Sustainable Working Capital Management and its Effect on Shareholder Wealth in a Downturn Economic Environment:

Evidence from German Listed Companies

by

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PART TWO

1. Introduction

1.1. Motivation

Per a practitioners' study published by The Boston Consulting Group[1] shortly after the American investment bank Lehman Brothers filed for bankruptcy on September 15th, 2008,[2] the management of working capital, i.e. the funds needed to finance the operating business, can be of great value to companies during an economic contraction, when faced with a reduced availability of external financing and sharp declines in sales. Putting it in the words of the authors of the study, *"[d]uring a downturn, effective working-capital management can spell the difference between bankruptcy and solvency or between acquiring and being acquired"* (p.1).

The conventional wisdom on working capital management as a value-enhancing tool has nonetheless shifted in the wake of the worst economic crisis since the Great Depression of the 1930's: Traditionally, working capital management was understood as an activity largely overlooked during times of economic expansion and called upon only in times where economic conditions deteriorated. Nowadays, a new perspective has emerged among management consultancies, corporate executives and members of corporate boards of directors. Working capital management is now regarded as a key strategic and sustainable tool that needs to be embedded in a comprehensive framework: Cash is allegedly always king in tough times, however, as the economy gets out of recession, companies should make sure that their grip over the management of their working capital remains tight over the long term. Moreover, when working capital is being regarded both as a strategic priority and as an *ongoing* business process, rather than an exercise carried out in response to economic downturns, it leads to cash being freed up that can be used to finance investments internally while also delivering higher-than-expected results to shareholders. Interestingly, another practitioners' study also sponsored by the Boston Consulting Group[3] has shown, using a sample of 351 companies with complete data for the period 1999 through 2008, that it remains a challenging task for companies to improve and maintain the cash conversion cycle

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[1] See Buchmann et al. (2009)

[2] This event was widely recognized among economists to have played a key role in the global financial crisis of 2007-2008 and its aftermaths.

[3] See Jung et al. (2010)

(CCC)[4] continuously over a long period of time: While thirty-two percent of the companies in the sample managed to improve their cash conversion (or at least keep it steady) for four years in a row, only eight percent improved or maintained their cash conversion over a period of six years in a row, and a mere two percent improved or maintained their cash conversion over a period of eight years in a row. Not a single company managed to improve or maintain their cash conversion over the entire period of nine years.

Nonetheless, this new conventional wisdom has yet to find its way into the world of academia, although the body of academic literature on corporate finance is focusing more and more attention on studying working capital management and its effect on firm profitability and value, particularly so in the aftermath of the global financial crisis of the late 2000's.

Up until the mid-1960's to the early 1970's, researchers traditionally studied long-term as opposed to short-term financing decisions.[5] In one of the earlier academic papers devoted solely to the topic of working capital,[6] Walker (1964, p. 21) asks himself whether is it possible to develop a theory of working capital, pointing to the dearth of pertinent literature available at the time which might have led students of finance to "*generally agree that a theory of working capital is not possible, or, perhaps, that such a theory, if developed, could not be practicably applied, and therefore would be useless*". Walker even goes so far as to state that "*[p]robably the strongest argument that might be used in denial of the formation of a theory is that business is an art and not a science, and as such, the various business decisions cannot be guided by theory.*" Fortunately, or unfortunately for Walker, thanks to improved technology, the availability of larger databases covering financial information about firms, and the use of new (empirical) research methodologies, it has been possible to develop a well-founded theory of working capital. This has ultimately led to closer ties

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[4] The cash conversion cycle is as a metric that attempts to measure how fast a company can convert cash resources that are tied up in the production and sales process by following cash as it is first converted into inventory and accounts payable, through sales and accounts receivable, and then back into cash. This metric was initially developed by Gitman (1974) and later operationalized by Richards & Laughlin (1980). It is commonly regarded as the key measure of working capital management efficiency as it integrates the three pivotal components of working capital, namely account receivables, inventory and account payables.

[5] Sartoris & Hill (1983) suggest that the neglect of the study of short-term financing decisions was the result of the academic focus on market efficiency. They argue that short-term financial decisions are barely relevant in a world of perfectly efficient capital and product markets. To illustrate this argument, they cite a study by Lewellen et al. (1980), who show that it is largely futile for a firm operating in a competitive securities and product market environment to search for an optimal trade credit policy.

[6] To the best of my knowledge, the first noteworthy academic paper to have been published and that is directly related to a theory of WCM was that by Sagan (1955), in which the author discusses the role and function of the money manager.

between the academic world and practice, although there certainly remains room for improvement. Moreover, it is now widely recognized, from an academic point of view, that the working capital considerations play a crucial role in increasing the profitability and growth of a firm and that a sketchy planning and management of working capital is one of the prevalent causes of business failure.[7] The focus, however, is not on the sustainability of working capital management – an aspect that is not only gaining increasing consideration among practitioners in response to heavy turmoil in the financial markets since 2007, but also requires thorough analysis from the part of academics.

1.2. Aim

This thesis aims to expand the existing body of literature by shedding light into the practices of working capital management of non-financial companies[8] listed in the German DAX, MDAX, SDAX and TecDAX indices. Companies listed in these indices all belong to the Prime Standard, which offers the highest standard in terms of transparency not only of all segments at the Frankfurt Stock Exchange,[9] but in the whole of Europe as well. This higher level of transparency implies a greater stock market efficiency[10] and thus not only permits the analysis of a rather homogeneously structured set of balance sheet, cash flow and income statement figures,[11] but also a possibility to relate these to stock price information with greater accuracy.

The focus on Germany is motivated by the fact that the capital markets of many continental European countries, including Germany, are believed to be "*underdeveloped in the sense that information and agency problems are particularly pronounced*" (Deloof, 2003, p. 574). With respect to Germany, Theissen (2003) also shows that its financial system, which he qualifies as the "*archetype of a bank dominated system*" (p. 2), is underdeveloped - however only in terms of volume, not in terms of operational efficiency. Demirgüç-Kunt & Maksimovic (2002) indicate that in countries characterized by more developed banking systems, such as in the case of Germany, firms tend to grant more trade credit to their

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[7] See Pass & Pike, 1984

[8] Excluding banks, insurance firms, financial institutions, and firms devoted to human resources consulting.

[9] Companies listed at the Frankfurt Stock Exchange can belong to three different standards, namely the Prime Standard or the General Standard for companies listed in the regulated market; or the Entry Standard for companies listed in the open market, all of which differ in terms of the transparency requirements. Further information on German stock market transparency standards is available at http://deutsche-boerse.com.

[10] Starcevic & Rodgers, 2011

[11] Since the year 2005, all European listed companies are required to use International Financial Reporting Standards (IFRS) as the framework for their financial reporting.

customers while at the same time being granted more finance from their own suppliers.[12] Although a trend can be observed in European countries of an international consolidation of their financial markets,[13] implying an increasing degree of development, they can still be considered underdeveloped relative to the U.S. financial market. This suggests, taking into consideration the findings of La Porta et al. (1997), that the legal protection of both corporate shareholders and creditors remains relatively weak, which translates into a higher attractiveness of both bank financing and trade credit as sources of financing. Fisman & Love (2003), besides, advocate that, given the better ability of trade creditors to soothe the impact of weak creditor protection and imperfect information than that of formal lenders, firms in countries characterized by a lower degree of development of their financial systems tend to use informal credit provided by suppliers for the sake of growth financing. Therefore, the use of working capital management for the sake of financing their ongoing activities or their growth is likely to be of higher importance for German companies than for U.S. companies.

More specifically, this thesis aims to explore whether the sustainable management of working capital, i.e. one that is long-lasting and insensitive, or to the least less sensitive to economic cycles than the short-term approach mostly adopted by firms, significantly enhances shareholder value. Indeed, strategies geared for example towards the reduction of the cash conversion cycle should free up cash that could be either reinvested in the company, used to service debt, or redistributed to shareholders via dividend payments and/or share buybacks. In either case, it is likely that the shareholders place some value on the extra cash arising from the adoption of a more efficient working capital management strategy.

Faulkender and Wang (2006) have shown empirically that the value to equity holders of additional cash held by firms varies considerably depending on the cash regime adopted by the firm, i.e. whether the additional cash goes to servicing debt, is being redistributed to shareholders or is being used in funding capital expenditures. This thought, however, when put into relation with the management of working capital, neglects the fact that altering working capital, e.g. reducing inventory levels, offering less trade credit and/or reducing customer's payment terms, while freeing up cash flow, might have a negative impact on future sales, which in turn will affect future (free) cash flows and, ultimately, shareholder

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[12] Demirgüç-Kunt & Maksimovic (2002) mention that trade credit exceeds one quarter of corporate assets in Germany.

[13] See Theissen, 2003

value. On the other hand, firms that extend payment terms or offer a greater credit limit to their customers, while at the same time improving the management of the credit and default risks associated, may significantly improve future sales, which, supposedly, should have a positive impact on shareholder value.

Thus, there is a trade-off that needs to be taken into consideration when analysing the effects of working capital management on shareholder value: the shareholder value of a firm could be positively affected by a reduction in levels of working capital since more free cash flow would be available in the short term that could be redistributed to shareholders. However, the same reduction in levels of working capital should have a negative effect on the pattern of future sales and therefore also on shareholder value.

In fact, from an accounting (and therefore static) point of view, the value of a firm should not change just because capital which is tied in inventory and receivables is being turned into a free cash flow. It is the efficiency with which a firm operates and the pattern of future sales that are affected by a change in levels of working capital. This in turn will most certainly alter shareholder value.

1.3. Contribution and Outline

I present, in the first part of this thesis, how the theory of working capital management has evolved since it first appeared as a topic relevant to academia. The first part should thus be understood by the reader, and that would represent part of my contribution to the body of existing literature, as a compendium on working capital and its sound management which could be used as a guide to both practitioners and academics interested in the research area of working capital management. I should note here that this thesis offers a literature review which only covers a purposive sample, following Cooper's (1988) Taxonomy of Literature Reviews, in which I examine only the pivotal research articles in the field of working capital management that are of relevance to the second, empirical part of this thesis. Indeed, since a great amount of ink has been spilled in the writing of research papers covering this topic, the research outcomes and methodologies of which are very similar, it represents a better article selection approach than an exhaustive review of all the existing literature, which would be nothing more than repetitive. The literature review is organized both in a historical as well as a methodological format. The first part is outlined as follows: In sections 2 to 6, I present the concept of working capital, the main factors affecting the level at which a firm chooses to set its working capital, the methods the firm may use in managing its working capital, the factors which may affect a firm’s working capital management efficiency, as well

as the factors associated with the year-end decline in working capital, a topic of paramount importance which nonetheless is rarely taken into consideration in the existing empirical studies of working capital management.

Since the focus in the second part of this thesis is on an empirical study of working capital management of non-financial companies listed in the German stock market and its association with shareholder value, the choice of a research methodology adapted to my purpose is of crucial importance. The empirical work and the findings I present in the second part of this thesis thus represent the other part my empirical contribution to the body of literature as there are, to the best of my knowledge, no empirical studies that specifically aim their attention at scrutinizing the link between working capital management and shareholder wealth for companies listed in the German stock market. Furthermore, I provide an alternative measure of working capital management which, given the nature of activity of the firms in my sample, turns out to be superior to existing measures commonly in use. The second part will begin with a review of the methods used in the most relevant empirical articles covering the link between profitability or shareholder wealth and the management of working capital.

PART ONE

2. The Nature of Working Capital

2.1. Definition

First and foremost, a thesis about working capital management should define the concept of working capital before setting out the different approaches to its management. The concept of working capital can be illustrated using a typical balance sheet. Figure 1 presents a diagram of such a balance sheet, in which the left-hand side is divided into current and fixed assets and the right-hand side into current and long term liabilities and equity. While the assets characterize the investments that have been undertaken, the liabilities represent the way those assets have been financed. *Current* (or short-term) assets, which are generally expected to become liquid within one year, include items such as, among others, cash, short-term bank deposits, marketable securities, trade receivables and inventories (consisting of raw materials, work-in-progress and finished goods awaiting sale and delivery), and differ from *fixed* (or long-term) assets such as property, plant & equipment (PPE) and goodwill, which are expected to take more than a year to become liquid. Similarly, *current* (or short-term) liabilities, which are generally due within a period of one year, include trade credit a firm owes its suppliers of goods and services, wages and other obligations due to the firm's employees in exchange for labour, taxes due within a year and payment obligations on short-term debt. Typically, the level of current assets represents the single largest investment of many firms, whereas firms finance these current assets in many instances for a large part through current liabilities (Smith, 1973).

Assets	Liabilities and Equity
Current assets, a_j	Current liabilities, l_j
Fixed assets, A_j	Long term liabilities, L_j
	Equities, E_j

Figure 1: A Typical Balance Sheet (source: Smith, 1973)[14]

Working capital relates to the categories 'current assets' and 'current liabilities' and is defined in standard corporate finance textbooks as the difference between these two categories, i.e.

[14] A subscript j on each balance sheet category points out to different specific accounts within each category.

$\Sigma a_j - \Sigma l_j$. It is also often referred to as Net Working Capital (NWC).[15] It indicates how much cash and other liquid assets (i.e. assets that are expected to be converted into cash within a period of one year) are available to a firm to fulfil the cash requirements imposed by its current liabilities and can therefore be understood as a short-term concept: A positive (negative) working capital value indicates the firm's (in)ability to pay off its current liabilities using its current assets.

To summarize, working capital is a measure – widely used by accountants - of a firm's net position of a firm's both real and financial liquid assets.[16] However, one should keep in mind here that a balance sheet provides only a static snapshot of the firm's investments and corresponding financing at a given moment in time. Though such snapshots can be analysed on different periodic bases and then compared to examine the evolution of a firm's working capital pattern over time,[17] a dynamic view of working capital as a 'flow' value[18] that takes into consideration what has happened between consecutive reports would provide a better understanding of its relation to the firm's evolution.

2.2. Interpreting the Concept of Working Capital

Although the definition set out above appears quite simple and straightforward, the concept of working capital remains complex in terms of its interpretation and both firm managers and owners have been found to be facing difficulty in applying it in practice. As a matter of fact, understanding only the explicit equation does not in itself provide the deeper understanding required for practitioners to efficiently perform standard corporate finance duties related to the management of working capital. One can assert that working capital is closely related to the liquidity of a firm. Indeed, after a firm has bought the property, plant and equipment that allow it to begin its operating activities, the bulk of its cash flows are generated by investing in and selling current assets. The firm will purchase, using cash and/or trade credit from its suppliers, raw materials; it eventually might have value added to these and will then be able to sell finished products to its customers, perhaps offering them the possibility to pay as soon as the goods are sold at a discount or later. Since current assets typically account for a large part of total assets, one can easily figure the importance of

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[15] As opposed to gross working capital, which refers to the value of all current assets. Gross working capital does however not reveal a firm's true financial position. Thus, whenever the term Working Capital is mentioned in this thesis, it should be understood as Net Working Capital.

[16] See Fazzari & Petersen (1993)

[17] See Preve & Sarria-Allende (2010)

[18] See Pass & Pike (1984)

decisions related to working capital: holding too high a level of current assets may for instance translate in the underperforming of a firm's investment. Moreover, if a firm holds inadequate levels of current assets, it may be faced with shortages and smoothly maintaining daily operations may prove difficult.[19]

However, despite conventional wisdom, the value of working capital, as it is defined in the previous section, is not in itself so relevant when assessing the liquidity of a firm. It is nevertheless without any doubt commonly reported as a stand-alone value in corporate financial communications. What can nevertheless be asserted is that the value of working capital gives an investor hints as to whether a firm operates efficiently[20] and whether it is in short-term financial health.[21]

An alternative, novel interpretation of the concept of working capital is provided by Preve & Sarria-Allende (2010) and departs from the traditional *accounting* view described above. It starts from the insight that a firm requires to finance in some way its operating investments[22] to maintain its commercial activities. Usually, part of these investments is financed by short-term operating liabilities, i.e. the credit provided by suppliers, employees, and the tax authority, which can be considered as *spontaneous resources*[23] as they are generated by the sheer fact of doing business. The remaining part of the operating investments which are not financed by short-term operating liabilities is being funded by the financial needs for operation (FNO). As can be seen from Figure 2 below, working capital, i.e. the balance between current assets and current liabilities, covers part of these financial needs for operation, the other part being covered by short-term financial debt. Note here that working capital can be written down not only as the difference between current assets and current liabilities, but also as the difference between permanent capital (i.e. long-term debt and equity) and fixed assets. Thus, a decrease (increase) of a firm's level of equity or long-term debt or an increase (decrease) in its level of fixed assets leads to a decrease (increase) of its working capital. Viewed in this light, it becomes straightforward that the firm's

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[19] See Van Horne & Wachowicz (2009)

[20] Capital which is tied in inventories or receivables cannot be used to repay any of the firm's obligations. Therefore, a firm not operating in the most efficient manner, for instance by collecting receivables too slowly or keeping too high levels of inventories, will tend to have a tendency of increasing working capital from one period to the next.

[21] A firm's whose current liabilities exceed its current assets may face difficulties paying back its debts in the short term and thus faces a higher probability of bankruptcy.

[22] These include inventories, receivables and a minimum of liquidity required by a firm to operate.

[23] See Faus (1997)

decision about how much working capital it uses to fund short-term financial needs for operation is a highly strategic one which is long-term in nature as it is closely related to the decision regarding fixed assets as well as long-term debt and equity.

