unobservable heterogeneity term captures the effects of those variables that are particular to each firm and that are constant over time (Wooldridge, 2002:248). Another important assumption of the FE estimation method is that those time-invariant characteristics are unique to the entity and should not be correlated with other entity's characteristics. A disadvantage of FE methodology is that it eliminates anything that is time-invariant from the model[18] (Wooldridge, 2002:266).

The presence of heteroskedasticity and serial correlation[19] in FE estimation requires the adoption of clustered robust standard errors (Cameron and Triverdi; 2009:233). Clustering is based on the reasonable assumption that observations of the same firm (cluster) across time are correlated with each other, whereas uncorrelated with observations of other firms.

As mentioned before, in FE estimation the unobservable heterogeneity term is correlated with the regressors and, as point out by Cameron and Triverdi (2009:231), this allows a limited form of endogeneity, while continuing to assume that the regressors are uncorrelated with the disturbance term. According to García-Teruel and

[17] In this particular study, unobservable individual effects can be defined as the characteristics of each firm (e.g., management style, location, financing structure, industry, etc.).

[18] Wooldridge (2002:266) argues that if the unobservable heterogeneity term can be arbitrarily correlated with the regressors, there is no way to distinguish the time-constant observables effects from the time-constant unobservable effects.

[19] A modified Wald test for GroupWise heteroskedasticity in FE regression model (suggested by Greene, 2003:328) and a Wooldridge test (Wooldridge, 2002:275) for serial correlation must be carried on, under the null hypothesis that residuals are homoskedastic and there is no serial correlation.

Martínez-Solano (2007) and Baños-Caballero *et al.* (2010), if results of regression analysis are affected by endogeneity it could be possible that independent variables in the estimation are being affected by the dependent variable and not vice-versa, and this casts doubts on the results of some previous studies about WCM. This suggests that we need a method to determine whether a particular regressor must be treated as endogenous. In order to test and to deal with endogeneity problems, we use panel instrumental variables (IV) methodology. Cameron and Triverdi (2009:281) point out that the IV methodology provides a consistent estimation by assuming the existence of valid instruments. According to them, an instrumental variable must satisfy two requirements: instruments must be correlated with the endogenous independent variable but under the exogeneity assumption that they are uncorrelated with the disturbance term. Given the fact that, in FE estimations, it may be reasonable to assume that observations on the same firm (cluster) in two different time periods are correlated, but observations on two different firms are not, it is also reasonable to assume that valid instruments are the endogenous independent variables lagged one or more periods. However, the use of, at least, two instruments for each endogenous independent variable, is the only way to carry on the Hansen test, which is based on overidentifying restrictions. This is a test for the absence of correlation between the instruments and the disturbance term, under the null hypothesis that instruments are valid (Cameron and Triverdi, 2009:185).

In order to confirm the use of IV methodology, it must be conducted a test to provide evidence that the regressors are endogenous. The most appropriate test is the Davidson-MacKinnon test[20], under the null hypothesis that regressors are exogenous. If the null hypothesis is rejected, so we may conclude that independent variables are endogenous, thus requiring and confirming the need for the use of IV estimations.

[20] The Davidson-MacKinnon test is similar to the Durbin–Wu–Hausman (DWH) test, but more appropriate for panel data.

4. SAMPLE DESCRIPTION

4.1 Data

This study uses a longitudinal database obtained from INE covering the 1996-2006 period. The data is obtained from an annual business survey conducted by INE, which contains financial information on firms´ balance sheets and income statements. All financial information is expressed in Euros at current prices.

Until 2003 this dataset comprises the universe of manufacturing firms operating in Portugal with more than one hundred employees and a representative random sample of firms with less than one hundred employees. After 2004, INE has changed its procedures of collecting data. In the period 2004-2006 this dataset comprises the universe of manufacturing firms[21] operating in Portugal.

The industries considered in this study are classified by the two-digit standard codes of business activities (CAE Rev. 2.1)[22]. Appendix A displays the description of industries by CAE.

The sample we use henceforward was constructed respecting some criteria. The firms which did not had information on items needed to compute the dependent, independent and control variables were excluded. Moreover, observations with anomalies in their accounting values were dropped[23].

Our final sample is an unbalanced panel data of 45,524 firm-year observations, related to 7,832 different firms, during the period 1996-2006.

4.2 Variables

All variables (except annual GDP growth rate) are Winsorized at the 1 percent level (0.5 percent in each tail) in order to avoid problems with outliers in the estimation procedures.

[21] Firms were identified through a code that uniquely identifies each firm across time. The data was made available by INE under the condition of censorship of any individual information. According to INE, the sample is representative of the Portuguese sector disaggregation.

[22] CAE Rev. 2.1 has a high correlation with Statistical Classification of Economic Activities in European Union, Rev. 1.1 (EUROSTAT NACE 1.1).

[23] Observations that exhibit negative values in fixed assets, current assets, financial assets, total assets, inventories, long-term liabilities, current liabilities, depreciation and sales were excluded from the sample. Observations with accounts receivable and accounts payable over 1.000 days were also excluded. In Portugal, and according to Portuguese Accounting Standards, those receivables and payables will be executed in Court.

4.2.1 Dependent variable

The main goal of this study is to analyze the effects of WCM on the firm´s profitability, so we use as dependent variable the return-on-assets ratio: ROA = [EBIT/ (Total Assets – Financial Assets)]. The ROA is defined as the ratio of earnings before interest and taxes (EBIT) to total assets minus financial assets. In line with Deloof (2003), the main point here is to focus on the return obtained from the operating cycle.

4.2.2 Independent variables

According to the aim of this study, the explanatory variables will be working capital accounts individually and the aggregate summary indicator NTC. Thereby, the independent variables are as follows.

- Average number of days-sales of accounts receivable: AR = [(Accounts Receivable/Sales)*365]. This variable measures the average number of days, relatively to firm´s sales, which the firms take to collect payments from customers.
- Average number of days-sales of inventories: INV = [(Inventories/Sales)*365]. This variable measures the average number of days that inventories remain in firms, relatively to firm´s sales.
- Average number of days-sales of accounts payable: AP = [(Accounts Payable/Sales)*365]. This variable measures the average number of days, relatively to firm´s sales, which firms take to make payments to their suppliers;
- Net trade cycle: NTC = [((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. The NTC variable indicates the average number of days, relatively to firm's sales, which the firm has to finance its working capital needs.

4.2.3 Control variables

In this study, the following variables are used as control variables.

- SIZE is measured by the logarithm of assets, as a proxy of firm size.
- Sales growth (SG = [$Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]), which measures past growth sales. This variable is used under the assumption that firms, which present higher growth rates so far, may be better prepared to continue to grow in the future. It is expected that such behavior affects positively the firm´s profitability (Caballero *et al.*, 2010).

- Current liabilities ratio (CL = Current Liabilities/Total Liabilities), which measures the proportion of current liabilities that are financing current assets. According to Ross *et al.* (2008:752), it is expected that this variable affects profitability because it indicates the degree of aggressive/conservative working capital policies adopted by firms.
- Fixed financial assets ratio (FFA = Fixed Financial Assets/Total Assets), representing the weight of fixed financial assets on total assets. Fixed financial assets are, mainly, shares in other (affiliated) firms. For some (few) firms of our sample, this kind of assets are a significant part of total assets.
- Current assets ratio (CA = Current Assets/Total Assets), which measures the firm's investment in current assets. It is expected that the CA variable affects profitability because it also indicates the degree of aggressive/conservative working capital policies, but in the opposite direction of CL variable.
- GDP indicates annual real GDP growth rate and is being introduced in order to control (for) the evolution of the economic cycle, i.e., to capture economic factors that may affect firm´s profitability that vary over time but remain constant across firms (this variable may be seen as a substitute for time dummy variables). This information was obtained from Eurostat.

4.3 Descriptive Statistics

Table 1 provides descriptive statistics[24] for the characteristics of the dependent, independent and control variables of the sample, during the period 1996-2006. According to the requirements established by the European Commission´s recommendation 2003/361/EC of 6th May of 2003[25], 96.07 percent of firm-year observations are SME´s and 3.93 percent of firm-year observations are large scale enterprises (LSE´s).

[24] All the results present in this section and in the next section were obtained using Stata Statistical Software, Version 10.1.

[25] The requirements established by the European Commission´s recommendation 2003/361/EC of 6th May, 2003, on the definition of medium-size firms are the following: (i) number of employees less than 250; (ii) total sales less than €50 million; (iii) total assets less than €43 million. The requirements established on the definition of small firms are the following: (i) number of employees less than 50; (ii) total sales less than €10 million; (iii) total assets less than €10 million.