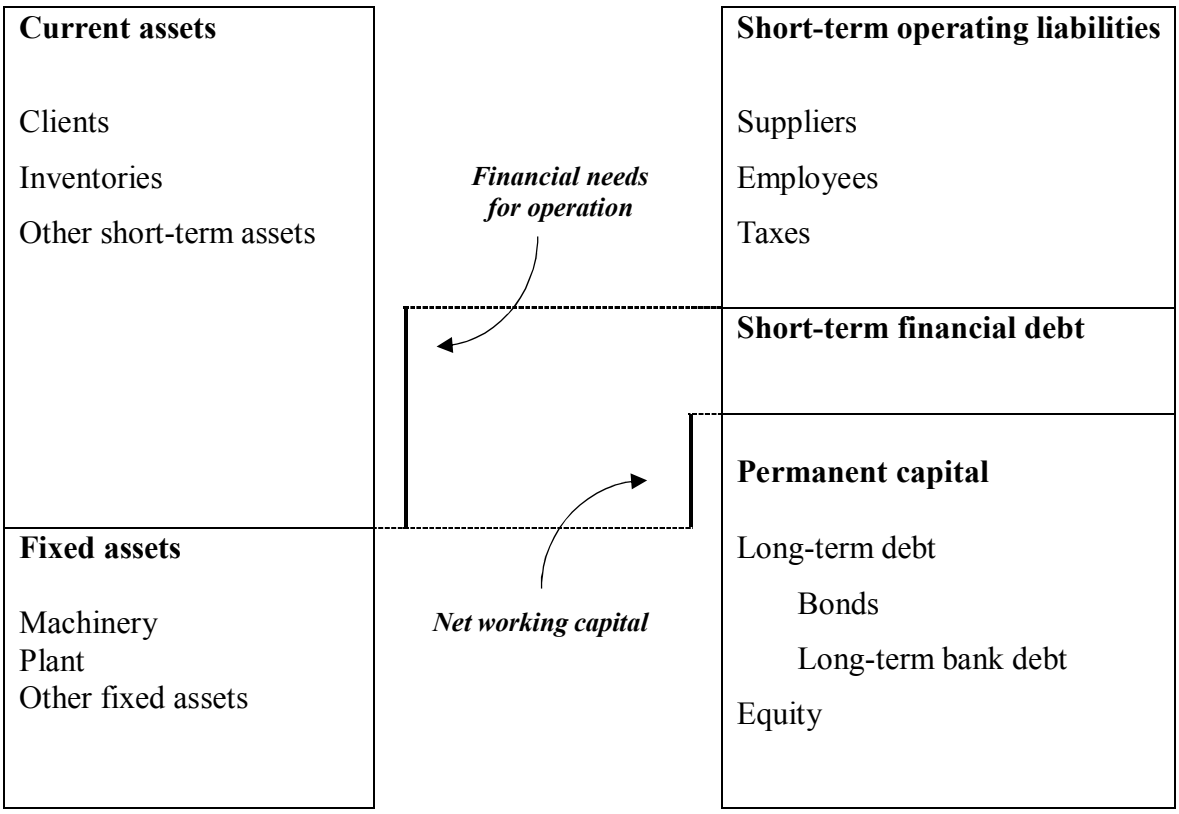

Figure 2: Financial Needs for Operation and Working Capital (Source: Preve & Sarria-Allende, 2010)

2.3. Working Capital Metrics

I have mentioned in Section 2.1. that a positive (negative) working capital value indicates a firm's (in)ability to pay off its current liabilities using its current assets. Sometimes, investors, financial analysts as well as financial managers use other financial metrics to evaluate a firm's working capital position.

2.3.1. Current Ratio – 3rd Degree Liquidity Measure

One such indicator is the current ratio, also known as the working capital ratio, which is defined as the relative proportion of its current assets to its current liabilities:

$$Current\ Ratio = \frac{Current\ Assets}{Current\ Liabilities}$$

It measures the working capital (or liquidity position) at the 3rd degree. A current ratio of less than 1 is commonly believed to be a strong indicator that a firm will face liquidity problems in the future. It can however be false to stick to this line of thinking: A current ratio of less than 1 is common in instances where firms are drawing down cash from a line of credit and cash balances are kept at a minimum, only being replenished when it is absolutely required to pay for short-term liabilities. Thus, in these instances, the presence of the line of credit renders it very unlikely that a firm will not be able to meet its short-term obligations. Though it is obvious that a higher current ratio points to a greater liquidity than a lower one, it is also judicious to compare a firm's current ratio to that of its industry peers and to consider the trend of that firm's current ratio over time. Moreover, it is important to take into consideration the composition of the current assets, since otherwise the current ratio can be misleading: It makes a great difference whether these current assets are predominantly in the form of inventories rather than in the form of cash, marketable securities or accounts receivable as the former can prove difficult to liquidate in the short term, particularly so in the case of a low inventory turnover ratio. A similar problem occurs when accounts receivables payment terms are quite stretched, which may indicate unrecognized bad debts.

2.3.2. Quick Asset Ratio – 2nd Degree Liquidity Measure

Another widely utilized measure of a firm's working capital (or short-term liquidity) position is the quick asset ratio (QAR), which is also known as *quick ratio* or *acid-test ratio* and measures the firm's liquidity at the 2nd degree. It is defined as:

$$QAR = \frac{(Cash\ \&\ Equivalents + Marketable\ Securities + Accounts\ Receivables)}{Current\ Liabilities}$$

It is more stringent than the current ratio as it further refines the current ratio by measuring a firm's ability to meet its short-term obligation using its most liquid assets, therefore excluding inventories, which of all the various current assets, is generally understood to be the most difficult to convert into cash when a firm is being liquidated.

2.3.3. Cash Ratio – 1st Degree Liquidity Measure

The third and most stringent and conservative ratio measuring a firm's liquidity (or working capital position) is the cash ratio. It measures the liquidity at the 1st degree and is given as:

$$Cash\ Ratio = \frac{(Cash\ \&\ Equivalents + Marketable\ Securities)}{Current\ Liabilities}$$

This ratio only considers the most liquid short-term assets of a firm, i.e. those which can most easily be used to meet short-term obligations. It ignores both inventory and receivables as these obviously take longer to be converted into cash to meet current liabilities. However, it is highly unlikely and unrealistic that a firm holds enough cash and equivalents to fully cover current liabilities, since it is perceived as poor asset utilization from the part of a firm to maintain on its balance sheet high levels of cash and equivalents. This money could be instead returned to shareholders, used to reduce debt or used in other ways to generate higher returns. Thus, this ratio, while providing an interesting liquidity perspective, has limited usefulness and is therefore not often used neither by analysts nor in financial reporting. I have nonetheless added it to this section for the sake of completeness.

2.3.4. Working Capital Requirements (WCR) and Net Liquid Balance (NLB)

Though the current, quick and cash ratios presented above generally provide a good picture of a firm's liquidity or working capital position, they tend to reflect the liquidity position of a firm from a liquidation perspective and not as a going concern, as noted by Shulman & Cox (1985, p.64). They further argue that "*current assets such as account receivable are often tied up in the operating cycle, and failure to account for this may distort the corporation's true liquidity picture. Consequently, current and quick ratio may imply a reasonable level of liquidity when in fact little exists.*" Other authors[24] have also questioned the adequacy of the current and quick ratios in assessing how efficiently a firm manages its working capital due to their being of static nature. Following Shulman & Cox (1985) line of thinking, Shin & Soenen (1998, p. 38) add that "*[l]iquidity for the on-going firm is not really dependent on the liquidation value of its assets but rather on the operating cash flow generated by those assets.*"

Given those reasons, Shulman & Cox (1985, p. 64) have introduced a liquidity indicator aimed at measuring "*the net amount of liquid financial assets and obligations along with an integrated expression that demonstrates the direct impact changes in operating resources have on a firm's financial liquidity position.*" They classify Net Working Capital (NWC)

[24] See for example Emery (1984) and Kamath (1989)

components into financial and non-financial items and refer to these as Net Liquidity Balance (NLB) and Working Capital Requirements (WCR) respectively. Thus, the integrated expression of net working capital is given as:

$$NWC = NLB + WCR,$$

NLB[25] encompasses all liquid financial assets minus all liquid financial obligations and WCR[26] are defined as the difference between current requirements and resources which represent spontaneous items associated exclusively with the operating cycle. A firm's WCR are similar in terms of interpretation to its financial needs for operations described earlier (see subsection 2.2.). NWC, as expressed above, contrasts with the traditional measure of working capital, i.e. the difference between current assets and current liabilities, in that it provides a better understanding of the liquidity of the firm: While the traditional expression both (i) fails at explaining the effect on NWC of long-term corporate decisions and (ii) disregards the effect on a firm's liquidity of changes in the operating cycle as well as the impact on the operating cycle of capital changes, the alternative characterization presented above "*demonstrates that corporate liquidity is, in fact, a subset of net working capital and is directly affected by spontaneous changes in the operating requirements and operational resources of the firm.*" (Shulman & Cox, 1985, p. 64) Besides, Shulman & Cox (1985) assert that the NLB, by focusing on liquid financial assets and financial obligations, allows a more representative assessment of a firm's default potential than other standard liquidity indicators.[27]

To conclude this section, it should be noted that most of the measures of working capital used in studies that I will henceforth present are, in one way or another, adaptations of the

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[25] Shulman & Cox (1985) express NLB as Cash + Marketable Securities – Notes Payable.

[26] Shulman & Cox (1985) express WCR as (Accounts Receivable + Inventory + Prepaid Expenses) – (Accounts Payable + Net Accruals)

[27] To assess the consistency of the NLB, or rather the NLB relative to total assets as a measure of a firm's default risk, Shulman & Cox (1985) have compared it to seven other ratios: Besides the ratio of cash to total assets, the other six are the standard solvency ratios used at the time of publishing of their study by Dun & Bradstreet, namely the current ratio, the quick ratio, the ratio of current liabilities to net worth, the ratio of current liabilities to inventories, the ratio of total liabilities to net worth and the ratio of fixed assets to net worth. I ought to mention here that Shulman & Cox (1985) have not compared the NLB to total assets ratio to the ratio of working capital to total assets, defined as (Current Assets – Current Liabilities) / Total Assets, frequently used in studies of corporate problems and which Altman (1968) has shown to be the most valuable measure of liquidity in terms of statistical significance – the other measures of liquidity Altman evaluated were the current and the quick ratio.

above presented measure of working capital requirements (WCR). These can alternatively be referred to as net operating working capital.

2.3.5. Measuring Working Capital Management Efficiency

In this subsection, I briefly introduce the commonly used measures of working capital management efficiency. I refer the reader to section 4 of this thesis for a more extensive discussion of issues related to the management of working capital. Working capital management performance is typically evaluated using one of the following metrics:

. Days Sales Outstanding (DSO):

$$DSO = \frac{Accounts\ Receivable}{\left[\frac{Revenues}{365}\right]}$$

The DSO represent the (fiscal) year-end trade receivables net of allowance for doubtful accounts, divided by one day of average revenues. An increase in DSO represents a deterioration, a decrease an improvement. It is also known as the receivables conversion period (see Fig. 3) and as the number of days accounts receivable.

. Days Inventories Outstanding (DIO):

$$DIO = \frac{Inventory}{\left[\frac{Cost\ of\ Goods\ Sold}{365}\right]}$$

The DIO represent the (fiscal) year-end inventory balance divided by an average daily cost of goods sold. An increase in DIO represents a deterioration, a decrease an improvement. It is also known as the inventory conversion period (see Fig. 3) and as the number of days inventories.

. Days Payables Outstanding (DPO):

$$DSO = \frac{Accounts\ Payable}{\left[\frac{Cost\ of\ Goods\ Sold}{365}\right]}$$

The DPO represent the (fiscal) year-end payable balance divided by an average daily cost of goods sold. An increase in DPO represents an improvement, a decrease a deterioration. It is also known as the payables deferral period (see Fig. 3) or as the number of days accounts payable.

. Cash Conversion Cycle (CCC):

$$CCC = (DSO + DIO - DPO)$$

The CCC, a metric related to the total cash cycle or operating cycle (see Fig. 3) initially developed by Gitman (1974) and later operationalized by Richards & Laughlin (1980), represents the overall working capital management performance in days as calculated above. It is an "*additive function [and] measures the number of days funds are committed to inventories and receivables, less the number of days that payments to suppliers are deferred.*" (Gentry et al., 1990, p. 90) It is indirectly linked to a firm's valuation: A short CCC relative to a lengthy CCC is a typical indication that a firm is collecting cash quickly while at the same time paying its suppliers near the due date. This in turn results in the net cash flows and the value of the firm having a higher present value.[28] Gentry et al. (1990) also suggest that a shorter CCC points to both a higher efficiency of a firm's internal operations and a closer availability of net cash flows. This argument, I should note, was already brought forward earlier by Hager (1976), who suggest that a low cash conversion cycle not only points to (i) managers' ability to curtail firms' holdings of assets that are

[28] See Gentry et al. (1990)

relatively unprofitable, e.g. cash and marketable securities,[29] but also (ii) sustains the firms' debt capacity as less short-term debt is needed to maintain liquidity, and (iii) reflects a higher net present value of net cash flow from the firm's assets. The shortfall of the CCC, Gentry et al. (1990) argue, is however that it fails to take into consideration the timing of the cash flows as they are tied up in each step of the operating cycle. Another criticism of the CCC comes from Shin & Soenen (1998), who argue that because of it being an additive concept and that the denominators of it three components are not one and the same, adding these does not make a very useful measure.

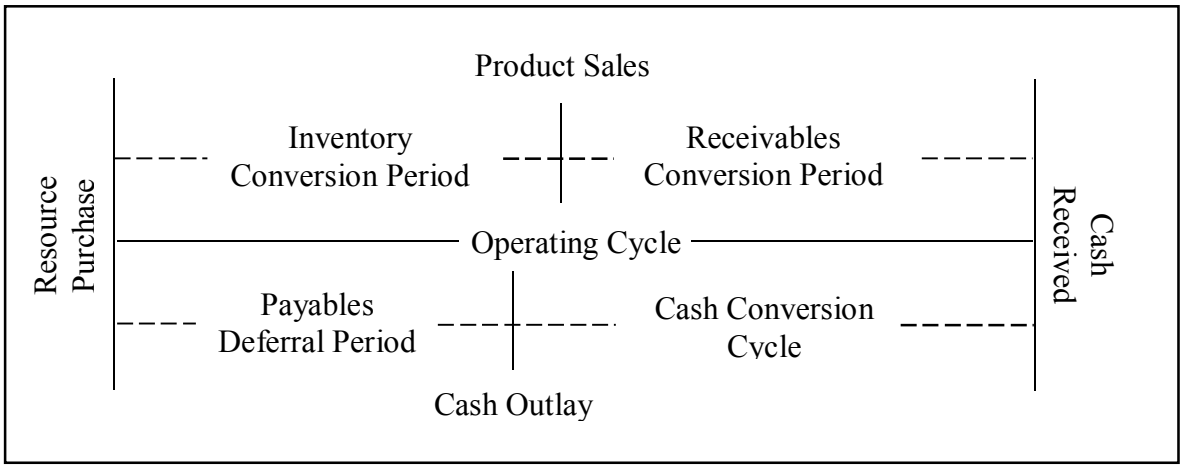

Figure 3: Cash Conversion Cycle (Source: Richards & Laughlin, 1980)

. Weighted Cash Conversion Cycle (WCCC)

$$WCCC = WOC - WDAP$$

In the above expression, WOC represents the weighted operating cycle and WDAP the weighted days in accounts payable. The weighted cash conversion cycle is a modified version of the cash conversion cycle developed by Gentry et al. (1990) that, unlike the CCC, "*combines the weighted information related to purchases, production, distribution and collection minus the payables effect*" (Gentry et al., 1990, p. 97). Specifically, WOC is determined by multiplying the weight of each component of the operating cycle, namely raw

[29] This argument is however not uncontroversial: Czyzewski & Hicks (1992), for instance, show firms with high relative concentration of cash assets to be successful, thereby suggesting that high levels of cash can lead to higher than average return on assets.

materials, work-in-progress, finished goods,[30] and accounts receivable, with the length of time funds are tied up in each of these components.[31] WPAD, which represents the payable effect, is obtained by multiplying the payable weight, a complex function reflecting the role played by suppliers in financing the raw material[32], with the number of days that payment is deferred to suppliers. While being a more complete measure and thus providing a better appreciation of the complexities of the cash cycle than the CCC, the WCCC lacks practicality for a simple reason: the differentiation of inventories into its three components is not always readily available to outside investigators, e.g. academic researchers, investors or financial analysts, and can therefore not always be calculated.

. Net Trade Cycle (NTC):

$$NTC = \frac{(Accounts\ Receivable + Inventory - Accounts\ Payable)}{\left[\frac{Revenues}{365}\right]}$$

The NTC, being basically equal to the CCC save for the fact that the days accounts receivable, inventories, and accounts payable are all expressed as a percentage of revenues, represents an indication of the *days sales* available to a firm in order to finance its working capital under ceteris paribus conditions. In addition, it provides per Shin & Soenen (1998, p. 38) "*an easy estimate for additional financing needs with regards to working capital management expressed as a function of the projected sales growth.*" Shin & Soenen (1998) also suggest that the NTC, similarly to the CCC, is closely related to the issue of shareholder value creation and firm valuation: Shortening the NTC results in a higher present value of the net cash flows generated by the assets, thus in turn increasing shareholder value. Besides, they suggest that shortening the NTC increases the efficiency with which a firm manages its

[30] Note here that inventory is split into its three different components.