Table 1 – Descriptive Statistics

Variable	Obs.	Mean	SD	Min.	Median	Max.	10^{th}Perc	90^{th}Perc
ROA	45,524	0.0380	0.0971	-0.3360	0.0360	0.4100	-0.0650	0.1460
NTC	45,524	49.1200	111.5300	-354.0000	39.0000	529.0000	-59.0000	172.0000
AR	45,524	128.0400	87.0600	0	111.0000	589.0000	43.0000	226.0000
INV	45,524	78.5400	89.1800	0	51.0000	582.0000	8.0000	177.0000
AP	45,524	158.2300	120.6200	0	128.0000	760.0000	46.0000	304.0000
SIZE	45,524	2,771,391	41.661	59,874	3,269,017	178,482,301	442,413	24,154,953
SG	37,353	0.0978	0.5139	-0.8059	0.0196	3.6973	-0.2928	0.4630
CL	45,524	0.4973	0.2311	0	0.4956	0.9828	0.1876	0.8125
FFA	45,524	0.0260	0.0725	0	0	0.4989	0	0.0797
CA	45,524	0.6137	0.2089	0.0856	0.6243	0.9957	0.3256	0.8880
GDP	45,524	0.0235	0.0173	-0.0090	0.0160	0.0500	0.0070	0.0440

This table reports descriptive statistics during the period 1996-2006. Descriptive statistics are the following: number of Observations, Mean, Standard Deviation, Minimum, Median, Maximum, 10^{th} Percentile and 90^{th} Percentile. Variables are as follows. Return-on-Assets: ROA=[EBIT/(Total Assets - Financial Assets)]. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Average number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured as the value of total assets expressed in thousands of Euros. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/Total Assets. Current assets ratio: CA=Current Assets/Total Assets. GDP indicates annual real GDP growth rate in Portugal.

As can be seen from statistics reported in Table 1, most of the firms in the sample are small firms, with average assets under €3 million. The ROA is, in average, 3.8 percent and the NTC displays a mean value of 49 days-sales. The average number of days-sales of accounts receivable (AR) is around 128, days-sales of inventories (INV) is around 79 and days-sales of accounts payable (AP) is around 158. The firm`s sales grow (SG), on average, almost 9.78 percent annually. Current liabilities (CL) are around 49.73 percent of total liabilities and 61.34 percent of their assets are current assets (CA). These statistics show that most firms have a large amount of cash invested in working capital accounts. Furthermore, the fixed financial assets ratio (FFA) is low, only 2.6 percent. During the period 1996-2006, the GDP (in Portugal) has grown, in average, 2.35 percent per year.

4.4 Correlation Analysis

Table 2 (below) presents the Pearson´s correlation coefficients and its significance levels across all variables used in the subsequent multivariate analysis. Most of the estimated coefficients are significant at the 1 percent level. Given the fact that we use sales growth as a control variable, correlation matrix was computed covering only the period 1997-2006.

At one hand, as we could expect, there is a negative relation between ROA and NTC. Moreover, there is a negative relation between ROA and days-sales of accounts receivable (AR), and also between ROA and days-sales of inventories (INV). These relationships suggest that an increase on those independent variables will have a negative impact on profitability.

On the other hand, and against to what might be expected, there is a negative relationship between ROA and days-sales of accounts payable (AP). One possible explanation for that could be the fact that delaying payments to suppliers means to lose discounts for early payments. However, if we assume discounts as financial, and according to Portuguese Accounting Standards, discounts received for prompt payment should be booked as financial income. Hence, financial discounts should not affect operating income. According to Deloof (2003), this may be a sign that less profitable firms delay payments to suppliers due to financial constraints. This argument is consistent with the evidence provided by Silva and Carreira (2010) that most of the firms of their sample (composed by Portuguese firms) operate under financial constraints.

As expected, there is a positive relation between ROA and control variables SIZE and sales growth (SG). As is often argued, sales growth looks like an ingredient for corporate profitability. There is also a positive relation between ROA and GDP growth, which means that profitability is affected by the economic cycle.

The ROA variable has a negative relationship with the current liabilities ratio (CL), which is consistent with the relation between ROA and days-sales of accounts payable (AP). On the other side, there is an unexpected positive relation between ROA and current assets ratio (CA). Given that previous studies provide evidence that aggressive working capital policies enhance profitability, we could expect that profitability increases when investment in current assets decreases, i.e., a negative relation between ROA and current assets ratio (CA); however our results show otherwise.

Regarding to the correlations between the independent variables, we find positive moderate coefficients between NTC, days-sales of accounts receivable (AR), days-sales of accounts payable (AP) and days-sales of inventories (INV). This correlation analysis was taken into account to prevent multicollinearity problems in subsequent multiple regression analysis.

However, a shortcoming of this analysis is that it does not allow to differentiate causes from consequences. So, we cannot conclude whether is the WCM which influences profitability or if it is profitability that influences WCM. This issue will be discussed and treated in section 5.

Table 2 – Correlation Matrix

	ROA	NTC	AR	INV	AP	SIZE	SG	CL	FFA	CA	GDP
ROA	1										
NTC	-0.0330***	1									
AR	-0.1279***	0.3958***	1								
INV	-0.2699***	0.4343***	0.1399***	1							
AP	-0.2661***	-0.3236***	0.4673***	0.4413***	1						
SIZE	0.0611***	0.0199***	0.0909***	0.0325***	0.0714***	1					
SG	0.1917***	-0.0810***	-0.1656***	-0.1581***	-0.1663***	0.0730***	1				
CL	-0.1041***	-0.4974***	0.0571***	0.0302***	0.5341***	-0.0766***	0.0622***	1			
FFA	0.0487***	-0.0396***	0.0246***	-0.0398***	0.0253***	0.2806***	-0.0271	-0.0870***	1		
CA	0.0154***	0.3224***	0.2317***	0.1806***	0.0029	-0.1814***	-0.0735***	0.1559***	-0.1542***	1	
GDP	0.0768***	-0.0262***	-0.1085***	-0.0619***	-0.1014***	0.0158***	0.1725***	-0.0390***	0.0050	-0.2493***	1

This table shows Pearson´s correlation coefficients covering the period 1997-2006. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. Total of observations are 37353. 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]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Average number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured by the logarithm of total assets. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/Total Assets. Current assets ratio: CA=Current Assets/Total Assets. GDP indicates annual real GDP growth rate in Portugal.

5. EMPIRICAL RESULTS

The empirical analysis is based on both univariate and multivariate analysis (based on multiple regression analysis). All methodological procedures applied in this empirical analysis are described in section 3.

Regression analysis is conducted taking into account the observations for the period 1997-2006 (a total of 37353 observations).

5.1 Univariate analysis

The objective of this univariate analysis is to determine if there are significant differences between the most profitable firms and the least profitable. Table 3 (below) exhibits the mean values of the variables (except for the GDP growth) for each quartile of the variable ROA. The quartiles are calculated annually[26].

Finally, a parametric test of differences between means, based on the *t* Statistic test, is used to determine whether the average values between the fourth quartile and the first quartile are significantly different.

As can be seen in Table 3, all the mean values of the variables, except SIZE, are (statistically significant) different between the fourth quartile, which represents the most profitable firms, and the first quartile, which represents the least profitable firms. Results in Table 3 also show that the most profitable firms (in the fourth quartile) present, comparing to the least profitable firms in the first quartile, a shorter number of days-sales in all variables representing working capital accounts (AR, INV and AP). The most profitable firms have a shorter NTC length and a higher sales growth (SG). Moreover, the most profitable firms exhibit shorter current liabilities ratio (CL) than firms in the first quartile, which means a less dependency of supplier financing. This evidence is consistent with the argument that less profitable firms delay payments to their suppliers because they operate under financial constraints.

[26] The range of variation of the ROA variable is different for each year.