[31] See Gentry et al. (1990)

[32] The greater the payment deferral to suppliers and the larger the reduction in WOC, the larger the payable weight. (See Gentry et al., 1990)

working capital, in turn lowering the need for external sources of financing and increasing its financial performance.[33]

. Cash Conversion Efficiency (CCE):

$$CCE = \frac{Cash\ Flow\ from\ Operations}{Sales}$$

The CCE is calculated as cash flow from operations divided by sales. It measures a firm's efficiency to convert its sales into cash: Typically, firms benefit from shortening (lengthening) all types of floats[34] associated with cash inflows (outflows).[35] It measures the efficiency with which a firm manages its working capital from a macro perspective and, in this respect, differs from the CCC or NTC measures of WCM efficiency. However, using the CCE as a measure of WCM efficiency may be misleading when comparing firms with one another as one needs to make sure every firm represented in one's study calculates its cash flow from operations figure in the same way. The *REL Consulting Company* and the *CFO* magazine used to evaluate the WCM efficiency when they started their annual surveying of firm's WCM efficiency in 1997 using the CCE, but later in 2003 it was dropped, giving way to the CCC, commonly considered to be the key measure of WCM efficiency.

3. Key Determinants of Working Capital Decisions

Before I turn to the different approaches to working capital management in the next section, I ought to provide a more complete understanding of the concept of working capital and what exogenous and endogenous factors determine its level. Specifically, I explore how the seasonality of a firm's underlying business, its growth aspirations, the industry the firm operates in, the financial constraints it may face as well as whether it is in risk of financial

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[33] In addition, Kamath (1989), in his examination of the firms operating in the retail grocery industry, also provides evidence of a negative association between the net trade cycle and operating performance, though his results do not hold true for every year under consideration in his study.

[34] Float is here referred to as the total time lapse from the purchasing of resources at the beginning of a firm's operating cycle until payment for goods and services is received at the end of the firm's operating cycle. (See Asaf, 2004)

[35] See Asaf (2004)

distress, the market power it enjoys impact on its working capital decision. I also explore issues relating working capital management to corporate governance as well to managers' incentives to reduce levels of working capital at the fiscal year-end.

Keeping in mind the aim of my study, i.e. to try to establish a relation of causality between working capital management and shareholder value using a sample of German publicly listed companies, it is key to consider these determinants of working capital to better address endogeneity concerns that may be present in the regressions that will be run. Another motivation for taking a closer look at the key factors affecting working capital management is that there has been scarce literature on the overall theory of working capital management. Finally, emphasizing on the determinants of working capital is also necessary as it provides a solid base for academics as well as practitioners to understand any issue they wish to scrutinize in relation to the field of working capital management. [36]

3.1. Seasonality and Growth Effects on Working Capital[37]

High seasonality is a feature intrinsic to a significant number of industries, meaning that the bulk of trade in these industries takes place during seasonal peaks clustered throughout the year. How does this feature affect the level of working capital required by a firm that goes through a peak season? One may assume that this firm will increase its level of cash to cover higher production and marketing costs. It will also most certainly hold higher levels of inventory during that period as well as build up more accounts receivables due to the higher turnover. On the other hand, these increases in operating investment will likely be funded by using trade credit granted to the firm by its suppliers, leading to an increase in account payables on the firm's balance sheet. Although the firm entering the peak season will eventually increase its operating investment, it is not clear what the effect will be on the level of working capital. Following conventional wisdom, it would typically be expected that the seasonal peak calls for a higher net investment in current assets, thus increasing the level of working capital. This thought, which might be intuitively correct, is nevertheless wrong and *part of the usual confusion*.[38] Indeed, taking into consideration the second definition of working capital presented in the previous section as the difference between *fixed assets* and *permanent resources* (i.e. long-term debt and equity), one can ask whether a higher operating

[36] Appuhami (2008) for instance notes that some firms are still struggling with the management of their working capital due to their lacking a sufficient understanding of the factors determining working capital.

[37] See Preve & Sarria-Allende (2010)

[38] See Preve & Sarria-Allende (2010), p. 27

activity in a short period would efficiently be financed by issuing new long-term debt or even equity. Given the agency, information and issuance costs that this would involve, it does not seem to be the most efficient solution. Thus, the *permanent resources* part of the working capital equation remains most probably unchanged throughout the year. The other part of the equation, *fixed assets*, will also most probably remain unchanged: It would not make much sense to invest in property, plant or equipment just to adjust to the high season's requirements only to sell it back once the high season is over. This leads Preve & Sarria-Allende (2010) to draw the following conclusion: Working capital, by construction, will not change throughout the year when a firm faces seasonal changes in its trading activity.[39] What changes throughout the year in consequence of the higher level of activity due to seasonality are rather the financial needs for operation. This argumentation is summarized graphically in Fig. 4. A question that nevertheless remains to be answered is how the increased financial needs for operation are being financed when the long-term financing is not altered. Going back to Fig. 2 in the previous section, one can see that the financial needs for operation can be computed as the sum of *working capital* and *short-term financial debt*. It therefore becomes clear that the net operating investment (or financial needs for operation) can be financed through either working capital or short-term debt, "*where working capital is interpreted not simply as an investment decision but also as a financing strategy.*" (Preve & Sarria-Allende (2010, p. 29)

Choosing the right level of working capital is nevertheless linked to the (seasonal) nature of a firm's operations. Indeed, a firm that wants to avoid raising long-term debt to curtail the financing costs associated with unnecessary capital in periods of lower activity will choose a level of working capital equal to the minimum monthly financial need for operation. Thus, any increased operating investment required during the high season will be financed solely by short-term debt. In contrast, all the financial needs for operation will be covered by working capital during the low season (See Fig. 5). Following this strategy could turn out to be a cheap option for a firm under *normal* conditions characterized by low levels of uncertainty as it allows the firm to use less long-term capital, which, assuming a typical upward-sloping yield curve, is more expensive.

Under riskier market conditions, such as those characterizing the economic environment our empirical study is embedded in, where for instance a credit crunch makes it difficult or even

[39] This implies that the level of working capital should change because of long-term rather than short-term changes in business activity.

impossible for firms to raise short-term debt, the strategy of keeping a low level of working capital would not only leave the firm facing a higher interest rate risk[40], but it may also be unable to participate in the busy high season as a result, which in turn could lead the firm to suffer huge losses or even face bankruptcy.

Alternatively, a firm can follow the opposite strategy and choose the highest level of working capital to finance its operations, therefore not using any short-term, but only long-term financial debt (See Fig. 6). This strategy, while allowing operating financial needs to be covered entirely by working capital, could turn out to be overly costly as the funds (sourced with long-term debt and/or equity, thus having a high cost associated to them) that are idle during a weak season, would require to be invested at a considerable return.

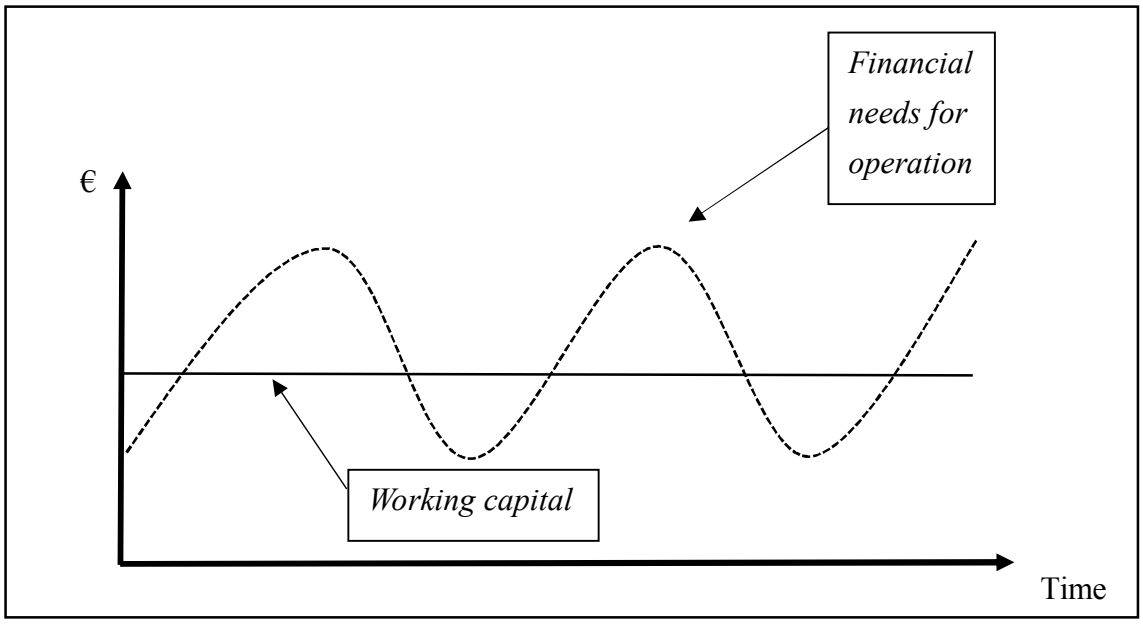

Figure 4: Effect of Seasonality in Operating Activity (Source: Preve & Sarria-Allende, 2010)

This could however not be achieved were these funds to be invested in short-term investments, which would guarantee their short-term availability. Taking into consideration the two extreme scenarios presented above, one might ask how firms engaged in seasonal businesses choose their level of working capital. Preve & Sarria-Allende (2010) argue that a firm's choice of working capital is likely to be influenced by the firm's debt capacity, its access to debt and perhaps even its location. A firm located in a country where financing opportunities are easily accessible would ideally opt for a lower investment in working

[40] Since the average investment over the course of year is higher than the lowest level of working capital the firm has chosen, the average life of the assets would not match the maturity of the corresponding financing source. (Preve & Sarria-Allende, 2010)

capital than if the same firm was in a developing country characterized by illiquid capital markets and regular liquidity crises.

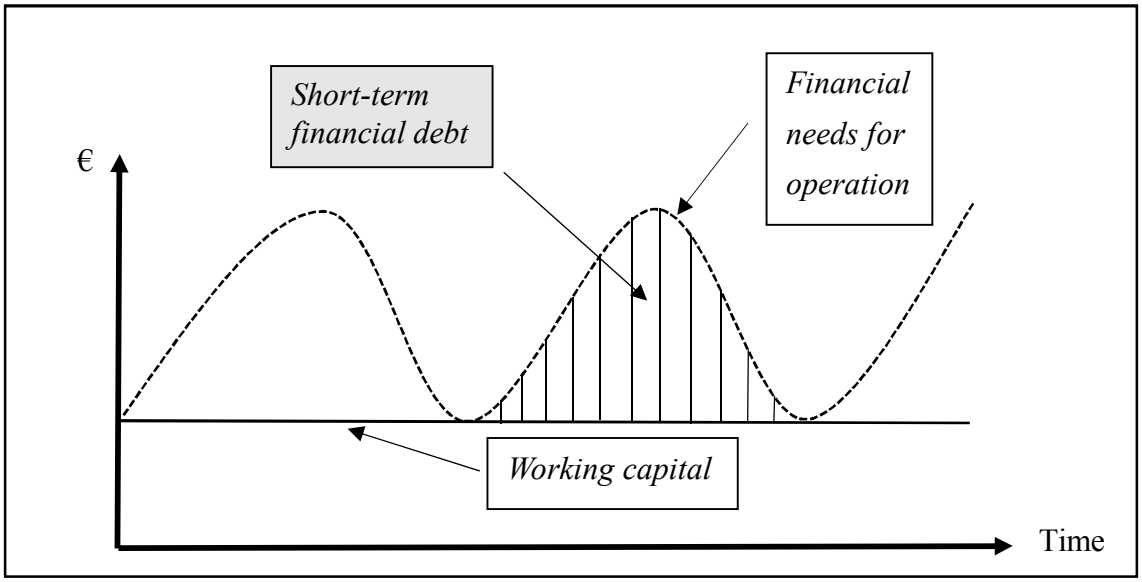

Figure 5: 'Low Working Capital' Strategy (Source: Preve & Sarria-Allende, 2010)

In general, though, it is unlikely that firms will follow either of these two extreme strategies; rather, the optimal working capital strategy will likely lie somewhere in between (see Fig. 7). What should nonetheless motivate the right level of working capital is the trade-off between the objective to minimize low-return investments and avoiding liquidity risk.

Since most firms not only face seasonal variations in activity, but also grow or shrink over time because of external shocks or the firms' own strategic decisions, the decision regarding the level of working capital is most probably dynamic in nature. How, then, is a firm expected to adjust its working capital when it is not just facing seasonality, but also a clearly upward or downward trend in its business activities? Understanding the theoretical implications of an economic slowdown on working capital is of interest in this study, as the empirical study presented in the second part of this thesis focuses on a period characterized by a major financial crisis.

In the same way that a firm following a growth strategy can generate more sales by investing in working capital (e.g. by granting longer payment periods to its customers or by increasing inventory to meet a growing demand), it can, when faced with deteriorating economic conditions, liquidate its working capital by redoubling its endeavours to collect receivables or by toughening credit policies on new sales. As such, working capital can be considered a reversible tool, as emphasized by Fazzari & Petersen (1993). It is interesting to note here that following evidence disclosed by Meltzer (1960), firms with a constrained liquidity stock

cut account receivables when facing "*tight money*",[41] whereas firms with a strong liquidity position[42] don't.

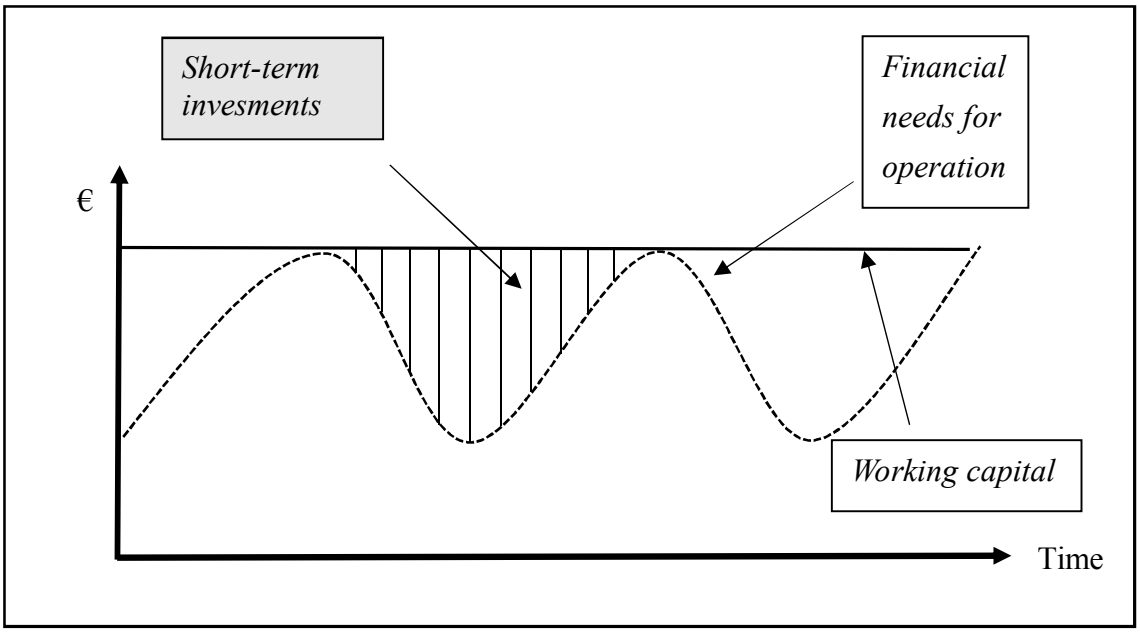

Figure 6: 'High Working Capital' Strategy (Source: Preve & Sarria-Allende, 2010)

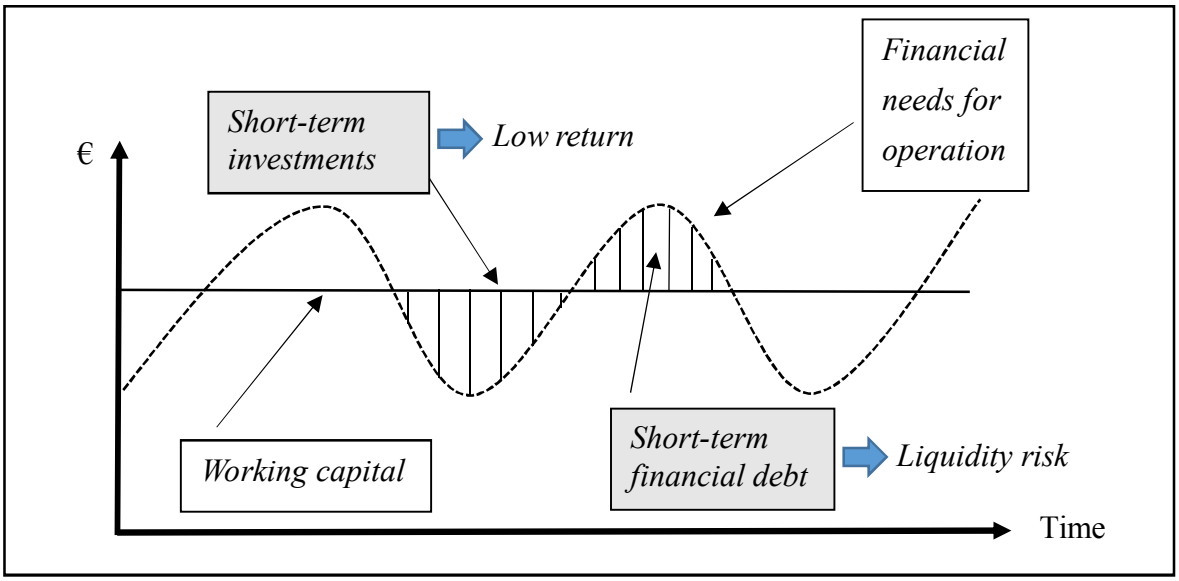

Figure 7: 'Intermediate Working Capital' Strategy (Source: Preve & Sarria-Allende, 2010)

In any case, one can generally expect firms to adapt their level of working capital not only to the current state of the economy they are facing, reducing it in times where the economy

[41] Meltzer (1960), p. 429

[42] The liquidity position, (or liquidity stock), is defined by Meltzer (1960) as the ratio of cash plus government securities to current liabilities and is comparable to the quick ratio [defined as the ratio of cash plus marketable securities plus accounts receivables to current liabilities]

is in recession and increasing it again when the economy takes off, but also to their own growth strategy. Failing to do so will lead to a situation as the one depicted in Fig. 8 below, where the level of working capital is not adapted to the growth trend and the need to finance growing operating investments would have to be covered by short-term debt.[43]

This implies that the firm that does not adapt its level of working capital to meet growth concerns, has unconstrained access to capital markets, which, in times of *tight money* is far from being guaranteed and thus represents a very risky suboptimal strategy. Rather, firms ought to fund growth by adjusting their level of working capital in response to a well-defined long-term trend in the level of economic activity, as depicted in Fig. 9.