Table 3 – Comparison of mean values of variables in function of ROA quartiles

	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile	*t* Statistic
ROA Range	[-0.336; 0.030[	]-0.014; 0.052[	]0.026; 0.103[	]0.068; 0.41]	
ROA	-0.0338	0.0214	0.0454	0.1376	224,4681
					(0.0000)
NTC	53.97	50.34	46.06	44.44	-8,3861
					(0.0000)
AR	138.03	135.07	130.42	111.92	-29,2668
					(0.0000)
INV	103.33	84.08	70.52	48.25	-64,2755
					(0.0000)
AP	188.67	169.57	155.44	115.92	-62,1330
					(0.0000)
SIZE	2,709,596	2,990,138	2,931,222	2,755,309	1,2808
					(0,2003)
SG	0.0154	0.0745	0.1112	0.2146	34,386
					(0.0000)
CL	0.5073	0.5060	0.5122	0.4716	-14,4643
					(0.0000)
FFA	0.0239	0.0232	0.0237	0.0305	7,4168
					(0.0000)
CA	0.6122	0.6098	0.6128	0.6168	2,0316
					(0,0422)

This table shows the mean values of the variables considering ROA quartiles, during the period 1997-2006. 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]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Average number of days-sales of inventories: INV=[(Inventories/ Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured as the value of total assets expressed in thousands of Euros. Sales growth: $SG=[Sales_t - Sales_{t-1})/Sales_{t-1}]$. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/Total Assets. Current assets ratio: CA=Current Assets/Total Assets. Last column shows the results of the *t* Statistic test for the difference of means between the fourth quartile and the first quartile. *P*-value of the *t* Statistic test in parentheses.

Curiously, the difference of the SIZE variable between the firms in the fourth quartile and in the first quartile is not statistically significant. According to some previous studies (Jose *et al.*, 1996; Shin and Soenen, 1998; Deloof, 2003), it would be expected that most profitable firms were larger than least profitable ones. Other unexpected result is that most profitable firms have a higher current assets ratio (CA), which is opposite to the argument that larger investment in current assets tends to decrease profitability. The results of *t* statistic tests are consistent with the results of Pearson´s correlation coefficients presented in Table 2. Results (provided by the

univariate analysis) suggest that the most profitable firms are more efficient on managing working capital accounts, which means a shorter NTC and a less dependency on credit from suppliers.

However, this analysis is not sufficient to test the effects of WCM on ROA. Hence, we will proceed with multivariate analysis.

5.2 Multivariate Analysis: Multiple Regression Analysis

Multiple regression analysis is conducted in order to test the hypotheses set out in section 3. This kind of analysis will help to understand the effects on profitability caused by a change in each independent variable. A set of control variables that impact firm´s profitability are also included.

First, we consider multiple regression analysis to test *Hypotheses 1*, *2*, *3* and *4*. Next, we run a set of robustness tests in order to validate our empirical results.

Finally, we test *Hypothesis 5* by investigating the possibility of a non-linear (concave) relation between profitability and WCM´s efficiency.

5.2.1 Multiple regression analysis: Linear relationships

In this stage, we seek to test empirically *Hypotheses*, *1*, *2*, *3* and *4*. In order to test each of the hypotheses, we use the methodology and follow the econometric procedures described in section 3.

First, regression analysis is conducted using Pooled OLS. The null hypothesis of *F* Statistic test of the Pooled OLS estimation was rejected, which means there are unobservable individual effects. The Hausman test is then used to determine if those unobservable effects are considered being random or, alternatively, fixed. The null hypothesis of the Hausman test was rejected, so the unobservable individual effects will have to be treated as FE. We also address heteroskedasticity and serial correlation problems adopting clustering technique that provides robust standard errors and more meaningful *t* Statistic test (robust *t* Statistic).

The estimations using FE methodology are obtained for equations (1) to (4). Equation (1) is estimated according to *Hypothesis 1,* in order to analyze the impact of WCM on profitability. Equations (2), (3) and (4) are estimated to test, respectively, the *Hypotheses 2, 3* and *4*. These estimations are carried on to analyze the impact of working capital accounts on profitability.

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{NTC}_{it} + \beta_2 \mathrm{SIZE}_{it} + \beta_3 \mathrm{SG}_{it} + \beta_4 \mathrm{CL}_{it} + \beta_5 \mathrm{FFA}_{it} + \beta_6 \mathrm{CA}_{it} + \beta_7 \mathrm{GDP}_t + \\ + \mu_i + \varepsilon_{it} \quad (1)$$

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{AR}_{it} + \beta_2 \mathrm{SIZE}_{it} + \beta_3 \mathrm{SG} + \beta_4 \mathrm{CL}_{it} + \beta_5 \mathrm{FFA}_{it} + \beta_6 \mathrm{CA}_{it} + \beta_7 \mathrm{GDP}_t + \\ + \mu_i + \varepsilon_{it} \quad (2)$$

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{INV}_{it} + \beta_2 \mathrm{SIZE}_{it} + \beta_3 \mathrm{SG}_{it} + \beta_4 \mathrm{CL}_{it} + \beta_5 \mathrm{FFA}_{it} + \beta_6 \mathrm{CA}_{it} + \beta_7 \mathrm{GDP}_t + \\ + \mu_i + \varepsilon_{it} \quad (3)$$

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{AP}_{it} + \beta_2 \mathrm{SIZE}_{it} + \beta_3 \mathrm{SG}_{it} + \beta_4 \mathrm{CL}_{it} + \beta_5 \mathrm{FFA}_{it} + \beta_6 \mathrm{CA}_{it} + \beta_7 \mathrm{GDP}_t + \\ + \mu_i + \varepsilon_{it} \quad (4)$$

In the equations above *i* refers to firms and *t* to time periods. The dependent variable ROA measures return-on-assets. β_0 is the intercept term. The following independent variables are considered to analyze their impact on profitability. NTC measures the average number of days-sales which the company has to finance its working capital needs (NTC = AR+INV-AP). AR measures the average number of days-sales of accounts receivable. INV measures the average number of days-sales of inventories. AP measures the average number of days-sales of accounts payable. The control variables are the following ones: SIZE is firm´s size proxy measured by the logarithm of assets, SG represents sales growth, CL is the current liabilities ratio, FFA is the fixed financial assets ratio, CA is the current assets ratio, GDP indicates annual real GDP growth rate in Portugal, which varies over time but is constant across firms. The μ_i measures the unobservable heterogeneity of the individual specific effects of each firm and ε_{it} is the disturbance term. Table 4 reports the results obtained for equations (1), (2), (3) and (4), using FE methodology.

Table 4 – Results from regression analysis using FE methodology

	(1)	(2)	(3)	(4)
Observations	37,353	37,353	37,353	37,353
NTC	-0.0001***			
	(-10.71)			
AR		-0.0001***		
		(-9.62)		
INV			-0.0004***	
			(-26.14)	
AP				-0.0002***
				(-22.04)
SIZE	-0.0274	-0.0043	0.0027*	0.0057***
	(-1.61)	(-0.25)	(1.68)	(3.42)
SG	0.0303***	0.0281***	0.0222***	0.0210***
	(24.95)	(22.57)	(18.77)	(17.13)
CL	-0.0860***	-0.0556***	-0.0529***	0.0110**
	(-18.44)	(-14.80)	(-14.50)	(2.24)
FFA	0.0430***	0.0531***	0.0345***	0.0655***
	(3.01)	(3.76)	(2.47)	(4.67)
CA	-0.0487***	-0.0467***	-0.0418***	-0.0423***
	(-7.75)	(-7.44)	(-6.74)	(-6.80)
GDP	0.1956***	0.2097***	0.1567***	0.2221***
	(5.39)	(5.80)	(4.43)	(6.24)
C	0.1477***	0.1050***	0.0715***	-0.0015
	(5.78)	(4.16)	(2.95)	(-0.06)
Hausman Test	460.65	601.38	284.74	676.52
(*P*-value)	(0.0000)	(0.000)	(0.0000)	(0.0000)
F test	179.52	182.42	248.09	230.60
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	7.63	7.53	12.05	9.73

This table reports the regression estimates for equations (1) to (4) using FE methodology, during the period 1997-2006. ***, ** 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. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Average number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured by the logarithm of total assets. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/ $Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA= Fixed Financial Assets/Total Assets. Current assets ratio: CA=Current Assets/Total Assets. GDP indicates annual real GDP growth rate in Portugal. C is the intercept term. Robust *t* Statistic in parentheses. Hausman test provides a statistical test that evaluates the significance of an estimator (RE) *versus* an alternative estimator (FE). *P*-value of Hausman test in parentheses. *F* test is carried on under the null hypothesis that the constant terms are equal across entities (firms). The null hypothesis, of both tests, must be rejected at the 5 percent significance level. *P*-value of *F* test in parentheses. R square expressed in percentage.

We observe in Table 4 that the sign and significance of the coefficients´ estimates are similar to that found in Table 2 (correlation analysis) and in Table 3 (univariate

analysis). Most of the coefficients´ estimates are statistically significant at the 1 percent level. The results of regression analysis exhibit a negative relationship between the WCM efficiency (measured by NTC) and firm´s profitability (measured by ROA). It means that if the NTC length decreases for one day, ROA increases 0.01 percent[27]. Hence, we fail to reject *Hypothesis 1*.