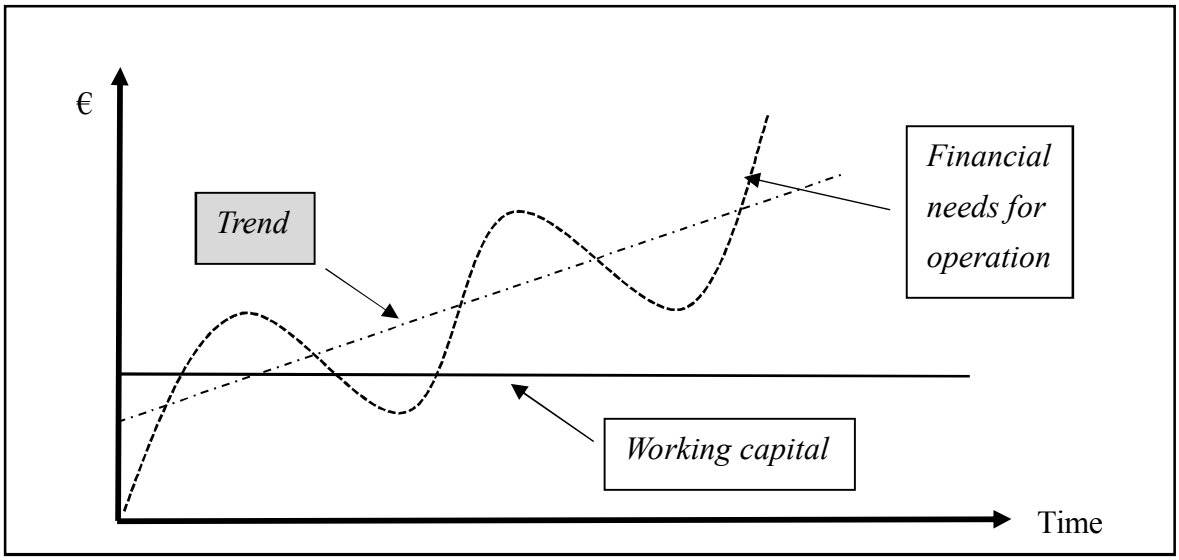

Figure 8: Financing Growth I (Source: Preve & Sarria-Allende, 2010)

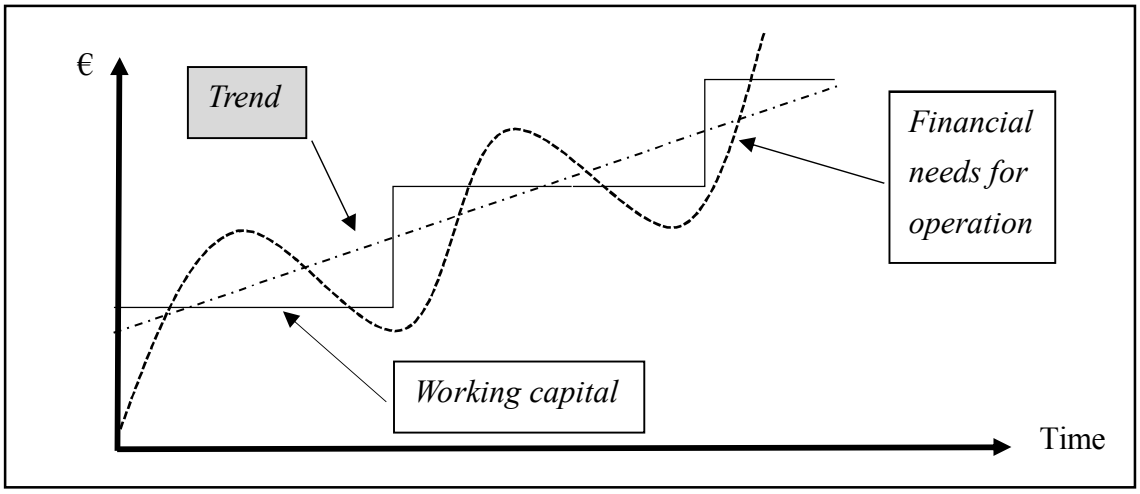

Figure 9: Financing Growth II (Source: Preve & Sarria-Allende, 2010)

[43] See Preve & Sarria-Allende (2010)

In conclusion, it is crucial for a firm that choose their level of working capital to distinguish between situations of seasonal fluctuations in economic activity and situations of actual growth. Failure to do so will lead the firm to "*either take suboptimal financing risks (financing with short term debt investments that really call for long-term financing, resulting in the risk that some opportunities may not receive funding) or pay too high a required return on financial capital (financing short-term needs with long-term debt, resulting in idle funds upon which payments are due)*" (Preve & Sarria-Allende, p.41).

3.2. Industry Influence on Working Capital Decisions

Another major determinant of a firm's working capital decision relates to the industry it belongs to. Evidence given by Hawawini et al. (1986) in their study of the industry influence on corporate working capital decisions, which analyses a sample of a total of 1,181 firms from thirty-six industries over a period of nineteen years (1960 to 1979), has uncovered "*a significant and persistent industry effect on a firm's investment in working capital*" (p. 15). Moreover, the results they report "*are also consistent with the notion that there exist industry benchmarks within industry groups to which firms adhere when setting their working capital investment policies.*" (Hawawini et al., 1986, p. 23) It should be noted here that the authors have based their study on the concept of Working Capital Requirement (WCR)[44], which constitutes "*a convenient accounting measure of the amount of capital a firm has tied up in its operating cycle [and] may prove to be a better measure than the traditional concept of Net Working Capital*" (Hawawini et al., 1986, p. 16). Indeed, they argue that the traditional notion of working capital (i.e. the balance of a firm's current assets and current liabilities) includes some items, such as cash and marketable securities, overdrafts and notes payable to the bank, that should be considered as decision variables which are purely financial in nature and thus are not closely related to a firm's investment in its current operations. To illustrate this point, they provide an example in which the level of cash is raised temporarily due to long-term debt being issued to finance capital expenditures, which may hype up its NWC. Nonetheless, the results obtained by Hawawini et al. (1986) when performing the same tests using Net Working Capital are not significantly different from the results of the tests using Working Capital Requirement.[45]

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[44] Working Capital Requirement is defined as the balance of the sum of accounts receivable and inventories and the sum of account payables and net accruals. Hawawini et al. (1986)

[45] On a side note, it should be mentioned that Hawawini et al. (1986) fail to mention in their article that the concept of WCR was first introduced by Shulman & Cox (1985), who defined WCR "*as the difference between current operational requirements […], and current operational resources*" (Shulman & Cox, 1985,

Hawawini et al. (1986) provide the following straightforward explanation as to why there is an industry effect of working capital decisions: The Working Capital Requirement of a firm is driven, per definition, by the amplitude of its four components, namely *accounts receivable*, *inventories*, *accounts payable*, and *net accruals*, which are themselves a function of the firm's technology, its efficiency in managing the operating cycle, and of course its level of sales. The level of WCR will naturally also depend on the nature of a firm's operating cycle: For example, a chain of grocery stores would need a lower WCR than a manufacturer of industrial equipment to sustain the same level of sales.[46] There are thus constraints imposed by the industry a firm operates in on its investment in working capital. It is nevertheless imaginable that two firms with similar technologies and equal level of sales that belong to the same industry have different levels of WCR. This can happen for instance when one firm is more efficient than the other in managing its operations, e.g. by holding tighter control over the level of inventories and receivables, which in turn leads it to invest less in working capital than its competitor. Usually, however, firms that are involved in the same industry should be able to operate with analogous degrees of managerial efficiency and are moreover expected to use similar technologies: in markets characterized by reasonable competitiveness, the spread in the degree of managerial efficiency of firms within the same industry is not expected to be very wide. If, for example, one firm attempts to enforce stricter terms of payment to its customers to reduce its investment in accounts receivable, customers would eventually move to the firm's competitors in the same industry. Thus, optimal industry standards in managerial efficiency should develop to which firms that form an industry are expected to adhere. As argued by Hawawini et al. (1986), assuming technology is the same for all firms that constitute an industry is also reasonable and consistent with the standard assumption of constant operational risks within an industry. In conclusion of their explanation, they argue that "*[i]f the degree of managerial efficiency and technology is assumed to be the same for all the firms making up an industry, then the ratios of Working Capital Requirement to Sales*[47] *of firms belonging to the same industry should not differ significantly and their average should constitute that industry's benchmark WCR-to-Sales*

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p. 65), both items they consider as spontaneous and exclusively related to the operating cycle: WCR = [Accounts Receivable + Inventory + Prepaid Expenses] – [Accounts Payable + Net Accruals].

[46] Given that much of its operations is handled on a cash basis, the chain of grocery stores will most probably carry a relatively lower level of inventories and accounts receivable than the manufacturer of industrial equipment. Hawawini et. al. (1986)

[47] This ratio is assumed by Hawawini et al. (1986) to be the measure of efficiency with which the components of WCR are managed.

ratio. The industries' mean WCR-to-Sales ratios should, however, be significantly different from one another." (p. 18)

Nonetheless, in an earlier empirical study by Nunn (1981) that covers the strategic determinants of working capital from a product-line perspective in the case of multi-divisional corporations, evidence is given as to why working capital policies can also differ *within*, not only *across* industries. Interestingly, instead of focusing on the "*temporary*" part of working capital, i.e. the part shaped by weekly and monthly fluctuations in a firm's business activities, which is undoubtedly a useful "*short-term or tactical* [mean in] *determining such matters as the economic order quantities and the amount of credit to extend to a particular customer*" (p. 207), Nunn (1981) is interested in the "*permanent*" part of a firm's working capital investment, the levels of which "*do not fluctuate with short-run changes, but persist year after year, continually representing a major portion of the asset structure*" (p. 207). Nunn (1981) uses data from 1971 to 1978 averaged over four years in his multiple regression model.[48] In designing his working capital model, Nunn (1981) uses, in a first step, correlation analysis to filter out 166 independent model variables from roughly 500 potential data base[49] variables which he assumed may potentially explain the level of the "permanent" portion of working capital investment of a business.[50] Since correlation analysis, while being useful as a screening method, is a limited tool as multivariate relationships are being ignored, Nunn (1981), in a second step, goes on to use factor analysis, a multivariate technique that allows the variable space under study to be reduced to a smaller number of factors. The ratio of Working Capital to Sales, set as the dependent variable, was regressed on the 43 orthogonal[51] factors resulting from the factor analysis.[52] It should be pointed out here that Nunn (1981), since his study models working capital from a product-line perspective, defines working capital to include only accounts receivable and inventories,

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[48] This method obviously allows for a reduction of the influence of short-term or yearly fluctuations in business activity. Nunn (1981)

[49] Nunn (1981) uses the Strategic Planning Institute's Profit Impact of Market Strategy database, which "*consists of information on the strategic experiences of 1700 plus businesses*" (pp. 207-208), and thus "*provides a unique cross-sectional resource, assembled from product-line businesses in many different industries.*" (p. 207)

[50] Nunn (1981) defines a business "*as a product-line, division, or other operating unit of a company, producing a well-defined line of products, and competing in a specific market*" (p. 207)

[51] The selection of individual variables from orthogonal factors reduces the possibility of multicollinearity between these variables, thus taking into consideration concerns about possible endogeneity in the cross-sectional model.

[52] The factor analysis led to 43 orthogonal factors being recovered and was performed in two steps: In a first step, the initial factors were recovered using principal component analysis. In a second step, a varimax rotation was performed. (see Nunn, 1981)

components typically controlled, as he argues, at the level of product-line managers. Other components, such as cash and short-term securities, were left out as they were supposedly not managed at the product line level but rather controlled directly at the level of the corporations' headquarters.[53]

In conclusion, the model designed by Nunn (1981), together with the empirical evidence provided in support of his model, explain "*why working capital varies from one business to the next, i.e. why some product-lines have low working capital requirements and others very high ones. For example, determinants such as relative price, relative product image, and relative breadth of product-line explain why working capital vary among competitors* ***within*** *an industry.*" (Nunn, 1981, p. 208)

The difference in working capital requirement *across* industries is explained by other determinants such as industry exports and industry concentration:

It is expected that export-oriented businesses are likely to carry higher raw material and work-in-process inventory and to maintain production facilities abroad, meaning that the receivables collection period is lengthened due to difficulties not only related to distance but also to different payment procedures in the host country. Similarly, businesses that rely significantly on the import of supplies are expected to carry higher buffer inventories to avoid the increased risk of interruptions in supplies.

Besides, the more concentrated an industry is, the greater the risk of collusion (e.g. through price fixing) between the industry players is likely to be. In such oligopolistic circumstances, businesses are likely to display a higher price-to-marginal cost ratio than would be the case under more competitive market conditions (See Scherer, 1970, p. 237). "*The more price exceeds* ***marginal*** *cost, the greater the benefits from carrying inventory relative to the cost and the more sensible it is to avoid shortages and dissatisfied customers by holding additional inventory. A similar argument could be made for extending generous credit.*" (Nunn - 1981, p. 213)

More recently, Filbeck & Krueger (2005) also provide significant empirical evidence of differences between industries in working capital measures as well as changes within industries across time. They base their study on data covering nearly 1,000 companies in the United States in the period 1996 to 2000 taken from the annual Working Capital Management Survey published by *CFO* magazine and use classical analysis of variance to

[53] This argumentation was certainly correct back in the days where Nunn (1981) published his article, when a non-integrative approach to working capital management (according to which each individual component of working capital was managed independently of the other components) was typically adopted by firms.

study industry rank difference within year as well as the Kendall's Coefficient of Concordance to assess the performance of WCM across years. Filbeck & Krueger (2005) use the following two of the five measures of working capital efficiency identified by *CFO* magazine to determine the overall rank:[54]

. Cash Conversion Efficiency (CCE) = (Cash flow from operations) / Sales

. Days Working Capital (DWC) = (Receivables + Inventory – Payables) / (Sales/365)[55]

Interestingly, they suggest the significant changes in the above measures over time to be partly explained by macroeconomic factors such as changes in interest rates, in the rate of innovation, and competition. This result, which is in line with commonly held expectations,[56] seems however not to hold true for small firms: A study by Lamberson (1995), who explored the linkages between changes in working capital positions and changes in levels of economic activity, measured using economic indicators, in a sample of 50 small U.S. companies covering the period 1980-1991, provides evidence suggesting that liquidity, measured by both the current ratio (defined as the ratio of current assets and current liabilities) and the quick ratio (defined as the ratio of cash, marketable securities and accounts receivable to current liabilities), "*increased slightly for these firms during economic expansion with no noticeable change in liquidity during economic slowdowns.*" Moreover, working capital investment of these firms, measured using the ratios of inventory to total assets and of current

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[54] The other measures identified by *CFO* magazine, Days Sales Outstanding, defined as accounts receivable/(sales/365), Inventory Turns, defined as inventory/(sales/365) and Days Payables Outstanding, defined as accounts payable/(sales/365), are not considered by Filbeck & Krueger (2005) in their overall ranking criteria, given as (Highest overall CCE – Company CCE) / (Highest overall CCE – Lowest overall CCE) x (Lowest overall DWC – Company DWC) / (Lowest overall DWC – Highest overall DWC).

[55] Days Working Capital (DWC) corresponds to the Net Trade Cycle (NTC) developed by Shin & Soenen (1998)

[56] See Lamberson (1995). Sathyamoorthi & Wally-Dima (2008), for instance, also come to a similar result: In their analysis of domestic retail companies listed on the Botswana Stock Exchange in the period 2004 to 2006, show that in times of high business volatility, firms tended to adopt conservative approach with regards to working capital, while an aggressive approach was more likely to be adopted in times characterized by low volatility. However, when looking at more mature capital markets, Chiou et al. (2006), who use quarterly data from the Taiwan Stock Exchange from 1996 to 2004, find no evidence in support of the effect of the business cycle on working capital management. Rather, they suggest a firm's debt ratio and operating cash flow (among other variables such as a firm's size, performance and age) to significantly impact their level of working capital, measured by the ratio of working capital requirements (WCR) to total assets.

assets to total assets, showed a relative stability during the period under study. (Lamberson, 1995, p. 45)

To conclude this section about the industry influence on working capital decisions, let me now present another noteworthy aspect related to the relative relationship between the degree of aggressiveness of a firm's working capital policy and the industry it belongs to. Indeed, Weinraub & Visscher (1998), who explored the working capital characteristics of 216 firms in ten different industries using a *Compustat* data set of quarterly levels of current liabilities, current assets and total assets between 1984 and 1993, have found out empirically that the degree of aggressiveness with which firms follow their working capital policies depends significantly on the industry they are active in. Interestingly, they opt for a methodology that considers the current assets and current liabilities components of working capital individually and dissect the concept of working capital policy into current asset management on the one hand and financing policy on the other hand: An aggressive asset management thus leads to capital being downsized in current assets against long-term investments and results in higher profitability expectations but also in an increased liquidity risk. Conversely, a more conservative management of assets shifts relatively more capital in liquid short-term assets, therefore lowering liquidity risk to the detriment of profitability.[57]

Similarly, a financing policy is defined as aggressive when more (less costly) short-term debt relative to long-term capital is utilized, thus lowering the cost of capital while increasing the short-term liquidity risk, whereas a conservative financing policy results in a higher use of capital (long-term debt or equity) relative to short-term debt, thus delaying the repayment of the debt principal or bypassing it completely by using only equity.[58]

As in the study of Nunn (1981), Weinraub & Visscher (1998) mitigate the seasonality effect by adding and averaging quarterly data for all firms in each industry and by compiling calendar rather than fiscal year data, thereby also getting rid of the bias that may arise when different periods of financial reporting are considered.