A decrease in days-sales of accounts receivables (AR) leads to an increase in profitability, which is consistent with *Hypothesis 2*. Thus, we do not reject *Hypothesis 2*. Also a decrease in days-sales of inventories (INV) produces an increase in ROA, so we fail to reject *Hypothesis 3*. The relation between ROA and the number of days-sales of accounts payable (AP) is negative what shows that delaying payments to suppliers tends to decrease profitability. Thus, we reject *Hypothesis 4*. According to Ng *et al.* (1999)[28] and Valadas (2005)[29], delaying payments to suppliers may have an opportunity cost of losing prompt payment discounts. If we assume, for instance, 3 percent for prompt payment discount, invoice payment being due in 30 days and 10 days of discount period, the effective opportunity cost is about 73.02 percent (annually). However and as already stated, prompt payment discounts are financial income and should not affect operating income. In line with Deloof (2003), a reasonable explanation is that less profitable firms delay payments to their suppliers because they operate under financial constraints. Such constraints lead firms to face higher costs when accessing to external financing.

The SIZE variable is not statistically significant, except for equation (4), which presents a positive relation between ROA and SIZE statistically significant at the 1 percent level. However, this is not a stable relationship among regression estimations.

In sum, we may conclude that corporate management should focus on reducing days-sales of accounts receivable, days-sales of inventories and also days-sales of accounts payable, in order to increase profitability.

[27] As already stated, the NTC represents the average number of days-sales that firms need to finance its working capital needs. All accounts of NTC are measured in days-sales, while control variables (except SIZE) are measured as ratios; probably we have what we can call a scale problem. Equations (1) to (4) were re-estimated using the independent variables expressed as percentage of sales. The estimates for these coefficients are reported on Table C.1 of Appendix C. According to those results a 1 percent change in the NTC will change ROA by 3.68 percent.

[28] According to Ng *et al.* (1999), the effective discount rate is computed in the following way:

$Implicit\ rate = \left(\frac{100\%}{100\% - Discount\%}\right)^{\frac{360}{\#days\ net - \#days\ discount}} - 1$, where, discount rate represents the financial discount of prompt payment, days net means payment is due a specified number of days after invoice date, and days discount means the discount period.

[29] Valadas (2005) points out that, in Portugal, it is a common practice to offer discounts for prompt payment between 2 and 3 percent.

In addition to this analysis and in order to analyze the stability of coefficients´ estimates, we re-estimate equations (1) to (4) considering time dummy variables (that also varies over time but are constant across firms) instead of the GDP variable.

Table 5 – Results from regression analysis using FE methodology considering time dummy variables

	(1)	**(2)**	**(3)**	**(4)**
Observations	37,353	37,353	37,353	37,353
NTC	-0.0001***			
	(-10.55)			
AR		-0.0001***		
		(-9.38)		
INV			-0.0004***	
			(-25.82)	
AP				-0.0002***
				(-21.73)
SIZE	-0.0010	-0.0013	0.0383**	0.0072***
	(-0.56)	(-0.77)	(2.31)	(4.21)
SG	0.0307***	0.0285***	0.0226***	0.0213***
	(25.12)	(22.73)	(19.00)	(17.29)
CL	-0.0861***	-0.0560***	-0.0530***	0.0098**
	(-18.42)	(-14.88)	(-14.50)	(2.00)
FFA	0.0447***	0.0549***	0.0355***	0.0667***
	(3.14)	(3.88)	(2.54)	(4.75)
CA	-0.0197**	-0.0174**	-0.0296***	-0.0196**
	(-2.25)	(-1.98)	(-3.42)	(-2.25)
C	0.1042***	0.0616**	0.0480*	-0.0359
	(3.86)	(2.32)	(1.87)	(-1.37)
F test	92.83	93.70	123.40	115.08
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	8.09	7.98	12.42	10.11

This table shows the regression estimates for equations (1) to (4), using FE methodology and considering time dummy variables, during the period 1997-2006. ***, ** 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. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Average number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured by the logarithm of total assets. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/Total Assets. Current assets ratio: CA=Current Assets/Total Assets. C is the intercept term. Robust *t* Statistic in parentheses. *F* test is as described before. *P*-value of *F* test in parentheses. Coefficients of time dummy variables not reported. R square expressed in percentage.

We can verify from Table 5, that the statistical significance of the coefficients´ estimates remains almost unchanged comparing with the results reported in Table 4. The coefficients´ estimates of the time dummy variables are not reported and none of them is statistically significant.

Motivated by previous studies (Shin and Soenen, 1998; Deloof, 2003), we re-estimate equations (1) to (4) using Pooled OLS. First, and aiming to compare our results to previous research, we run Pooled OLS considering time dummy variables instead of the GDP variable. Results are reported in Table B.1 of Appendix B. Second, we consider dummy variables for each CAE (see classification at Appendix A). Results are reported in Table B.2 of Appendix B. These results provide evidence of the stability of the coefficients´ estimates with different estimation methods[30].

5.2.2 Robustness checks

In order to validate the results obtained in the regression analysis, we run some robustness tests. Firstly, we examine if the effects of the WCM on the profitability of audited firms are (statistically significant) different than in non-audited firms. This test is motivated by the frequently raised suspicions on the reliability of accounting information of non-audited companies. Secondly, we examine the effects of the economic cycle, measured by GDP growth, on the intensity of the relationship between the ROA and the NTC variables. Finally, we address the endogeneity problem (mentioned before) that may affect our results.

5.2.2.1 Comparing the effects of the WCM on the profitability of audited firms "versus" non-audited firms

As mentioned before, the data used in this study was obtained from INE and includes information from balance sheet and income statement reported by firms. The accounting information disclosed by firms, in most of the cases, is not controlled by external financial auditors. In order to control for the differences between audited and non-audited firms, we identify which firms may be considered as the audited firms in our

[30] The coefficients 'estimates of the time dummy variables are not reported. However, some of those coefficients 'estimates are statistically significant at the 1 percent level. Such is the case of the dummy variables for 1997, 1998, 1999 and 2005, across all estimations. In fact, the evolution of the economic cycle was above average during the period 1997-1999 and below average in 2005. On the other hand, some dummy variables for each CAE are also statistically significant at the 1 percent level. Namely, codes of business activities 16, 24, 28 and 37 are statistically significant across all estimations because their profitability is significantly above average. On the other side, code 17 is also statistically significant because it exhibits a significantly below average profitability.

sample. This analysis was conducted according to the requirements established by the *Código das Sociedades Comerciais* (Portuguese Commercial Companies Code)[31], No. 2, Article 262. According to those requirements, we add a dummy variable to identify audited firms in previous equations (1) to (4). This dummy variable is included individually (DA) and also under multiplicative form (DNTC, DAR, DINV, DAP) to each of independent variables. This regression analysis is conducted in order to analyze if the effects of the WCM and of each one of the working capital accounts on profitability are statistically different in audited firms. Estimates are obtained from the following equations using FE methodology.

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{NTC}_{it} + \beta_2 SIZE_{it} + \beta_3 \mathrm{SG}_{it} + \beta_4 \mathrm{CL}_{it} + \beta_5 \mathrm{FFA}_{it} + \beta_6 \mathrm{CA}_{it} + \beta_7 \mathrm{GDP}_t + \\ + \beta_8 DA_{it} + \beta_9 DNTC_{it} + \mu_i + \varepsilon_{it} \quad (5)$$

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{AR}_{it} + \beta_2 SIZE_{it} + \beta_3 \mathrm{SG}_{it} + \beta_4 \mathrm{CL}_{it} + \beta_5 \mathrm{FFA}_{it} + \beta_6 \mathrm{CA}_{it} + \beta_7 \mathrm{GDP}_t + \\ + \beta_8 DA_{it} + \beta_9 DAR_{it} + \mu_i + \varepsilon_{it} \quad (6)$$

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{INV}_{it} + \beta_2 SIZE_{it} + \beta_3 \mathrm{SG}_{it} + \beta_4 \mathrm{CL}_{it} + \beta_5 \mathrm{FFA}_{it} + \beta_6 \mathrm{CA}_{it} + \beta_7 \mathrm{GDP}_t + \\ + \beta_8 DA_{it} + \beta_9 DINV_{it} + \mu_i + \varepsilon_{it} \quad (7)$$

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{AP}_{it} + \beta_2 SIZE_{it} + \beta_3 \mathrm{SG}_{it} + \beta_4 \mathrm{CL}_{it} + \beta_5 \mathrm{FFA}_{it} + \beta_6 \mathrm{CA}_{it} + \beta_7 \mathrm{GDP}_t + \\ + \beta_8 DA_{it} + \beta_9 DAP_{it} + \mu_i + \varepsilon_{it} \quad (8)$$

Dependent, independent and control variables are specified as before. The only difference is the introduction of those two control variables stated above, which are as follows. DA[32] is a dummy variable that assumes the value 1 if firms are audited and 0 otherwise. The variables DNTC, DAR, DINV and DAP, represent the product of the previous dummy variable for audited firms and each independent variables in the equations (5), (6), (7) and (8), specified as follows. In equation (5): DNTC= DA×NTC. In equation (6): DAR= DA×AR. In equation (7): DINV= DA×INV. In equation (8): DAP= DA×AP.

[31] The requirements established by the *Código das Sociedades Comerciais* (Portuguese Commercial Companies Code), n.º 2, Art.º 262.º, on the obligation of firms to be audited if two of the following three boundaries are exceeded during two consecutive years : (i) average number of employees around 50; (ii) total sales higher than €3 million; (iii) total assets higher than €1,5 million.

[32] As we have mentioned before, FE methodology does not allow introducing dummy variables that are constant over time. However, DA is a dummy variable that varies over time.

As can be seen in Table 6, the sign and significance of most of the coefficients´ estimates are quite similar to those presented in Table 4. The estimates of the coefficients of the dummy variable (DA) are not statistically significant, which means that profitability in audited firms is not significantly different from that of non-audited firms. Also the coefficients´ estimates of the DAR, DINV and DAP variables are no statistically significant, except for the DNTC variable in equation (5), which is statistically significant at the 5 percent level. This result suggests that the intensity of relationship between the ROA and the NTC variables is lower for audited firms. However it is noteworthy that the coefficient estimate, although statistically significant, is very small. We also carried on a Wald test to estimate the statistically significance of the coefficients of the additional variables. In equation (8), although none of the coefficients´ estimates of those variables are significant, when tested as a group, they are statistically significant at the 5 percent level. This result also suggests that the intensity of the relationship between ROA and accounts payable (AP) is lower in audited firms.

Indeed, based on these results, we may conclude that the fact the firm be audited or not, does not change the type of relationship found in previous regression analysis (in results reported in Table 4).

Table 6 – Results from regression analysis comparing the effects of the WCM on the profitability of audited firms "versus" non-audited firms

	(5)	(6)	(7)	(8)
Observations	37,353	37,353	37,353	37,353
NTC	-0.0001***			
	(-10.06)			
AR		-0.0001***		
		(-6.05)		
INV			-0.0004***	
			(-20.22)	
AP				-0.0002***
				(-17.70)
SIZE	-0.0026	-0.0048	0.0025	0.0053***
	(-1.55)	(-0.28)	(1.52)	(3.19)
SG	0.0303***	0.0281***	0.0222***	0.0208***
	(24.91)	(22.56)	(18.76)	(17.02)
CL	-0.0866***	-0.0556***	-0.0528***	0.0122***
	(-18.58)	(-14.83)	(-14.49)	(2.48)
FFA	0.0431***	0.0532***	0.0344***	0.0653***
	(3.03)	(3.76)	(2.46)	(4.66)
CA	-0.0483***	-0.0471***	-0.0418***	-0.0424***
	(-7.55)	(-7.47)	(-6.72)	(-6.79)
DA	-0.0022	0.0046	0.0016	0.0025
	(-0.84)	(1.26)	(0.51)	(0.72)
D_k	2.84E-05**	3.03E-05	2.01E-05	1.82E-05
	(2.28)	(1.58)	(0.87)	(1.32)
GDP	0.1940***	0.2112***	0.1594***	0.2268***
	(5.33)	(5.83)	(4.49)	(6.36)
C	0.1477***	0.1037***	0.0745***	0.0028
	(5.77)	(4.10)	(3.07)	(0.11)
Wald test	2.72	1.27	1.08	3.13
	(0.0600)	(0.2800)	(0.3400)	(0.0400)
R^2	7.65	7.54	12.06	9.76

This table reports the regression estimates for equations (5) to (8) using FE methodology, during the period 1997-2006. ***, ** 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. Net trade cycle: NTC= [((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Average number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured by the logarithm of total assets. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/ $Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/Total Assets. Current assets ratio: CA=Current Assets/Total Assets. DA is a dummy variable that assumes the value 1 if firms are audited and 0 otherwise. D_k represents the variables DNTC, DAR, DINV and DAP in the equations (5), (6), (7) and (8), respectively. GDP indicates annual real GDP growth rate in Portugal. C is the intercept term. Robust *t* Statistic in parentheses. Wald test is a statistical significance test, under the null hypothesis that coefficients estimates of the additional variables (DA and $D_{k)}$ are zero. The null hypothesis of Wald test must be rejected at the 5 percent significance level. *P*-value of Wald test in parentheses. R square expressed in percentage.

5.2.2.2 The effects of the economic cycle on the intensity of the relationship between ROA and NTC

As can be seen in the previous results of regression analysis reported in Table 4, the ROA and the GDP variables are positively related and this relationship seems to be robust to the different estimations. In order to test the intensity of the relation between ROA and NTC, we identify in our sample the period which corresponds to the highest GDP growth and the period reflecting the lowest GDP growth. From 1997 to 2001, annual GDP growth rate grew by 3.86 percent, which corresponds to the period with the highest GDP growth rate. On the other hand, from 2002 to 2006, GDP growth rate grew by 0.87 percent, which corresponds to the period with the lowest GDP growth rate. According to the purpose of this robustness test, we add to equation (1) a dummy variable that assumes the value 1 for the period with the highest GDP growth rate and 0 otherwise. The product of that dummy variable and the NTC variable is also included. The estimates for the coefficients from equation (9) are obtained using FE methodology.

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{NTC}_{it} + \beta_2 SIZE_{it} + \beta_3 \mathrm{SG}_{it} + \beta_4 \mathrm{CL}_{it} + \beta_5 \mathrm{FFA}_{it} + \beta_6 \mathrm{CA}_{it} + \beta_7 \mathrm{GDP}_t + \\ + \beta_8 DG_{it} + \beta_9 DGNTC_{it} + \mu_i + \varepsilon_{it} \quad (9)$$

Dependent, independent and control variables are specified as before. The only difference was the inclusion of control variables as follows. DG is a dummy variable that assumes the value 1 for the period with the highest GDP growth rate and 0 otherwise. DGNTC represents the product of previous dummy variable and NTC.

As can be seen in Table 7, the sign and significance of the coefficients´ estimates remain almost unchanged (comparing with results in Table 4). The estimate of the coefficient of the DG variable is not statistically significant. However, the coefficient estimate of the DGNTC variable is positive and statistically significant at the 5 percent level, which means that the intensity of the relationship between ROA and NTC is lower when the economic cycle is upward. This result suggests that the slowdown of the economic cycle increases the adverse effects associated with the tradeoff between profitability and risk. Some of those adverse effects are higher storage costs, more difficulties in collecting receivables and higher costs of customers default (Valadas, 2005). Indeed, when the economic cycle is adverse it is reasonable to assume that

money is locked up more time in working capital accounts, which increases the intensity of the relationship between ROA and NTC.

Table 7 – Results from regression analysis testing for the effects of the economic cycle on the intensity of the relationship between ROA and NTC

	(9)
Observations	37,353
NTC	-0.0001***
	(-9.18)
SIZE	-0.0029*
	(-1.67)
SG	0.0303***
	(15.50)
CL	-0.0854***
	(-12.90)
FFA	0.0431***
	(2.88)
CA	-0.0496***
	(-7.45)
DG	-0.0015
	(-0.79)
DGNTC	2.01E-04**
	(1.98)
GDP	0.2031***
	(4.16)
C	0.1501***
	(5.84)
Wald test	39.68
	(0.0000)
R^2	7.64

This table reports the regression estimates for equation (9) using FE methodology, during the period 1997-2006. ***, ** 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. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. SIZE is measured by the logarithm of total assets. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/Total Assets. Current assets ratio: CA= Current Assets/Total Assets. DG is a dummy variable that assumes the value 1 during the period 1997-2001 and 0 otherwise. DGNTC is the product of the dummy variable and the NTC variable, as follows: DGNTC=DG×NTC. GDP indicates annual real GDP growth rate in Portugal. C is the intercept term. Robust *t* Statistic in parentheses. Wald test is as described before. *P*-value of Wald test in parentheses. R square expressed in percentage.