To determine whether statistically significant differences prevailed in the degree of aggressiveness in working capital policies across industries, Weinraub & Visscher (1998) performed one-way analysis of variance (ANOVA) tests on both the sets of 10 ten-year

[57] To measure the degree of aggressiveness in asset management, Weinraub & Visscher (1998) use the ratio of current assets to total assets, where a lower ratio translates into a more aggressive management.

[58] To measure the degree of aggressiveness in financing policy, Weinraub & Visscher (1998) use the ratio of current liabilities to total assets, where a higher ratio translates into a more aggressive financing policy.

average current assets to total assets ratio industry means and of 10 ten-year average current liabilities to total assets ratio industry means. The power of differences between industry values of both ratios (current assets to total assets and current liabilities to total assets) was further examined using Tukey's HSD test, which compared the industry means on a paired sample basis. The results obtained in the one-way ANOVA tests indicate that statistically "*significant industry differences do exist in the relative degree of aggressive/conservative working capital policies for both asset and liability management*" (p. 13). Nonetheless, the result of both the ANOVA and a Tusk's honest significance difference (HSD) test reveal that these differences in means are generally wider and more significant in the case of asset management than in the case of liability management. Furthermore, Weinraub & Visscher (1998) analysed the persistency of these relative differences over time using rank order correlations and found that both the asset management as well as the liability management aspects of aggressive/conservative working capital policies revealed a remarkable statistically significant persistence over time.[59] Interestingly, when examining the relationship between aggressive asset management and aggressive financial management, again by ranking industries from low to high (high to low) ratios of current assets to total assets (current liabilities to total assets) and computing rank order correlations, Weinraub & Visscher (1998) found "*that industries which pursued relatively aggressive asset policies simultaneously followed relatively conservative financing policies*" (p. 16).

3.3. Working Capital and Financing Constraints

3.3.1. Empirical evidence from after the 2007-2008 global financial crisis

The working capital regime adopted by a firm also chiefly depends on whether that firm faces financing constraints. A firm is facing financial constraints when its access to external funds (e.g. from credit markets) is limited, rendering these costlier thus increasing the debt expense burden on the firm (Kieschnick et al., 2013). This was particularly the case for smaller firms, during and after the global financial crisis of 2007-2008, a period covered in the timeframe of my empirical study. A study by Cole (2012), covering data for U.S. firms collected by U.S. banking regulators, indicates that bank lending to firms of all sizes plummeted by about 9 % from a peak of $2.14 trillion as of June 2008, to about $1.96 trillion in June 2011. The decline in bank lending was far more severe for small firms than for larger firms, falling by almost 18 % over the same period (from $659 billion in June 2008 to $593

[59] Although here again the revealed effect was strongest in the case of asset management.

billion in June 2011). This flight-to-quality pattern, characterized by credit flowing away from smaller, constrained firms towards larger, higher graded firms, has also been documented by Psillaki & Eleftheriou (2015) in the case of French small and medium-sized enterprises (SME) following the global financial crisis. They also provide evidence of the increasing significance of the complementary rather than substitutive role trade credit takes for small firms facing a credit crunch, a result which they argue is in support of the redistribution role of trade credit. This view had already been adopted by García-Appendini & Montoriol-Garriga (2013) in their empirical study of the impact of the 2007-2008 financial crisis on the provision of liquidity between firms. "*Consistent with a causal effect of a negative shock to bank credit, [they] find that firms with high precrisis liquidity levels increased the trade credit extended to other corporations and subsequently experienced better performance as compared with ex ante cash-poor firms. Trade credit taken by constrained firms increased during this period. These findings are consistent with firms providing liquidity insurance to their clients when bank credit is scarce and offer an important precautionary savings motive for accumulating cash reserves.*" (García-Appendini & Montoriol-Garriga, 2013, p. 272) Interestingly, though, while constrained smaller firms were heavily reliant on trade credit rather than bank loans as a source of external financing during the financial crisis, unconstrained ones could still depend on bank loans, as shown by Carbó-Valverde et al. (2016) using a sample of Spanish SMEs. In an earlier study, Casey & O'Toole (2014) already obtained similar results using data from European SMEs since the 2007-2008 financial crisis. Specifically, their evidence points to a higher propensity of credit-rationed firms to use and apply for trade credit to finance their working capital, as opposed to smaller and younger firms self-rationing their borrowings due to high lending costs, turning instead to informal loans and inter-company loans as substitutes for bank loans.

3.3.2. Working Capital Investment Behavior of Financially Constrained Firms

In their 2010 survey of 1050 Chief Financial Officers (CFO's) in 39 countries across the U.S., Europe and Asia, Campello et al. (2010) report that "*financially constrained firms planned to cut more investment, technology, marketing, and employment relative to financially unconstrained firms during the crisis. [The authors] also show that constrained firms [, unlike unconstrained firms,] were forced to burn a sizeable portion of their cash savings during the crisis and to cut more deeply their planned dividend distributions.* (Campello et al., 2010, p. 486) Another interesting finding is that firms facing financial constraints, again unlike unconstrained firms, strategically withdraw funds from their

outstanding lines of credit at an accelerated pace due to fears that their access to those lines may be restricted by their banks in the future. Other noteworthy findings include that almost 90% of the CFO's of constrained firms in their questionnaire-based survey report "*that financial constraints restrict their pursuit of attractive projects*" (Campello et al., 2010, p. 486), that positive NPV investment projects were forcibly cancelled by over the half of these firms, and that these firms show a stronger tendency to liquidate existing assets as a means to generate liquidity throughout the crisis, thus relying on internal sources of funding. It should be noted here that the survey-based approach by Campello et al. (2010), while providing an innovative perspective on the effects of the global financial crisis of 2007-2008 by allowing the authors to gather (ex-ante) information that cannot be gathered from financial statements,[60] has limitations common to all survey-based approaches relating to replicability and selection biases.

To fully understand how the above relates to a firm's choice of working capital policy, it is useful to consider the basic argumentation set out in an often-cited empirical study by Fazzari & Petersen (1993) that emphasize "*the often-neglected role of working capital as both an input and a readily reversible store of liquidity*" (Fazzari & Petersen, 1993, p. 329) and relate a firm's use of working capital to its investment smoothing efforts, especially when it faces financing constraints. Given the existence of agency costs, asymmetric information or transaction costs, it may be costlier for a firm to fall back on external (whenever available) rather than internal sources of finance to fund its investment projects.[61] While *insiders* are fully informed of the prospects of a firm's investments, *outsiders* are unable to tell the difference in individual firms' quality. Asymmetric information, as argued by Stiglitz & Weiss (1981), may thus cause credit to be rationed by lenders in debt markets because of either moral hazard or adverse selection.[62] A similar argument holds in the case of external equity markets, when firms' managers are better informed about the value of the firms' existing assets and their investment prospects than potential shareholders may be. In such a

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[60] The large existing body of empirical literature that looks into how capital market imperfections impact corporate behavior commonly use archival data drawn from financial statements and other indirect measures such as asset size, ownership form, credit ratings, firm age (Oliner and Rudebusch, 1992), dividend payer status (Fazzari, Hubbard, and Petersen, 1988) and affiliation to conglomerates (Hoshi, Kashyap and Sharfstein, 1991) to identify firms as being either financially constrained or unconstrained. (Campello et al., 2010).

[61] See Gertler (1988)

[62] Stiglitz & Weiss (1981) use "*the term credit rationing for circumstances in which either (a) among loan applicants who appear to be identical some receive a loan and others do not, and the rejected applicants would not receive a loan even if they offered to pay a higher interest rate; or (b) there are identifiable groups of individuals in the population, who, with a larger supply of credit, are unable to obtain loans at any interest rate, even though with a larger supply of credit they would.*" (p. 394-395)

setting, new shares may forcibly have to be sold at a discount, should they find any buyers (Myers & Maljuf, 1984).

It follows from the above argumentation that changes in internal sources of finance may affect firms' investment decisions when external sources of finance are rationed or only available at a premium, a point which has been corroborated in many empirical studies using reduced-form regressions of investment on cash-flow[63] as well as testing financial constraints using Euler equation methods.[64] Both approaches however ignore, according to Fazzari & Petersen (1993), the possibility that financially constrained firms, when facing cash-flow shocks, will opt to smooth fixed investment with working capital. Investment smoothing may occur in response to the very nature of the investment projects firms need to undertake. Indeed, as was emphasized by Myers & Maljuf (1984), these can neither be *stored* nor delayed without difficulty: Firms operating in a fast-paced environment characterized by high levels of innovation and short product life cycles, such as the information and communications technology (ICT) industry, ought to undertake new investment opportunities as they arise. Failure to do so will lead their value to the firm to drop rapidly due for instance to the first-mover advantage from new technologies being commercialized. Furthermore, should the marginal value of perishable investment projects decrease with the number of firms undertaking them, "*a firm that allows cash-flow fluctuations to dictate its investment spending would sacrifice projects with high marginal value in periods of below-average cash flow only to undertake projects with comparatively low marginal value in periods of high cash flow"* (Fazzari & Petersen, 1993, p. 330), which would clearly represent a suboptimal behavior in the presence of a mechanism that responded to cash-flow shocks by smoothing investment. Since investment projects are also often discrete and are completed over a lengthy period, cutting spending on an ongoing project following a temporary cash flow shortfall may turn out to be costly. (Fazzari & Petersen, 1993)

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[63] See among others Fazzari et al. (1998), Gertler & Hubbard (1988), Devereux & Schianterelli (1990), Hoshi et al. (1991) and Oliner & Rudebusch (1992) which examine finance constraints on fixed investment using a conventional fixed-effects regression equation similar in essence to the one used by Fazzari & Peterson 1993:

$$(I/K)_{jt} = \gamma_1(Q_{jt}) + \gamma_2(CF/K)_{jt} + \gamma_j + \gamma_t + u_{jt},$$

where I_{jt} represents plant & equipment investment for firm j at time t, Q_t the tax-adjusted measure of Tobin's q (as defined by Fazzari et al., 1988) at the beginning of year t (as a control for changes in investment demand), CF the cash flow (defined as after-tax income plus non-cash charges such as depreciation and amortization) and is scaled by the firm's stock of capital K at the beginning of the period t to control for heteroscedasticity, γ_j and γ_t coefficients capturing firm-specific and year fixed-effects and u_{jt} random errors. (Fazzari & Petersen, 1993)

[64] See, among others, Gilchrist (1990), Himmelberg (1990), Hubbard & Kashyap (1992), Whited (1992) and Carpenter (1992)

Another rationale for the investment smoothing is given by Eisner & Strotz (1963) and Lucas (1967), who emphasize that "*because marginal adjustment costs of acquiring and installing capital rise as the rate of investment increases […], firms will reduce long-run costs by maintaining stable investment over time, for any given long-run path of capital accumulation*". (Fazzari & Petersen, 1993, p. 330) This aim might be hindered in the presence of financing constraints in circumstances where cash flow fluctuations cannot be offset using external sources of finance without a cost. Financially constrained firms can however "*offset the impact of cash-flow shocks on fixed investment by adjusting working capital, even setting working capital investment at negative levels. These actions release short-run liquidity, allowing firms to smooth fixed investment relative to cash-flow shocks. The marginal opportunity cost of adjusting working capital, and therefore the extent of investment smoothing, should depend on the firm's initial stock of working capital.*" (Fazzari & Petersen, 1993. P. 329) Therefore, by including working capital as an (endogenous) variable in the fixed investment regression,[65] Fazzari & Petersen (1993), using a panel data of U.S. low-dividend paying[66] manufacturing firms covering the period 1970-1979, predict and empirically find robust evidence of a negative relationship for financially constrained firms, meaning that "*working capital competes with fixed investment for a limited pool of finance*" (Fazzari & Petersen, p. 328). They also report evidence of working capital investment being highly sensitive to changes in cash flow.[67]

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[65] The regression equation that includes working capital investment used by Fazzari & Petersen (1993) takes the following form:

$$(I/K)_{jt} = \beta_1(Q_{jt}) + \beta_2(CF/K)_{jt} + \beta_3(\Delta W/K)_{jt} + \beta_j + \beta_t + u_{jt},$$

where $(\Delta W/K)$ represent working capital investment scaled by the firm's stock of capital K at the beginning of period. To address the endogeneity concern of changes in working capital investment inherent in the above equation, various forms of it are estimated using (i) the beginning-of-period q, (ii) cash flow, (iii) the beginning-of-period stock of working capital scaled by fixed capital, $(W/K)_{jt}$, (iv) and the fixed time and firm effects as instrumental variables.

[66] Fazzari & Petersen (1993) use the database described in Fazzari et al. (1988) and focus on those firms that essentially follow a zero dividend-policy as they assume that these are most likely to be financially constrained. However, as in Fazzari et al. (1988), they also include firms that pay high dividends in their sample.

[67] Their first-stage OLS regression for changes in working capital, $\Delta W/K$, leads to the following result (Fazzari & Petersen, 1993, p. 336, firm and year fixed not reported – *t*-statistics in brackets below the coefficients):

$$(\Delta W/K)_{jt} = \underset{(3.5)}{0.0064}(Q_{jt}) + \underset{(12.1)}{0.883}(CF/K)_{jt} - \underset{(5.1)}{0.217}(W/K)_{jt} + \theta_j + \theta_t$$

The above negative coefficient of the initial level of working capital, $(W/K)_{jt}$, also corroborates Fazzari & Petersen's (1993) prediction that the marginal value of working capital decreases as its stock rises.

When looking at the relationship between investment in individual components of net operating working capital[68] and the availability of credit from financial institutions, both Petersen & Rajan (1997) and Danielson and Scott (2004) provide evidence suggesting that financially constrained (small) firms make more use of trade credit to finance their operations despite the higher costs associated with this source of financing. In addition, Carpenter et al. (1998) expose evidence in corroboration of the argument that firms facing less financial constraints invest more in inventories. Finally, Atanasova & Wilson (2003) and Atanasova (2007), by estimating a model for trade credit that accounts for the influence of bank-borrowing constraints on the financing policies of corporations over the business cycle, expose evidence of an increased use of trade credit - which represents an unattractive as well as expensive substitute for bank credit - by bank constrained firms.

3.3.3. Measuring Financial Constraints

It is noteworthy to mention at this point a more recent empirical study by Baños-Caballero et al. (2014) which suggests that firm's financial constraints affect the relationship between working capital investment and corporate performance and provide evidence that the optimal level of working capital is lower for firms that face a higher likelihood of being financially constrained. This result has been found to hold true under each of the classification schemes[69] of financial constraints employed by Baños-Caballero et al. (2014) and is in line with the results obtained by both Fazzari & Petersen (1993) and Hill et al. (2010), who also conclude that "*[f]irms with greater internal financing capacity and superior capital market access employ more conservative working capital policies*" (Hill et al., 2010, p. 783). Since it is still open to academic debate as to which method of measurement is best suited to differentiate financially constrained from unconstrained firms,[70] I ought to present here the different measures used in selected studies of the corporate finance literature:

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[68] Net operating working capital (NOWC) is defined as INV+AR-AP and concerns solely the management of accounts receivable (in other words the extension of trade credit), the management of inventories and the use of trade credit. (See Hill et al., 2010 and Kieschnick et al., 2013)

[69] Baños-Caballero et al. (2014) classify firms "*according to a variety of characteristics designed to measure the level of financial constraints borne by firms*" (p. 333)

[70] According to Hadlock & Pierce (2010, pp. 1909-1910), this comes as no surprise as "*each method relies on certain empirical and/or theoretical assumptions that may or may not be valid. In addition, many of these methods rely on endogenous financial choices that may not have a straightforward relation to constraints. For example, while an exogenous increase in cash on hand may help alleviate the constraints that a given firm faces, the fact that a firm chooses to hold a high level of cash may be an indication that the firm is constrained and is holding cash for precautionary reasons*"

a) *Dividends:* As already mentioned in the presentation of the study of Fazzari & Petersen (1993) and in line with Fazzari et al. (1988), financially constrained firms, to reduce the likelihood of having to raise external funds in the future, tend to follow a zero-dividend policy or at least distribute a lower dividend to their shareholders. Thus, it makes sense to identify financially constrained from financially unconstrained firms by not only classifying them into zero-dividend and positive-dividend groups, but also according to their dividend payout ratio (defined as the ratio of dividends to net profit) as in Almeida et al. (2004) and Faulkender & Wang (2006). It should be noted here that Kaplan & Zingales (1997) disagree with Fazzari et al. (1988), arguing that firms that pay out low dividends although they have the necessary funds to pay out higher dividends cannot be considered as financially constrained. Rather, Kaplan & Zingales (1997) use quantitative data as well as qualitative information included in firm's financial communications "*to derive as complete a picture as possible of the availability of internal and external funds for each firm as well as each firm's demand for funds*" (Kaplan & Zingales, 1997, p. 170).[71] Based on that *complete picture*, Kaplan & Zingales (1997) identify as *likely constrained* those firms that do not have access to more funds than required to finance their investment, and as *never constrained* those firms that have access to more funds than required to finance their investment. (See Moyen, 2004)

b) *Cash-flow:* Keeping in mind the still unresolved debate introduced above, firms can also be classified into financially constrained and unconstrained depending on their level of cash flow, defined as the ratio of earnings before interest and tax plus depreciation to total assets (see Baños-Caballero et al., 2014). This follows the approach elaborated by Moyen (2004) who, in her successful effort to replicate both the results obtained by Fazzari et al. (1988) as well as by Kaplan & Zingales (1997), considers, as in Allayannis and Mozumdar (2004), the cash flow variable as a viable proxy for financing constraints. Unlike dividends, which "*represent the residual of the firm's cash flow […] after the firm's investment […] and financial […] decisions [and thus] reflect both the state in which the firm finds itself at the beginning of the period and its decisions taken during that period [,] using cash flow focuses on the*

[71] However, the direct approach advocated by Kaplan & Zingales (1997), i.e. using qualitative information to determine a firm's financial constraint status, while being quite useful in principle, lacks practicality for large samples since it involves extensive hand data collection. (Hadlock & Pierce, 2010)

firm's beginning of the period funds and abstracts from the current periods decisions" (Moyen, 2004, p. 2073). In this respect, firms – within a large sample – with a lower than average/median[72] cash flow, as defined above, are considered as financially constrained, whereas firms – within the same sample – with a higher than average/median cash flow, are considered as financially unconstrained.

c) *Size*: A whole range of empirical studies (among which Petersen et al., 1994, Almeida et al., 2004, Faulkender & Wang, 2006, Baños-Caballero et al., 2014) explicitly use size, mostly measured by the natural logarithm of sales, as an inverse proxy for financing constraints. The rationale behind the use of this variable is that smaller firms are expected to face both higher informational asymmetries as well as higher agency costs and therefore may have greater difficulty in accessing external capital markets (Baños-Caballero et al., 2014). This rationale is consistent with the argument brought forward by Whited (1992) that larger firms face lower costs of external financing as they have better access to financial markets, hence facing fewer borrowing constraints.

d) *Cost of external financing*: Baños-Caballero et al. (2014) also use the cost of external financing, calculated as the ratio of financial expenses to total debt, as a proxy for financing constraints, and thereby follow the line of argumentation of Fazzari et al. (1988) who consider a firm to be financially constrained when its cost of external financing is too high.

e) *Whited & Wu Index:* An often used measure of financing constraints is the index developed by Whited & Wu (2006) on the basis of a standard intertemporal investment model in which financing frictions are accounted for and which "*predicts that external finance constraints affect the intertemporal substitution of investment today for investment tomorrow via the shadow value of scarce external funds*" (Whited & Wu, 2006, p.531).

The Whited & Wu (WW) Index of firm *i* in period *t* is calculated using the following

[72] In the paper by Moyen (2004), the average cash flow is used as the border to separate the financially constrained from the unconstrained firms, whereas Baños-Caballero et al. (2014) use the median to delimit both categories of firms.

formula:

$$WW_{it} = -0.091CF_{it} - 0.062DIVPOS_{it} + 0.021TLTD_{it} - 0.044LNTA_{it} + 0.102ISG_{it} - 0.035SG_{it},$$

where CF is defined as the ratio of cash flow to total assets and represents a firm's profitability, DIVPOS a dummy variable which takes the value of one if the firm pays dividends in cash and zero otherwise, TLTD the ratio of long-term debt to total assets, LNTA the natural log of total assets, ISG the firm's three-digit SIC industry sales growth and SG the firm's sales growth. (Whited & Wu, 2006)

It is important to cluster out the advantage of designing an index based on a structural model rather than using traditional tests of financial constraints based, as in Fazzari et al. (1988), on regressions of investment on Tobin's q: it avoids the complexity issue associated with the measurement of Tobin's q, which basically renders the reduced-form regression approach cryptic, as exposed by Erickson & Withed (2000), Bond & Cummins (2001) and Cooper & Ejarque (2001). Furthermore, the Whited & Wu index is therefore better suited to measure financing constraints than is the Kaplan-Zingales Index,[73] which is not only prone to measurement error due to the inclusion of Tobin's q,[74] but is also altogether based on a modelling flaw in that both the dependant and independent variables used to derive it include the same quantitative information, as the evidence reported in Hadlock & Pierce, (2010) suggests.

f) *SA-Index*: Finally, the index developed by Hadlock & Pierce (2010) appears, as evidenced in their own study, to be superior to the previous measures presented here in determining whether a firm faces financial constraints. In their effort to design an alternative measure of financial constraints that addresses the endogeneity concern prevalent in measures that use leverage and cash flow variables, they show that both the variables *firm size* and *age* turn out to particularly useful in predicting financial constraints. Moreover, they present evidence pointing to the non-linear nature of the

[73] The Kaplan-Zingales Index is based on a five-factor model as described in Lamont et al. (2001)

[74] See Whited & Wu, 2006, p. 533

relationship between these variables and financial constraints.[75]

Their SA index thus focuses solely on these two firm characteristics and is computed as follows:

$$SA - Index: (-0.737 * Size) + (0.043 * Size^2) - (0.040 * Age),$$

where Size equals the log of inflation-adjusted to 2004 book assets, and Age is the number of years the firm is listed with a non-missing stock price on Compustat. In calculating this index, both Size and Age are winsorized at (the log of $4.5 Billion) and thirty-seven years respectively. Hadlock & Pierce (2010, p. 1938) strongly recommend using the SA Index over other approaches given that it "*has substantial intuitive appeal and relies on factors that are surely more exogenous than most of the alternatives*", especially given the fact that firm size and age had been identified in previous research as valid predictors of financial constraints.

3.4. Working Capital and Financial Distress at the Firm Level

Asquith et al. (1994), in their comprehensive study of how firms respond to financial distress, have shown poor firm-specific performance to be the major factor causing financial distress, followed by poor industry performance and high interest expenses. Therefore, an inefficient management of working capital, one which adversely affects a firm's operating performance or its interest expenses, can cause the firm to run into financial distress or even bankruptcy if it fails to achieve a quick turnaround in its operating activities or fails to restructure. A prominent example illustrating this point is given by Shin & Soenen (1998), in which Kmart and Wal-Mart, both America's leading retailing behemoths back in the mid-1990's, who in 1994 had a similar capital structure of about 31% debt financing, but differed in terms of both their cash conversion cycle (61 days for Kmart vs. just 40 days for Wal-Mart) and their profitability (Return on sales, assets and equity being respectively 0.87%, 1.74% and 4.91% for Kmart vs. 3.25%, 10.1% and 24.9% for Wal-Mart). Shin & Soenen (1998) argued, assuming, taking a cost of capital of 10%, that 21 extra days in the cash conversion cycle of Kmart should have cost it an additional $198.3 million in financing expenses, that the

[75] Hadlock & Pierce (2010) estimate (i) an essentially flat relation between these two firm characteristics (firm size and age) and financial constraints for very large or mature firms, (ii) a quadratic relation between size and financial constraints below certain cut-off points and (iii) a linear relation between age and financial constraints.

difference in profitability of the two companies could be in part due to higher financing costs triggered by a poor working capital management. Eventually, Kmart had to file for Chapter 11 bankruptcy protection on January 22, 2002, a move partly attributed to the high costs of financing its inefficient working capital management, which contributed to its losses (Kieschnick et al., 2013).[76]

Furthermore, the literature suggests that the argument runs both ways: adapting the net operating working capital behavior in response to a situation of financial distress a firm find itself in also helps it in redressing its financial situation. Molina and Preve (2009) for instance, not only expose evidence pointing to the particular relevance of trade receivables policies for U.S. firms facing financial distress, reporting "*that drops in trade receivables account for at least one-third of the average drop in sales and stock returns experienced by firms in financial distress*"[77], but also "*find that firms increase their level of trade receivables, presumably in an attempt to buy market share, when they have profitability problems, but change their policy when they are in financial distress, effectively reducing their investment in trade receivables*", noting however "*that financially distressed firms in concentrated industries seem to have sufficient market power to enforce a less painful reduction in trade receivables, while financially distressed firms in competitive industries find it more difficult to reduce their trade receivables.*" The authors explain this result (p. 684) with *"the fact the clients of firms in competitive industries are less pressured to maintain a reputation for reliable payment given the higher probability of supplier failure and the availability of alternative providers.*" (See Molina & Preve, 2009, p. 684 for all aforementioned citations).

In a second article published more recently, Molina & Preve (2012) extend and complement their previous work, which was concerned with the study of the investing behavior of distressed firms, turning their focus now towards the relationship between financially distressed firms and the credit behavior of suppliers towards these firms using a sample consisting of 85,727 firm-year observations of firms in Compustat with trade payable data available from 1978 to 2000. In general, trade credit granted by suppliers in commercial transactions is a commonly utilized source of short-term financing (Molina & Preve, 2012)

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[76] According to Kieschnick et al. (2013), external debt capital is being tapped into to finance net operating working capital investments.

[77] This result also holds true in a setting in which financial distress is clearly exogenous to the firm's performance, where instead of using a firm-level indication of financial distress, an alternative model based on Opler & Titman (1994) is considered where a firm is assumed to be in financial distress if it is highly leveraged when the industry it belongs to is hit by an economic shock. (Molina & Preve, 2009)

and is widely recognized as a substitute to financial credit in times of tight monetary conditions (Metzler, 1960) and widespread economic crises (Love et al., 2007) as well as in the case of smaller firms with weaker relations to banks (Petersen & Rajan, 1997). On a side note, this work by Molina & Preve (2012) is the first to quantify the effect of a firm's financial distress on trade credit granted by the firm's suppliers and can be related to other noteworthy academic literature pointing to the severely weakened ability of firms entering financial distress to enjoy trade credit (Baxter, 1967 and Andrade & Kaplan, 1998) – given the augmented default risk, as well as to the potential reluctance of suppliers to sell their products to financially distressed firms save in a significantly restricted way and at greater costs (Altman, 1984), thus eventually pushing these firms into bankruptcy once they "*lose confidence*" and no longer "*foresee an acceptable probability of [their] survival*" (Molina & Preve, 2012, p.203). This last point is illustrated by Molina & Preve (2012) using an article which appeared in the business press citing that "*the Chapter 11 filing in US Bankruptcy Court in Boston by Waltham-based Molten Metal was triggered when suppliers refused to extend additional credit to the company, which had already slowed payment of its bills.*"[78] The results obtained by Molina & Preve (2012) are manifold, suggesting not only that financially distressed firms make significantly more use of trade credit relative to healthier firms with easier access to financial credit,[79] but also, consistent with Atanasova & Wilson (2003) and Atanasova (2007), that they "*substitute financial debt and equity for trade credit*"[80] (Molina & Preve, 2012, p. 188) and that the overall significant reduction in their performance - as evidenced elsewhere in the literature, see for instance Altman (1984), Opler & Titman (1994) and Andrade & Kaplan (1998) - is attributable to more than one-third to the increased use of trade credit. The influence of financial distress on trade credit is however less significant and smaller in the case of larger firms – thought, by Molina & Preve (2012, p. 188), to be superior to smaller firms in terms of "*the quality of management, corporate governance, the quality of reported information, opaqueness, and access to financial credit*".

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[78] See Molina & Preve (2012), footnote 2, p. 187, citing from Kimberly Blanton's article in *The Boston Globe* (City Edition) dated 4th of December 1997.

[79] This result is consistent with the findings of a stream of literature on the theories of trade credit [Schwartz (1974), Emery (1984), Smith (1987), Biais & Gollier (1997), Frank & Maksimovic (2005) and Cuñat (2007)], according to which firms with easier access to financial credit will make use of it rather than of the costlier trade credit. Furthermore, Petersen & Rajan (1994, 1995) argue that trade credit is taken advantage of after all alternative cheaper sources of financing have been dried up.

[80] This results thus suggests that trade credit rates lower than other traditional financing sources in the pecking order (Myers & Maljuf, 1984) of financing options.

It should be noted here that both aforementioned papers by Molina & Preve (2009 and 2012) measure the cost underlying the trade credit policy of financially distressed firms, thereby implicitly assuming the trade credit behavior of healthy firms, i.e. firms not facing financial distress, to be optimal, further implying that firms deviating from this optimum when entering financial distress follow a suboptimal trade credit behavior.

Consistent with the results obtained by Molina & Preve (2009 & 2012), Hill et al. (2010), in their examination of the drivers of a firm's integrative operating working capital strategy,[81] i.e. which accounts for the net influence of receivables, inventories and payables, also find evidence, using an unbalanced Compustat data set of 20,710 firm-year observations for 3,343 companies from 1996 to 2006, that the working capital requirement (WCR) [82] is negatively related to financial distress,[83] inferring from that result "*that distressed firms manage operating working capital more aggressively than nondistressed* firms," arguing further that following a more restrictive working capital strategy, i.e. reducing "*investment in operating working capital by collecting on receivables, tightening credit terms, liquidating inventory, and stretching supplier credit*" constitutes "*a rational response to financial distress due to the limited financial slack and cash generating ability of distressed firms*." (See Hill et al., 2010, p. 798 for all above citations). This intuition is shared by Preve & Sarria-Allende (2010), who besides point to a gap in knowledge with respect to the relation between a firm's inventory levels and financial distress. Preve & Sarria-Allende (2010) also offer interesting arguments concerning the hypothetical impact of financial distress on a

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[81] Hill et al. (2010, p. 794) specify and estimate the following empirical model:

$$WCR_{i,t} = \beta_0 + \beta_1 Growth_{i,t-1} + \beta_2 GPM_{i,t-1} + \beta_3 SalesVar_{i,t} + \beta_4 OCF_{i,t-1} + \beta_5 M/B_{i,t-1} + \beta_6 Size_{i,t-1} + \beta_7 MktShare_{i,t-1} + \beta_8 Distress_{i,t-1} + \beta_j Controls_{i,t} + \varepsilon_i$$

where *WCR* is the ratio of the [annual sum of (accounts receivable and inventory) minus (accounts payables)] to sales, *Growth* the annual percentage change in sales during the previous year, *GPM* the gross profit margin computed as the ratio of (sales minus cost of goods sold) to sales, *SalesVar* represents the sales volatility and is computed as the ratio of the standard deviation of sales to net assets (defined as total assets minus cash and short-term investment), *OCF* is operating income before depreciation minus income taxes, scaled by net assets, *M/B* the ratio of the [sum of (market value of equity and total liabilities) minus payables)] to net assets, *Size* the natural logarithm of market value of equities in 2006 inflation-adjusted dollars, *MktShare* the ratio of annual firm-level sales to the industry's annual sum of sales and *Distress* a dummy variable taking the value one if a firm is in financial distress and zero otherwise. The model also includes a set of binary annual variables to control for time-specific and macroeconomic factors influencing WCR.

[82] Hill et al. (2010) define the WCR as the sum of accounts receivable and inventories net of accounts payable. It is slightly modified from the definition given by Shulman & Cox (1985) in that prepaid expenses and accruals are not taken into consideration. Hill et al. (2010) use the simplified version as (i) it parallels with the cash conversion cycle and (ii) "*the theoretical implications of holding prepaid expenses and accruals are not well developed in the extant literature*" (See Hill et al., 2010, footnote 3, p. 784)

[83] Hill et al. (2010) estimate their model using the same three proxies of financial distress (see footnote 56) than Molina & Preve (2009) and come to a similar result, both in terms of quality and quantity.

firm's working capital policy: Since firms that find themselves in a situation of financial distress are, per definition, suffering losses,[84] their equity's book value starts to diminish, rendering it quite likely that their equity's market value will also drop. This in turn suggests that financially distressed firms are likely to exhibit a decrease in their equity level, should they refrain from issuing new equity. With respect to debt-financing considerations, it is unlikely the firm will be able to raise long-term debt unless it can convince its investors to buy its long-term debt. The financially distressed firm will then most probably have to turn to the (fire) sale[85] of part of its fixed assets to be able to increase its working capital, although the price it obtains from their sale does not reflect their fair market value. The overall effect of financial distress on the working capital of the firm, however, will without any doubt greatly depend on both firm- and industry-specific features. Preve & Sarria-Allende (2010, p. 140) "*hypothesize that, on average, financially distressed firms tend to observe a decrease in the level of working capital relative to FNOs, increasing the gap between the two,*" meaning that firms in financial distress would require more short-term financing from financial institutions, which in turn would lead to a worsening in their overall financial health.

3.5. Working Capital and Market Power

The market power a firm enjoys is also thought to be directly linked to its net operating working capital behavior. Indeed, as suggested by Hill et al. (2010), more relevant customers are in a better position to negotiate credit terms in their favour with their suppliers, not to mention that stretching credit terms offered by their suppliers is not likely to lead to much repercussion, mostly so when smaller suppliers are highly dependent on the contracts they have with industry leaders. This argumentation is in line with the observations of Wilner

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[84] The two most commonly used measures of financial distress are those developed by Asquith et al. (1994) and, more recently, DeAngelo & DeAngelo (1990), both of which rely on some form of negative profit: While Asquith et al. (1994, p.628) consider a firm "*as financially distressed if in any two consecutive years […] the firm's earnings before interest, taxes, depreciation, and amortization (EBITDA) is less than its reported interest expense; or, if in any one year, EBITDA is less than 80 percent of its interest expense"*, DeAngelo & DeAngelo (1990, p. 1426) identify in their sample covering the period 1980 to 1985 a firm as financially distressed if it "*reported three or more years of negative net or operating income during*" that period.
A third proxy for financial distress, also used by Molina & Preve (2009,2012), takes the form of a dummy variable taking the value of one if a firm, in addition to fulfilling the conditions set out by Asquith et al. (1994), is in the top two deciles of industry leverage in a given year (following Opler & Titman, 1994). This measure is better suited to recognize firms in distress because of high leverage, according to Molina & Preve (2012).