5.2.2.3 Testing for endogeneity problems

Previous empirical studies about WCM subject (Deloof, 2003; García-Teruel and Martínez-Solano, 2007) have shown concern about the causality issues between dependent and independent variables that can lead to endogeneity problems in regression analysis. In this context, it is important to test and treat endogeneity problems. As already described in section 3, one possible way to test and treat endogeneity problems is to adopt the IV methodology. Hence, equations (1), (2), (3) and (4) were re-estimated using the IV methodology. We consider two instrumental variables in order to conduct the Hansen test on the validity of the instruments. Thus, we use as instruments the first lagged value of independent variables and the first lag of average value by CAE and by year of independent variables[33]. By using just the first lag of the instruments, we only lose one year of observations.

We can verify from Table 8 (below), that most of coefficients´ estimates are statistically significant at the 1 percent level. Comparing these to the results obtained by FE estimations (reported in Table 4), the sign and statistical significance of the coefficients remain almost unchanged. The variable SIZE is statistically significant in estimations (2) and (4), showing a positive relationship between ROA and SIZE. Although this is not a consistent relation between estimations, these results suggest that larger firms are positively correlated with profitability.

According to the Hansen test, the null hypothesis of the validity of instruments is not rejected. On the other hand, the rejection of the null hypothesis of the Davidson-MacKinnon[34] test for exogeneity, indicates that endogenous regressor`s effects on the estimations are meaningful. In such case, using IV methodology provides more consistent estimators than using FE methodology.

[33] We assume that only the independent variables, described in subsection 4.2.2, could be affected by endogeneity problems.

[34] Although the Davidson-MacKinnon test presents a statistical significance at the 10 percent level for equation (1), we reject the null hypothesis of exogeneity of the regressors.

Table 8 – Results from regression analysis testing for endogeneity problems using IV methodology

	(1)	(2)	(3)	(4)
Observations	29,300	29,300	29,300	29,300
NTC	-0.0002***			
	(-3.28)			
AR		-0.0004***		
		(-9.28)		
INV			-0.0002***	
			(-3.43)	
AP				-0.0004***
				(-5.89)
SIZE	-0.0070	0.0050**	0.0007	0.0121***
	(-1.41)	(2.36)	(0.34)	(3.87)
SG	0.0313***	0.0211***	0.0260***	0.0107***
	(21.25)	(11.52)	(11.53)	(2.80)
CL	-0.1041***	-0.0488***	-0.0572***	0.0778**
	(-7.71)	(-11.04)	(-13.64)	(3.26)
FFA	0.0473***	0.0550***	0.0541***	0.0845***
	(2.92)	(3.61)	(3.55)	(5.47)
CA	-0.0570***	-0.0387***	-0.0542***	-0.0375***
	(-7.42)	(-4.80)	(-6.79)	(-4.11)
GDP	0.1170***	0.1179***	0.1324***	0.1872***
	(2.70)	(2.86)	(3.27)	(4.56)
C	0.1677***	0.0576***	0.1040***	-0.0983**
	(7.15)	(2.50)	(4.70)	(-2.41)
Hansen Test				
(*P*-value)	(0.7640)	(0.9096)	(0.3536)	(0.7381)
J(df)	1.000	1.0000	1.0000	1.0000
Davidson-MacKinnon	2.2628	69.3882	4.8400	11.4200
	(0.1011)	(0.0000)	(0.0279)	(0.0000)
R^2	7.65	3.74	11.69	7.28

This table reports the regression estimates for equations (1) to (4) using IV methodology, during the period 1997-2006. ***, ** 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. Net trade cycle: NTC= [((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/Sales)*365]. Average number of days-sales of inventories: INV=[(Inventories/ Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured by the logarithm of total assets. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/ $Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA= Fixed Financial Assets/Total Assets. Current assets ratio: CA=Current Assets/Total Assets. GDP indicates annual real GDP growth rate in Portugal. C is the intercept term. Robust *z* Statistic in parentheses. The Hansen test is an overidentifying restrictions test, distributed as a chi-square, under the null hypothesis that instruments are valid. *P*-value of Hansen test in parentheses. *J* (df) reports the degrees of freedom of estimations. Davidson-MacKinnon test is an exogeneity test, under the null hypothesis that regressors are exogenous. The null hypothesis, of both tests, must be rejected at the 5 percent significance level. *P*-value of Davidson-MacKinnon test in parentheses. R square expressed in percentage.

Following García-Teruel and Martínez-Solano, 2007, we re-estimate equations (1), (2), (3) and (4) using IV methodology but considering only as instrument the first lagged value of independent variables. As can be seen in Table D.1 of Appendix D, results are similar to the previous ones.

In addition, we also re-estimate equations (1) to (4) considering two instrumental variables (specified as before) but considering time dummy variables instead of the GDP variable. Table D.2 of Appendix D show the results, which are also quite similar to those reported in Table 8.

5.2.3 Multiple regression analysis: Non-linear relationship

Previous studies about WCM, based on linear relations between profitability and WCM performance measures, point out that working capital aggressive policies increase profitability. Most recently, Baños-Caballero *et al*. (2011) provide evidence of a non-linear relationship between profitability and WCM that indicates there is an optimum working capital level, which balances benefits and costs of investing in working capital. According to that, and in order to test *Hypothesis 5*, we investigate for a possible non-linear relation between ROA and NTC. Coefficients´ estimates were obtained from equation (10) using FE methodology.

$$\mathrm{ROA}_{it} = \beta_0 + \beta_1 \mathrm{NTC}_{it} + \beta_2 \mathrm{NTC}^2{}_{it} + \beta_3 \mathrm{SIZE}_{it} + \beta_4 \mathrm{SG}_{it} + \beta_5 \mathrm{CL}_{it} + \beta_6 \mathrm{FFA}_{it} + \beta_7 \mathrm{CA}_{it} + \\ + \beta_8 \mathrm{GDP}_t + \mu_i + \varepsilon_{it} \qquad (10)$$

Dependent, independent and control variables are specified as before. The difference is the inclusion of the square value of the NTC.

As it can be seen in Table 9, most of the coefficients´ estimates are statistically significant at the 1 percent level. Our results provide evidence that the relation between ROA and NTC is positive, which indicates that a lower working capital investment level has a positive impact on profitability. On the other side, the relation between the ROA and the NTC^2 variables is negative, which indicates that, from some point, higher working capital investment level has a negative impact on profitability. Thus, we may conclude that there is a non-linear relation between ROA and NTC. These results are consistent with previous findings of Baños-Caballero *et al*. (2011).

Table 9 – Results from regression analysis testing for a non-linear relationship between ROA and NTC

	(10)
Observations	37,353
NTC	5.86e-05***
	(7.29)
NTC^2	-3.63e-07***
	(-14.02)
SIZE	-0.0017
	(-1.02)
SG	0.0270***
	(21.89)
CL	-0.0391***
	(-6.38)
FFA	0.0687***
	(4.89)
CA	-0.0523***
	(-8.27)
GDP	0.2539***
	(6.99)
C	0.0908***
	(3.62)
F test	141.14
(*P*-value)	(0.0000)
R^2	6.79

This table reports the regression estimates for equation (10) using FE methodology, during the period 1997-2006. ***, ** 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. Net trade cycle: NTC= [((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. NTC^2 is the square value of NTC. SIZE is measured by the logarithm of total assets. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/Total Assets. Current assets ratio: CA=Current Assets/Total Assets. GDP indicates annual real GDP growth rate in Portugal. C is the intercept term. Robust *t* Statistic in parentheses. *F* test is as described before. *P*-value of *F* test in parentheses. R square expressed in percentage.

The quadratic function proposed in equation (10) presents a maximum point, since the second partial derivative of the profitability measure ROA, with respect to the NTC, is negative. Indeed, β_2 is negative, so $2\times \beta_2$ is also negative. The maximum point of the quadratic equation can be derived by differentiating the ROA variable with respect to the NTC, and making this derivative equal to zero. On solving for the NTC, the maximum point is: NTC = $(-\beta_1/2\beta_2)$. Replacing these by the coefficients´ estimates provided in Table 8, it will be: NTC = (-5.86e-05/ (2*-3.63e-07)) = 80.72 days-sales. This result show there is an optimum NTC level when NTC is around 81 days-sales,

ceteris paribus. In that point ROA is around 9.31 percent[35]. Thus, we fail to reject *Hypothesis 5.*

According to our findings, we expect that benefits of investing in working capital will increase until the maximum point is reached, which means profitability will rise until that breakpoint is achieved. After reached that breakpoint, an increase in working capital investment level will lead to a decrease in profitability, given the fact that investing in working capital is a low return investment (Baños-Caballero *et al*., 2011).

In line with previous robustness tests and observing the econometric procedures stated in section 3, we re-estimate equation (10) using IV methodology to treat for possible endogeneity problems. We consider the variables NTC and NTC^2 as endogenous variables. The instruments are the same as before. In addition, we also used the square of those instruments.

Results reported in Table 10 show that most of the coefficients´ estimates remain statistically significant at the 1 percent level. The only change is the coefficient estimate of the NTC variable, which is now statistical significant at the 5 percent level. These results do not question our previous conclusions. There is still evidence of a non-linear relation between ROA and NTC, but the maximum point has changed to 99 days-sales[36], *ceteris paribus*. According to the result provided by the Hansen test, the null hypothesis of the validity of instruments is not rejected. However, we must to reject the null hypothesis of the Davidson-MacKinnon test for the exogeneity of the independent variables. Once more, using IV methodology provides more consistent estimators than using FE methodology.

[35] When the NTC length is around 81 days-sales, ROA will assume a maximum point of 9.31 percent; those values correspond to the vertex point of the quadratic function, which can be obtained by: $x_{max} = {}^{-b}/_{2a}$; $Y_{max} = -\frac{b^2-4ac}{4a}$.

[36] The maximum point is NTC = $(-\beta_1/2\beta_2)$, replacing by coefficients provided in Table 9: NTC = (-0.0006/ (2*-3.03e-06)) = 99 days-sales. In that point, ROA will have a maximum of 6.23 percent; those values correspond to the vertex point of the quadratic function, which can be obtained by: $x_{max} = {}^{-b}/_{2a}$; $Y_{max} = -\frac{b^2-4ac}{4a}$.

Table 10 – Results from regression analysis testing for a non-linear relationship between ROA and NTC using IV methodology

	(10)
Observations	37,353
NTC	0.0006**
	(2.20)
NTC^2	-3.03e-06***
	(-2.80)
SIZE	0.0024
	(0.81)
SG	0.0117***
	(2.89)
CL	-0.0663***
	(-3.30)
FFA	0.1009***
	(4.45)
CA	-0.0348***
	(-2.42)
GDP	0.2196***
	(3.90)
C	0.0326***
	(4.80)
Hansen Test	0.8800
(*P*-value)	(0.6441)
J(df)	1.0000
Davidson-MacKinnon	10.1447
(*P*-value)	(0.0000)
R^2	5.79

This table reports the regression estimates for equation (10) using IV methodology during the period 1997-2006. ***, ** 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. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. NTC^2 is the square value of NTC. SIZE is measured by the logarithm of total assets. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/ Total Assets. Current assets ratio: CA=Current Assets/Total Assets. GDP indicates annual real GDP growth rate in Portugal. C is the intercept term. Robust *z* Statistic in parentheses. Hansen test is as described before. *P*-value of Hansen test in parentheses. *J* (df) reports the degrees of freedom of estimations. Davidson-MacKinnon test is as described before. *P*-value of Davidson-MacKinnon test in parentheses. R square expressed in percentage.

This finding is perhaps the most important of this study. If corporate managers know the optimum level of working capital investment, at one hand, they will not underinvest on working capital accounts. Such WCM strategy tends to minimize the risk due to decreasing working capital investment. On the other hand, managers also will not overinvest on working capital. Hence, money is released and invested in higher return assets.

6. CONCLUDING REMARKS

Previous studies about WCM provide evidence that most firms have a large amount of cash invested in working capital accounts, then it is expected that WCM will have a significant impact on the firm's profitability. Therefore, the impact of WCM on profitability will depend on working capital policies that firms adopt, which are sensitive to industry factors, to economic cycle and to financial constraints. Thereby, the aim of WCM is to achieve the optimum working capital level that maximizes corporate profitability. According to that aim, the role of WCM is to manage the tradeoff of benefits and costs of investing in working capital. This is (of) extremely importance in small firms that operate under financial constraints.

Keeping in mind that the aim of this study is to provide empirical evidence about the relationship between the WCM and profitability of Portuguese manufacturing firms, our results, in general, are in line with previous studies (Jose *et al*., 1996, Shin and Soenen, 1998; Wang, 2002; Deloof, 2003; Valadas, 2005; García-Teruel and Martínez-Solano, 2007; Baños-Caballero *et al.*, 2011).

To our knowledge, this study is the first one exploring financial data available from INE to provide evidence of the effects of WCM on profitability of the Portuguese manufacturing firms. In fact, we used the largest sample of Portuguese manufacturing firms for the period 1996-2006. Our findings provide evidence that there is a negative linear relation between profitability and WCM. This kind of relation is also found between profitability and working capital accounts. In fact, an increase in working capital investment tends to decrease profitability. Furthermore, our results suggest that most profitable firms have a shorter NTC.

In addition, this is also the first study to test a non-linear relation between profitability and WCM for a sample of Portuguese firms. Following Baños-Caballero *et al.* (2011), although using a different methodology, our results show a non-linear (concave) relationship between profitability and the NTC, which indicates there is an optimum NTC level that maximizes corporate profitability.

Further research could consider examine the existence of a non-linear relation between profitability and each one of the working capital accounts.

However, we must mention what are, in our opinion, some limitations of this study. We only access data until 2006, therefore we cannot include in this study the most recent years (at least, until 2008). This would be important because the most recent years are characterized by the slowdown of the economic cycle, so it would be interesting to analyze further this impact on profitability. Another limitation is the financial information available in INE database. Until 2003, financial data covers several accounts of balance sheet and income statement. Unfortunately, since 2004 not all financial data from balance sheet and income statement were available. Given that fact, we cannot, for instance, include information of prompt payments discounts, which are booked as financial discounts, in order to analyze those effects on profitability.

Another issue for further research is conducting a survey to corporate management, covering a wide range of industries, in order to study in depth the reasons of the adoption of working capital policies, mainly, in what concerns the connection between working capital policies and financial constraints.

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Appendix A

Table A.1 – Industry description by CAE (Rev. 2.1)

Industry Code	Sector description
15	Food, beverages
16	Tobacco
17	Textiles
18	Wearing apparel (Clothing)
19	Leather and footwear
20	Wood
21	Paper and pulp
22	Printing
24	Chemicals
25	Rubber and plastic
26	Non-metallic mineral product
27	Basic metals
28	Fabricated metal products
29	Machinery
30	Office machinery and computers
31	Electrical machinery
32	TV and communication equipment
33	Medical, precision and optical instruments
34	Motor vehicles
35	Other transport equipment
36	Furniture
37	Recycling

This table describes the industries in the manufacturing sector. This description is according to INE classification of business activities.

Appendix B

Table B.1 – Results from regression analysis using Pooled OLS considering time dummy variables

	(1)	(2)	(3)	(4)
Observations	37,353	37,353	37,353	37,353
NTC	-0.0002***			
	(-19.06)			
AR		-0.0001***		
		(-15.63)		
INV			-0.0003***	
			(-34.32)	
AP				-0.0002***
				(-31.58)
SIZE	0.0033***	0.0037***	0.0042***	0.0046***
	(5.25)	(5.84)	(6.76)	(7.39)
SG	0.0357***	0.0333***	0.0291***	0.0268***
	(28.86)	(26.47)	(24.15)	(21.50)
CL	-0.0931***	-0.0487***	-0.0490***	0.0112**
	(-23.05)	(-15.70)	(-16.36)	(3.08)
FFA	0.0497***	0.0619***	0.0453***	0.0660***
	(3.51)	(4.34)	(3.23)	(4.62)
CA	0.0841***	0.0578***	0.0667***	0.0290***
	(18.23)	(13.88)	(16.61)	(7.26)
C	-0.0226**	-0.0239**	-0.0298***	-0.0332
	(-2.24)	(-2.32)	(-2.98)	(-3.29)
F test	116.09	114.52	171.49	166.32
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	8.27	7.63	12.79	10.62

This table presents the regression estimates obtained for equations (1) to (4), using Pooled OLS and including time dummy variables, during the period 1997-2006. ***, ** 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. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/ Sales)*365]. Average number of days-sales of inventories: INV=[(Inventory/ Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/ Sales)*365]. SIZE is measured by the logarithm of total assets. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/ Total Assets. Current assets ratio: CA= Current Assets/ Total Assets. C is the intercept term. Robust *t* Statistic in parentheses. *F* test is as described before. *P*-value in parentheses. Coefficients of time dummy variables not reported. R square expressed in percentage.