[85] See Pulvino (1998)

(2000), who considers the level of bilateral dependency between trade creditors and their debtors to influence the debtor's use of trade credit as "*larger firms and firms that are in industries in which they can choose among a large number of clients are likely to enforce their market power in a trade relation and enjoy a bargaining advantage*" (Molina & Preve, 2012, p. 190) A similar argument is brought forward by Hill et al. (2010) according to which strong ties to vendors enable firms enjoying greater market power to hold lower levels of inventory.

Turning their attention to the situation where firms are in a stronger position relative to their customers, Hill et al. (2010) propose two explanations as to why shorter credit terms are likely to be negotiated with their customers: Not only is the likelihood of losing customers over a decrease in credit terms diminished for firms with large market share as it faces less competition from rival firms, but switching suppliers is implied to be associated with higher costs for customers as suppliers with greater market power are more likely to have built stronger ties with their client base. These costs are referred to in the literature as consumer switching costs and include learning and transactions costs.[86]

Though Hill et el. (2010) "*expect firms with greater negotiating powers to have more payables, fewer receivables, and less inventory*" (p. 787), and thus the working capital requirement (WCR) to be negatively correlated to market power, measured as the lagged ratio of annual sales of a firm to the total annual sales in the industry the firm belongs to, they however only find evidence of a weak negative correlation between WCR and market share, which furthermore lacks robustness.[87]

4. Working Capital Management (WCM)

As briefly mentioned previously,[88] the effective management of working capital is basically concerned with satisfying the conflicting goals of profitability, which may alternatively be expressed in terms of shareholder wealth maximization, and liquidity. On the one hand, the decision of a firm to invest in current or long-term assets is dependent on whether these offer positive net present values "*when discounted at their individual risk-commensurate costs of*

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[86] See Chevalier & Scharfstein (1996) and Klemperer (1987) for more detailed information on consumer switching costs.

[87] Hill et al. (2010) mention that this insignificant result may be due to the possibility that the effect of negotiating ability, which they proxy using a lagged measure of market share, is absorbed by the firm-specific heterogeneity.

[88] See Subsections 1.2 and 2.3.1.

capital" (Pass & Pike, 1984, p.1). On the other hand, the firm must make sure that it can meet its financial duties while carrying on going concern. However, choosing the level of components of working capital in such a way as to maximize a firm's profitability tends to negatively affect liquidity, whereas a too high focus on liquidity impedes its profitability. Thus, working capital "*[m]anagement must seek to establish the optimal trade-off between profitability of net current assets employed and the ability to pay current liabilities as they fall due – given a clearly defined risk policy of which a firm's liquidity level should be a function.*" (Pass & Pike, 1984, p.1)

4.1. Theoretical Approaches to WCM – The Beginnings

Given the dual objective of WCM, there obviously exist many different approaches managers can follow to plan and control for working capital. In his article entitled *State of the Art of Working Capital Management*, Smith (1973) has classified these in eight distinctly different approaches which can be grouped into (i) partial models, which are deterministic in nature, (ii) models that stress future uncertainty and interdependencies, and (iii) models that have a wider, systematic focus. I will briefly present these eight approaches below:

(i) Partial models

a) Aggregate guidelines

This first approach, as its name bespeaks, sets guidelines on when to use short instead of long-term financing to cover net asset requirements[89] However, Smith (1973) himself argues that such aggregate guidelines, although being correct in principle, perhaps do not offer much valuable practicality.

b) Constraint set

This approach considers working capital as a *constraint set* for the broader challenge of cost minimization or firm value maximization and treats

[89] Following the terminology already used in Figure 1, the variable of interest in this approach for short-term considerations is the level of short-term financing and is given by $b = \left(\sum a_j^* + \sum A_j - \sum l_j^*\right) - \left(\sum E_j + \sum L_j\right)$, where $\sum a_j^*$ excludes short-term marketable securities and $\sum l_j^*$ excludes short-term financial debt. The term in the first bracket defines the net asset requirement (NAR), the term in the second bracket defines the long-term sources of financing (LTSF). If NAR > LTSF, then short-term financial debt is required. Conversely, if LTSF > NAR, funds in excess should be used to invest in short-term marketable securities.

"*working capital requirements as a component of a larger mathematical representation for financial management*" (Smith, 1973, p. 51) While studies using this approach (see Smith, 1961, and Vickers, 1968 to name just two outstanding studies[90]) highlight the crucial role of working capital in broader financial decision-making, they implicitly consider (net) working capital to be a *single entity*, thereby ignoring the fact that it is constituted by "*a series of interacting accounts on both sides of the balance sheet*" (Smith, 1973, p. 51)

c) Cost balancing

In the cost-balancing approach to analyse working capital, the problem to be solved takes the following form:

$$\underset{a_j}{Minimize}\ [C_1(a_j) + C_2(a_j) + \ldots + C_n(a_j)],$$

where the decision variable, a_j, is a specific current asset and $C_i(a_j)$ are the costs associated with an investment in that current asset. These multiple cost components typically move in different directions when a_j is altered. One area where this approach is prominently being used relates to the *economic order quantity* (EOQ) model first presented by Harris (1913), in which the decision variable of interest is the level of inventory. Similarly, this approach can be used to determine the level of appropriate accounts receivables or cash holdings. The shortcoming of these cost balancing approaches is "*that they usually focus on only a single current asset, without giving due consideration to important interrelationships with other current assets and with current liabilities*" (Smith, 1973, p. 51)

[90] While the problem Smith (1961) offers to solve is the minimization of total production cost subject to the requirements of money capital, which include fixed assets and net working capital (defined as $\sum a_j - \sum l_j = \alpha S - \sum_i ß_i W_i X_i$, where S represents firm sales, X_i the number of units of production resource i, W_i the resource's unit price and α and $ß_i$ appropriate constants), Vickers (1968) in his classic work on production, capital and finance, sets the problem as the maximization of the firm's equity value subject to its money capital constraint, which also included the net working capital requirement he defined as $\sum a_j - \sum l_j = g(Q)$, where Q represents the firm output.

(ii) Uncertainty and interdependencies models

a) Probability models

The next approach to managing working capital relies on probability models, in which the same variables than mentioned earlier are considered, with the difference that some of them follow random patterns, thus allowing for risk and uncertainty to flow into working capital considerations. Beranek (1963), for instance, in his attempt to analyse credit policy, has designed such a model to include random sales and collection patterns.

b) Portfolio theory

Similarly, portfolio theory, the focus of which is on the uncertainty as well as the interrelationships among items, and more specifically the *capital asset pricing model* (CAPM), which offers a compelling tool for analysing risk-return relationships in a great number of important financial decisions, can be used to provide guidelines related to WCM.

When considering the right mix of current assets in a portfolio context, firms could want to solve the following optimization problem:[91]

$$\underset{a_j}{Maximise}\ [\sum a_j e_j - \lambda \sum \sum a_i a_j \sigma_{ij}],$$

where e_j is the expected profitability per unit of current asset, σ_{ij} is the covariance between current asset a_i and a_j, and λ is an appropriate risk-return constant.

Similarly, the CAPM, which has gained enormous attention since its inception in the 1960's, can also be applied in the field of WCM, although very scant attention has been directed towards that goal in the finance literature,[92] a fact

[91] See Friedland (1966)

[92] See Pringle & Cohn (1974) for an adaptation of the CAPM to working capital management.

that might surprise since (i) "*the capital asset pricing model is a single-period model that is close[r] to the horizon of working capital decisions*" than to that of long-term investments decisions (Smith, 1973, p. 52) and (ii) because "*much of the working capital is 'permanent' in the sense that there always exists a portfolio of current assets and current liabilities*" (Pass & Pike, 1984, p. 6).

Nonetheless, although both the portfolio theory in general and the CAPM in particular provide useful groundworks for the conceptualization of the management of a firm's (current) assets,[93] they "*would seem to offer little operational help in controlling specific asset level over time.*" (Smith, 1973, p. 52) Furthermore, given that one of the key conclusions of the capital asset pricing theory is that diversification by the firms themselves may be far less effective than diversification by its stakeholders, the portfolio approach to working capital management get its potential value somewhat diluted.

(iii) Systematic models

a) Mathematical programming

One of the more interesting features of models based on mathematical programming is that working capital can be dealt with in a direct manner while also taking into consideration the numerous interrelationships between the determinants of working capital such as cash, accounts receivable or accounts payable. One of the more prominent such models addressing the issue of short-term financial planning under uncertainty using a mathematical linear programming framework is the one developed by Robichek et al. (1965), in which the objective is to minimize the short run financing costs subject to a set of limitations on different types of financial debt, as formally set out hereafter:

[93] The major contribution of the CAPM being the specification of a market risk premium, it is of great help when analysing investments in cash, marketable securities and other current assets generally assumed to be of lower risk than investments in permanent assets and enables a superior risk assessment of the different kinds of short-term assets and liabilities. (See Pass & Pike, 1984)

$$\underset{l_j}{Minimize}\ [\sum_k C_k(l_j)],\ subject\ to\ f_i(l_j) \leq l_i^*,$$

where l_j represent different types of borrowing, $C_k(l_j)$ the relevant financing cost components that make up the objective function and $f_i(l_j)$ the constraints used to place limits l_i^* on types of indebtedness. Others designed mathematical programming models that consider accounts receivable and cash balances (see Beranek, 1963) or addressed cash management considerations within a dynamic programming context (see Mao, 1969). Although models based on mathematical programming can accommodate for the different components of working capital, their shortcoming is that they usually focus on a single goal, be it for instance profit maximization or cost minimization.

b) Multiple goals

As suggested by its name, this approach to working capital management includes *multiple goals* (instead of one as in the previous approaches). The decision-making problem of a firm can, for example, be formally written as:

$$\underset{b,\pi}{Maximize}\, u\big[b(a_j, l_j), \pi(a_j, l_j)\big]\ ,$$

Here, u represents a utility function that "*summarizes management's feelings about the relative importance of the liquidity,* $b(a_j, l_j)$*, and profitability,* $\pi(a_j, l_j)$*, goals*" (Smith, 1973, pp. 52-53). Though being difficult to implement in practice,[94] this approach to working capital management "*probably come[s] closer than any alternatives to capturing the decision-*

[94] Specifying such a utility function to solve the maximization problem in practice would not be easy and not only requires assumptions about its shape, but also depends on the nature of the underlying business as well as the investment and financing opportunities available to the firm. Krouse (1974) has suggested to solve the problem by optimizing a set of goals ranked hierarchically in the order of their relative importance to the firm. After the management of the firm has determined the optimal level of the first goal, a specific satisficing level for that goal is chosen as a constraint in the optimization of the second goal and so on. This enables management to 'see' the trade-offs between the various goals at each step of the optimization procedure.

making process actually employed by financial managers" (Smith, 1973, p. 53), because it captures the trade-off between the profitability and liquidity goals inherent to any working capital consideration.

c) Financial simulation

Models based on financial simulation for the purpose of developing a consistent working capital policy are meanwhile employed by many firms (Pass & Pike, 1984) as they not only take into account both the uncertainty of the future as well as the many interdependencies between the components of working capital and other balance sheet accounts, but also allow for the inclusion of multiple goals without having to neither be explicitly specified into an objective function nor incorporated in an optimization algorithm. Several noteworthy papers have been published that propose a financial simulation approach to working capital management. Lerner (1968), for instance, points out how the simulation of cash budgeting, using both the expected value and the standard deviation of forecasted cash balances, helps an informed judgement not only of "*the size of the buffer stock of cash, liquidity, or bank line [a firm] needs to meet the uncertainties that surround [its] activities"*, but also of *"the effect of [...] a change in receivable policy, payable policy, or the timing of purchases that enter the production process"* (Lerner, 1968, p. 80). Similarly, Van Horne (1969), Warren and Shelton (1971) and Mao (1969) have designed probabilistic simulation models of the interdependencies between components of a firm's working capital, which all account for the uncertainties in these components future patterns.

4.2. An Integrated Approach to WCM

Although since the publication of Smith's (1973) article a great amount of highly interesting research has been undertaken, covering, in isolation, individual aspects of working capital management such as e.g. the management of cash balances and marketable securities (e.g. Mauer et al., 1998) and the use and management of trade credit (see, among others, Schwartz, 1974, Emery, 1984, Biais & Gollier 1997, Peterson & Rajan, 1997, Frank & Maksimovic 2005, Cuñat, 2007, Gianetti et al., 2008), it would nowadays be unthinkable to research the field of working capital management without taking a generalized approach that integrates

all aspects of working capital management, as emphasized primarily by Schiff & Lieber (1974), Sartoris & Hill (1983) and Kim & Chung (1990).[95] This not only allows to consider the interdependencies of the individual components of working capital, but also better reflects the evolved information and communication technology (ICT) capabilities of firms with regards to working capital accountability, given their increased use of enterprise resource planning (ERP) software as a management tool. Such a tool is, on a side note, of great help to firms in following a cross-functional approach to working capital management, involving the firm's sales, supply chain, treasury and finance functions. It nevertheless remains struggling for many firms "*to break down barriers that prevent functions from working together on process improvements.*" (APQC Report, 2011, p. 22). Still, the firms' focus on issues of working capital management decisions is no longer driven by "*compartmentalization"*, i.e. where "*each element of short-term finance is managed by an organizationally separate entity"* (Sartoris & Hill, 1983, p. 349), as it used to be before the turn of the century.[96] Indeed, a study by Gilbert & Reichert (1995) concerning the practices of financial management among *Fortune 500*'s corporations in the United States clearly shows the compartmentalization thinking that was prevalent during the 1980's and the early 1990's as the models used by these firms as a tool in WCM were categorized into either cash management models, security portfolio models, accounts receivable management models or inventory management models.

Given the preceding argumentation, the following only reviews the prior research that emphasizes on an integrative approach to WCM.

4.2.1. Modelling the Interrelationship Between Inventory and Receivables Policies

In this section, I briefly describe the integrative dynamic model designed by Schiff & Lieber (1974) for the management of receivables and inventory. I include it in my work as it provides a rationale for how choosing the right credit policy in conjunction with the right inventory policy can lead a firm to optimize its profits and eventually its value to shareholders over time, and is thus of relevance to my own work. Underlying the model are

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[95] A few other studies attempting to examine working capital decisions using an integrative approach include Beranek (1967), who points out to the interdependencies between inventory, order-quantities and the opportune time to settle accounts payable, and Schiff (1972), who, as in Schiff & Lieber (1974), examines the inventory and accounts receivables investments jointly. Mehta (1974), using a linear programming, and Mao (1969) and Sartoris & Spruill (1974), using a goal programming framework, also provide attempts to treat elements of working capital decisions simultaneously.

[96] Similarly, Schiff & Lieber (1974) also highlight that inventory management was typically considered as being part of production management whereas credit management fell under the treasurer's or the controller's duties.

several assumptions of which the more relevant are that a firm, operating in a continuous, finite time interval (0, T) produces one product it sells at a constant price *P*. It faces the demand, *D,* which is determined by time, *t*, terms of credit, *q*, and inventory level, *x*. A longer credit period, *q*, used as a measure of credit terms, as well as a higher level of inventory are assumed to increase the demand for the product. Moreover, the demand function for the product is assumed to be linear, non-stationary and may be subject to arbitrary fluctuations over time, thus allowing for seasonality or trend effects.[97] Schiff & Lieber (1974) also assume the interest rate to be accumulated linearly relative to the level of accounts receivables.[98] The cost of accounts receivable is given by Schiff & Lieber (1974) as *rqPD*, where *r* is the interest rate, i.e. the cost of holding one unit of accounts receivable for one unit of time, q the length of the credit period.[99] The marginal effect of increasing the credit period q on the cost of accounts receivable is therefore given as:

$$\frac{\partial rqPD(q,x,t)}{\partial q} = rPD(q,x,t) + rqPa_1,$$

a_1 being the marginal effect of credit terms on the quantity demanded. The above equation implies a twofold effect of an increase in the length of the credit period by one unit: The first term on the right-hand side of the equation, $rPD(q,x,t)$, represents the increased cost of credit associated with lengthening the credit period. The second term on the right-hand side of the equation, $rqPa_1$, represents the additional cost associated with the increase in sales resulting from the increase of the credit period by one unit.

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[97] The demand function *D* is given by Schiff & Lieber (1974) as $D(q(t), x(t), t) = a_1 q(t) + a_2 x(t) + b(t)$, where $q(t)$ is the credit period for the amount sold at time t, $x(t)$ is the level of inventory at time t (the level of inventory might be negative, thus allowing for the possibility of backlogging), a_1 and a_2 are marginal effects of credit terms and inventory, respectively, on the quantity demanded and $b(t)$ an arbitrary function of time (p. 135). Schiff & Lieber (1974) assume, to avoid complexity, that changing the credit terms over time is not associated with any costs.

[98] According to Schiff & Lieber (1974), this assumption should hold true in many cases taking into account the proportion of accounts receivable to total assets, as many firms for which this proportion is relatively small should be "*able to obtain funds at the same interest rate to finance incremental investments in accounts receivable*" (p. 135)

[99] Selling *D* units of the product leads to an increase of the accounts receivable by the amount *PD*, which is associated with an interest cost of *rPD* for each unit of time and *rqPD* over a credit period length of q.