Table B.2 – Results from regression analysis using Pooled OLS considering dummy variables for each CAE

	(1)	**(2)**	**(3)**	**(4)**
Observations	37,353	37,353	37,353	37,353
NTC	-0.0001***			
	(-17.86)			
AR		-0.0001***		
		(-15.94)		
INV			-0.0003***	
			(-33.41)	
AP				-0.0002***
				(-31.87)
SIZE	0.0027	0.0031***	0.0038***	0.0039***
	(4.33)	(4.78)	(6.18)	(6.30)
SG	0.0347***	0.0321***	0.0281***	0.0257***
	(28.36)	(25.84)	(23.57)	(20.89)
CL	-0.0903***	-0.0489***	-0.0493***	0.0119**
	(-22.69)	(-15.90)	(-16.61)	(3.30)
FFA	0.0467***	0.0587***	0.0424***	0.0640***
	(3.51)	(4.41)	(3.24)	(4.80)
CA	0.0658***	0.0451***	0.0544***	0.0196***
	(15.17)	(11.41)	(14.31)	(5.25)
GDP	0.3692***	0.2961***	0.3243***	0.2117***
	(11.52)	(9.21)	(10.42)	(6.70)
C	-0.0078	-0.0095	-0.0215**	-0.0199*
	(0.74)	(-0.91)	(-2.10)	(-1.92)
F test	63.62	64.42	91.12	91.93
(*P*-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	8.68	9.22	13.38	11.49

This table reports the regression estimates for equations (1) to (4) using Pooled OLS and including dummy variables for each CAE, during the period 1997-2006. ***, ** 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. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/ Sales)*365]. Average number of days-sales of inventories: INV=[(Inventories/ Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/ Sales)*365]. SIZE is measured by the logarithm of total assets. Sales growth: SG=[$Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/ Total Assets; Current assets ratio: CA=Current Assets Total Assets. GDP indicates annual real GDP growth rate in Portugal. C is the intercept term. Robust *t* Statistic in parentheses. *F* test is as described before. *P*-value in parentheses. Coefficients of dummy variables not reported. R square expressed in percentage.

Appendix C

Table C.1 – Results from regression analysis using FE methodology considering independent variables in percentage of sales

	(1)	(2)	(3)	(4)
Observations	37,353	37,353	37,353	37,353
NTC`	-0.0368***			
	(-10.71)			
AR`		-0.0383***		
		(-9.62)		
INV`			-0.1351***	
			(-26.14)	
AP`				-0.0790***
				(-22.04)

This table shows the coefficients estimates from regressing equations (1) to (4), using FE methodology during the period 1997-2006. ***, ** 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. Net trade cycle measures working capital needs expressed in percentage of sales: NTC`=((Accounts receivable + Inventories – Accounts Payable)/Sales). Ratio of accounts receivable to sales: AR`=(Accounts Receivable/ Sales]. Ratio of inventories to sales: INV`=(Inventories/Sales). Ratio of accounts payable to sales: AP`= (Accounts Payable/Sales). Robust *t* Statistic in parentheses. Table C.1 reports only the coefficients of variables that have changed (the coefficients for the control variables can be seen in Table 4). According to these results, 1 percent change in the NTC will change ROA by 3.68 percent.

Appendix D

Table D.1 – Results from regression analysis using IV Methodology considering one instrument

	(1)	(2)	(3)	(4)
Observations	30,409	30,409	30,409	30,409
NTC	-0.0002***			
	(-3.25)			
AR		-0.0004***		
		(-8.97)		
INV			-0.0003***	
			(-3.36)	
AP				-0.0004***
				(-5.16)
SIZE	-0.0027	0.0050**	0.0011	0.0119***
	(-1.41)	(2.36)	(0.54)	(3.59)
SG	0.0312***	0.0211***	0.0247***	0.0110***
	(21.25)	(11.29)	(9.55)	(2.58)
CL	-0.1039***	-0.0488***	-0.0564***	0.0759**
	(-7.67)	(-10.99)	(-13.20)	(2.83)
FFA	0.0473***	0.0549***	0.0511***	0.0842***
	(2.92)	(3.61)	(3.29)	(5.43)
CA	-0.0597***	-0.0387***	-0.0524***	-0.0377***
	(-7.42)	(-4.80)	(-6.43)	(-4.06)
GDP	0.1174***	0.1173***	0.1227***	0.1880***
	(2.70)	(2.83)	(2.94)	(4.58)
C	0.1674***	0.0574***	0.0991***	0.0537**
	(7.14)	(2.49)	(4.39)	(2.05)
Davidson-MacKinnon	2.2029	66.3743	6.6367	11.43
	(0.1010)	(0.0000)	(0.0100)	(0.0000)
R^2	7.66	3.71	12.02	9.57

This table reports the regression estimates for equations (1) to (4) using IV methodology and considering one instrumental variable, during the period 1997-2006. ***, ** and * mean statistical significance at the 1 percent level, 5 percent level and 10 percent level, respectively. The instrumental variable is the first lagged value of independent variables. The variables used in this analysis are as follows. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/Sales)*365]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/ Sales)*365]. Average number of days-sales of inventories: INV=[(Inventories/ Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/ Sales)*365]. SIZE is measured by the logarithm of total assets. Sales growth: $SG=[Sales_t - Sales_{t-1})/Sales_{t-1}]$. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/Total Assets. Current assets ratio: CA=Current Assets/Total Assets. GDP indicates annual real GDP growth rate in Portugal. C is the intercept term. Robust *z* Statistic in parentheses. Davidson-MacKinnon test is as described before. *P*-value of Davidson-MacKinnon test in parentheses. R square expressed in percentage.

Table D.2 – Results from regression analysis using IV Methodology considering time dummy variables

	(1)	**(2)**	**(3)**	**(4)**
Observations	29,300	29,300	29,300	29,300
NTC	-0.0002***			
	(-2.84)			
AR		-0.0004***		
		(-8.55)		
INV			-0.0003***	
			(-2.96)	
AP				-0.0004***
				(-4.02)
SIZE	-0.0007	0.0066***	0.0027	0.0119***
	(-0.35)	(3.10)	(1.33)	(3.44)
SG	0.0319***	0.0216***	0.0247***	0.0135***
	(21.57)	(11.25)	(8.14)	(2.73)
CL	-0.1012***	-0.0491***	-0.0563***	0.0606**
	(-7.12)	(-10.97)	(-12.56)	(1.97)
FFA	0.0503***	0.0563***	0.0509***	0.0836***
	(3.07)	(3.69)	(3.19)	(5.39)
CA	-0.0248**	-0.0134	-0.0324***	-0.0160*
	(-2.35)	(-1.36)	(-2.97)	(-1.62)
Hansen Test	0.1900	0.7370		1.9770
(*P*-value)	(0.6632)	(0.3906)	(0.)	(0.1598)
J(df)	1.000	1.0000	1.0000	1.0000
Davidson-MacKinnon	1.5329	63.1014	4.84	11.42
	(0.1141)	(0.0000)	(0.0000)	(0.0000)
R^2	8.24	4.29	12.54	8.75

This table reports the regression estimates for equations (1) to (4) using IV methodology and considering time dummy variables, during the period 1997-2006. ***, ** 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. Net trade cycle: NTC=[((Accounts Receivable + Inventories - Accounts Payable)/ Sales)*365]. Average number of days-sales of accounts receivable: AR=[(Accounts Receivable/ Sales)*365]. Average number of days-sales of inventories: INV=[(Inventories/Sales)*365]. Average number of days-sales of accounts payable: AP=[(Accounts Payable/Sales)*365]. SIZE is measured by the logarithm of total assets; Sales growth: SG=($Sales_t$ – $Sales_{t-1}$)/$Sales_{t-1}$]. Current liabilities ratio: CL=Current Liabilities/Total Liabilities. Fixed financial assets ratio: FFA=Fixed Financial Assets/Total Assets. Current assets ratio: CA=Current Assets/Total Assets. C is the intercept term. Robust *z* Statistic in parentheses. Hansen test is as described before. *P*-value of Hansen test in parentheses. *J*(df) reports the degrees of freedom of estimations. Davidson-MacKinnon test is as described before. *P*-value of Davidson-MacKinnon test in parentheses. Coefficients of time dummy variables not reported. R square expressed in percentage.