Schiff and Lieber (1974) then include a production cost function, $F(v(t))$, where $v(t)$ represents a decision variable concerning the rate of production at time t ,and a holding cost (of inventory) function, $h(x(t))$,[100] to devise the firm's objective function as follows:

$$Max \int_0^T [PD(q(t), x(t), t) - F(v(t)) - h(x(t)) - rq(t)PD(q(t), x(t), t)]dt$$

The above objective function represents the net profits of the firm over the planning horizon, which the firm ought to maximize. Moreover, Schiff & Lieber (1974) introduce the rate of change in inventory, *x'(t)*, as the difference in production rate and demand[101], or:

$$x'(t) = v(t) - D(q(t), x(t), t), \text{ so that}$$

$$x(t) = x_0 + \int_0^t [v(\tau) - D(\tau)]d\tau$$

Substituting the above equation in the maximization problem leaves the firm with two decision variables, namely $v(t)$ and $q(t)$, or in other words its production and credit policy to choose from to maximize its profits. Solving this problem provides a unique solution, which varies only due to seasonality and upward or downward trends in demand (which was introduced through the term *b(t)* in the demand function).[102] Fluctuations in demand will thus result in an adjustment of both the inventory and credit policies followed by the firm.

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[100] Both functions are assumed by Schiff & Lieber (1974) to be strictly convex and twice continuously differentiable, with the holding cost function taking a value of 0 for values of $x \leq 0$, implying zero holding costs for backlogging. The demand function however implicitly includes penalty costs for backlogging, i.e. a high backlogging is associated with a lower demand for the product.

[101] Both the production rate and the credit period length are subject to a non-negativity constraint (i.e. $v(t) \geq 0$ and $q(t) \geq 0$) in the model of Schiff & Lieber (1974), the latter excluding the possibility of prepayment in the model (however allowing for prepayment leads to a similar solution to the maximization problem according to the authors). A terminal constraint is also imposed so that all demand must be met at the end of the planning horizon, i.e. no backlogging is allowed ($x(T) \geq 0$).

[102] The reader interested in how the solution is derived should refer to the article of Schiff & Lieber (1974), as outlining each step of the solution is not relevant to the aim of this thesis.

This implies that changes in credit terms ought to be contemplated in an environment of changing demand, e.g. due to seasonal fluctuations.

It should be noted, moreover, that two effects crystallize out of this model with regards to inventory. The first effect, which Schiff & Lieber (1974) name the *service effect*, considers that "*[b]y holding inventory the firm can better service its customers, thus directly affecting quantity demanded"*; the second effect, titled *transaction effect*, considers that "*if inventory and backlogging are not accumulated, the production schedule must equal demand, and hence, high fluctuations are introduced in production, resulting in relatively high production costs. The smoother the production pattern is for a given demand pattern, the lower [the] production costs*"[103] (Schiff & Lieber, 1974, p. 136)

To conclude this section, I shall note that the model outlined above rightly calls for an integrative and coordinated view of the credit and inventory management functions, both key components of a firm's working capital management policy.

4.2.2. A Cash Flow Approach to Working Capital Management

Though the dynamic model developed by Schiff & Lieber (1974) I described in the previous subsection provides a useful starting point on which firms can build their working capital management decisions, as it allows for the joint consideration of credit and inventory policies, there remained a need, up until the early 1980's, to develop an approach to short-term financial decisions which not only incorporated the various elements of working capital but the goal of which would be to maximize a firm's net present value, thus taking into account cash flows rather than using accounting variables in the decision problem. The work by Lieber & Orgler (1975) remains pioneering in this respect by being the first to embed the credit policy in a firm's net present value maximization problem[104] and has inspired the previously cited articles by Sartoris & Hill (1983) and later Kim & Chung (1990) I will briefly describe hereafter. In these studies, the concept of net present value is extended to include the interdependencies between the various elements of working capital, thus providing integrative "*models that focus on how the joint management of a firm's credit policies and inventories influences firm value*" (Kieschnick et al., 2013, p. 1830) and being of relevance to my own study. Firm value is here to be related to the standard free cash flow

[103] This smoothing argument is similar in terms of interpretation to the investment smoothing argument brought forward by Fazzari & Petersen (1993).

[104] Other, such as Kim & Atkins (1978), Hill & Riener (1979) and Sartoris & Hill (1981) have followed in the same footpath.

(FCF) valuation model and is expressed in standard corporate finance textbooks, such as that of Erhardt & Brigham (2009), as:

$$V_{firm} = \sum_{t=1}^{\infty} \frac{FCF_t}{(1+WACC)^t},$$

where $\mathrm{FCF_t} = \mathrm{NOPAT_t} - \Delta\mathrm{NOWC_t} - \Delta\text{Fixed Assets}_t$, $\mathrm{NOPAT_t}$ being the net operating profit after tax at time t, $\Delta\mathrm{NOWC_t}$ the investment in net operating working capital at time t, $\Delta\text{Fixed Assets}_t$ the investment in long-term assets, and WACC the weighted average cost of capital.[105]

4.2.2.1. Joint Management of Credit and Receivables Policies

Let me begin by exposing the work of Sartoris & Hill (1983), who in a first step devise the cash flow timeline (see Fig. 11) as the framework on which they build their model, which focuses on changes in that timeline due to managerial decisions.

Sartoris & Hill (1983) rightly point out that given that many organizational borders such as cash, credit, inventory and payables management are being crossed within this timeline, the use of such an approach permits to focus on changes affecting both the amount and timing of cash inflows and outflows along the whole timeline rather than changes in single components of working capital, such as accounts receivables.

They also stress the importance of considering the interrelationships between the timing and amount of the cash flows in order to correctly assess the effect of a working capital policy decision on the firm's value.[106] In a second step, Sartoris & Hill (1983) develop a model in which cash flows associated with any working capital policy decision are assumed to be known with certainty,[107] with regards to both their timing and amount, and in which all production costs are variable in nature and can be written as a percentage of sales. They

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[105] It becomes clear from that expression that net operating working capital is an essential determinant of firm value; however, "*it does not make it clear what its relationship is because investments in net operating working capital are like investments in long-term assets in that they reduce current free cash flow while influencing future free cash flow*" (Kieschnick et al., 2013, p. 1829)

[106] Since short-term financial decisions are usually a blend of unrelated and intertwined decisions, some decisions will have an isolated impact on the timing of one set of the operating cash flows, while others will impact the timing and/or amount of a group of sets of the operating cash-flows. (Sartoris & Hill, 1983)

[107] Sartoris & Hill (1983) also introduce uncertainty in the model for working capital decisions which they suggest to deal with using one of three methods: (1) simulation, (2) explicit pricing and (3) neutralization. The interested reader is referred to their original article for more details relating to this issue.

identify as relevant cash flows "*the payment for factors of productions (materials and labor), the collection of credit sales during a cash (or early payment) discount period, and the collection of the remainder of the credit sales*" (Sartoris & Hill, 1983, p. 351), and set a planning/decision horizon of *N* days.

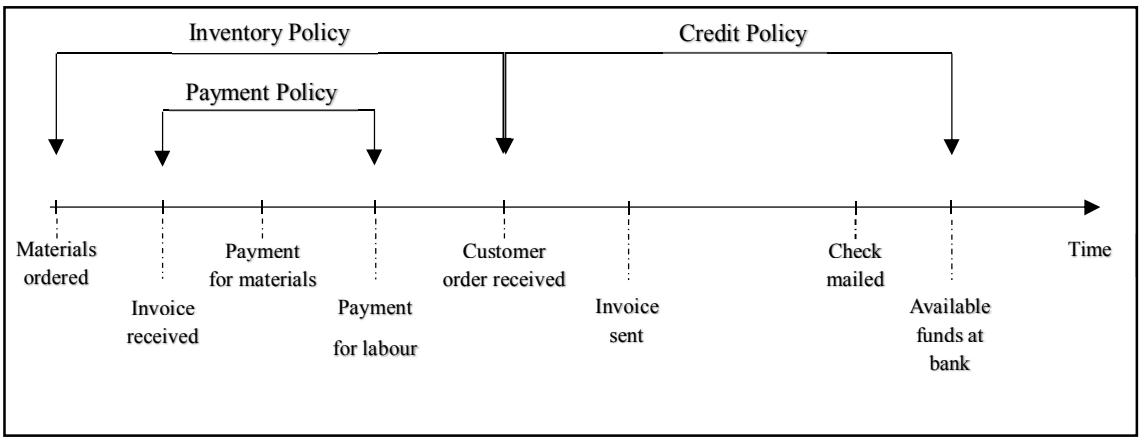

Figure 10: The Cash Flow Timeline (Source: Sartoris & Hill, 1983)

Given the above assumptions and following the cash flow timeline depicted in Fig. 10, the timing and amount of the operational cash flows can also be depicted (see Fig. 11).

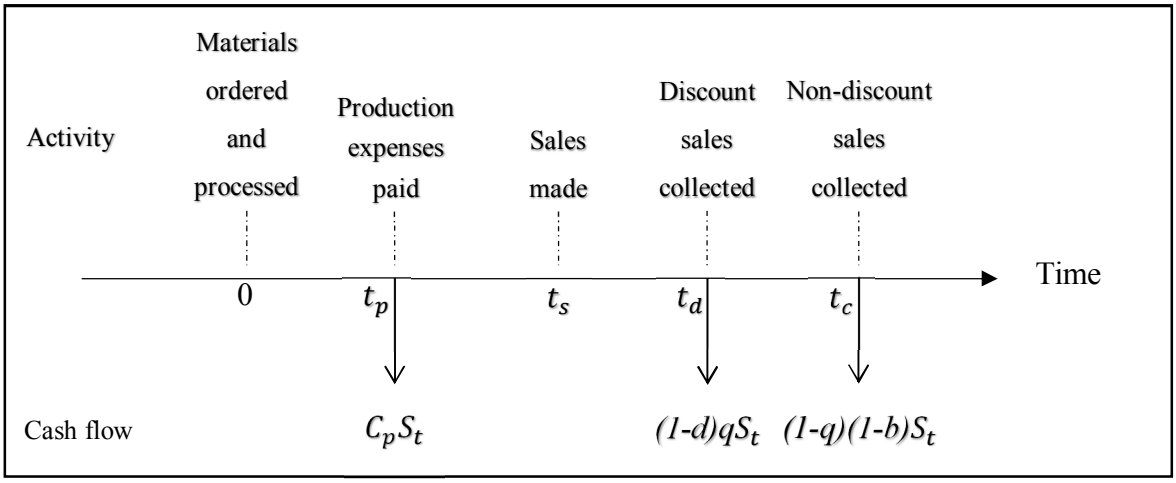

Figure 11: Operating Cash Flows (Source: Sartoris & Hill, 1983)

In Fig. 11, C_pS_t is the cash outflow, realized in t_p, related to the payment for the production factors, where C_p is the variable cost of production denominated as a percentage of sales S_t. In t_d, customers making use of the cash discount pay the firm $(1-d)qS_t$, where *d* represents the discount and *q* the percentage of sales paid at discount. The last inflow of cash, equal to $(1-q)(1-b)\ S_t$, happens in t_c, where *b* represents the fraction of uncollected, non-discount sales, i.e. foul debts.

Given a risk-free interest rate of *r*, Sartoris & Hill (1983) then express the net present value of the cash flows from operations **for day *t*** as:

$$NPV_t = -C_p S_t e^{-rt_p} + (1-d)qS_t e^{-rt_d} + (1-q)S_t(1-b)e^{-rt_c}$$

Furthermore, they assume the level of future sales to follow any generalized growth path over time, thus $S_t = S_0 f(t)$, where S_0 is the amount of sales a $t = 0$ and $f(t)$ is a continuous and non-negative function of t representing the time pattern of sales.[108]

Finally, Sartoris & Hill (1983) provide the below mentioned expression for the total net present value of operating cash flows over the entire planning period:

$$NPV = \int_0^N (-C_p e^{-rt_p} + (1-d)qe^{-rt_d} + (1-q)(1-b)e^{-rt_c})S_0 f(t)e^{-rt}$$

By using this integrative cash flow valuation approach, a firm can analyse, in principle, whether a proposed change in its working capital policy is beneficial, i.e. would change the amount and timing of its operational cash flows in such a way that their total net present value, as expressed above, is increased. However, as Sartoris & Hill (1983) highlight, since any working capital policy may affect both the time pattern of sales, $f(t)$, one "*must examine the sales growth which would occur over the indefinite planning horizon before [one] can establish whether the old or the proposed working capital policy will result in the higher NPV. To evaluate the change in general, [one] need[s] to know both the planning horizon over which the policies are to be evaluated, and the time pattern of sales that will result from the alternative policies.*" (Sartoris & Hill, 1983, p. 353)

4.2.2.2. Accounting for the Inventory Policy

While the cash flow based model developed by Sartorius & Hills (1983) rightly calls for a working capital management that integrates different working capital components, it does

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[108] Though they assume a generalized growth pattern over time in the model, i.e. not specifying the exact form of the function *f(t)*, Sartoris & Hill (1983) point out to several possible and realistic growth patterns, of which one follows a constant growth rate g, where $f(t) = e^{gt}$, one that allows for seasonal growth, where $f(t) = e^{g(t)t}$, *g(t)* being some function of time, one mimicking product lifecycle growth, where *f(t)* is polynomial, and one modelling declining sales, i.e. allowing for negative growth rates.

not concern itself with the decision regarding a firm's inventory policy, which it considers as *given* in its formulation, thus leaving room for further evaluation.[109] Said further evaluation is given by Kim & Chung (1990), who present a model in which both the inventory and the credit policy are evaluated jointly based on the maximization of the cash flow based net present value. Their model relies on a finished goods inventory system[110] and addresses the relevant policy questions regarding the optimal batch size of each shipment as well as its corresponding terms of sale. Kim & Chung (1990, p.384) underlie their model with the following assumptions:

1. Uniform rate of production of U units per time
2. Goods held in inventory until sold in a batch (at the end of each inventory cycle) at a price of P dollars per unit
3. Cash discount (d) offered for early payment
4. Rate of sales at cash discount, ($r(d)$), is a function of the discount's magnitude
5. Continuous cash outflows related to production expenses of $\$CU$ per unit of time
6. Inventory carry costs proportional to the level of inventory, i.e. equal to $\$hCUt$ at time t
7. Cash outflows of selling costs E (e.g. shipping and insurance costs) when goods are sold and shipped at the end of the inventory cycle

Given the above assumptions, Kim & Chung (1990, p. 385) express the NPV of the cash outflows related to production costs (PC), out-of-pocket inventory carrying costs (IC), and selling expenses (SE) respectively as follows:

$$PC = CU \int_0^T e^{(-kt)} dt,$$

$$IC = hCU \int_0^T te^{(-kt)}\, dt,$$

[109] Kim & Chung (1990)

[110] With regards to manufacturing firms, inventories can be categorized into raw materials, work in process and finished goods, i.e. completed products that are expected to be sold. Kim & Chung (1990) argue that "*most consumer and industrial products are manufactured and stored in inventory to meet forecasted future sales*." (p. 384) Failing to hold finished goods in inventory would be highly impractical and for the least overly costly, as in such an instance the pattern of sales would have to follow exactly the rate of production.

$$SE = Ee^{(-kT)},$$

where T represents the cycle time, k the opportunity cost of funds per time unit, and h the out-of-pocket inventory carrying costs expressed as a percentage of inventory level.

Let me now turn to the net present value of the cash inflows from sales, i.e. the sales revenue (SR), the timing and magnitude of which are dependent on both a firm's credit and inventory policies, and which Kim & Chung (1990, p.385) express as:

$$SR = (1-d)r(d)PUTe^{\{-k(M-T)\}} + \{1-r(d)\}(1-b)PUTe^{\{-k(L-T)\}},$$

the first term being the present value of the cash discounted sales revenue while the second term represents the present value of the revenue from credit sales. In the above equation, M and L represent the cash discount and the credit periods respectively, and b the fixed bad debt loss proportion of the sales not cash-discounted.

Thus, in the first inventory cycle, the net present value of the cash in- and outflows is expressed as:

$$NPV = -PC - IC - SE + SR.$$

Based on this model, the goal of the decision maker(s), whoever that may be within a firm, is then to choose both the inventory as well as the credit (i.e. receivables) policies to maximize the net present value of all future cash flows, that is

$$NPV\ (\infty) = NPV \sum_{n=0}^{\infty} e^{(-nkT)}$$

Solving the above optimization problem leads Kim & Chung (1990) to infer that the optimal accounts receivables and inventory policies are intertwined, thus calling for their joint evaluation in a working capital management framework based on a NPV-maximizing cash-

flow approach.[111] More specifically, they assert that the isolated evaluation of these interrelated working capital components, namely inventories and accounts receivable, will result in suboptimal solutions,[112] and conclude that the model they develop represents "*a theoretically correct and conceptually straightforward alternative to both the traditional cost minimization approach to inventory decisions, and to the isolated analysis of accounts receivable policies.*" (Kim & Chung, 1990, p. 388)

5. Does Good Governance Boost WCM Efficiency?

The previous section was concerned with how a firm should approach its working capital management. Specifically, the literature presented suggested that a firm should adopt a policy that evaluates all the components of working capital jointly, as opposed to individually. In this section I will present a few relatively recent academic articles that try to answer the question of whether good quality corporate governance can enhance the efficiency of its working capital management policy. Following Eljelly (2004), the management of a firm's working capital is efficient when current assets and current liabilities are planned and controlled in such a way that the risk of the firm falling short of meeting its due short-term obligations is eliminated and excessive investment in current assets is avoided. Taking a closer look at the above-mentioned question is relevant for my own study for the following reason: If it is the case that corporate governance - which is commonly referred to as the set of explicit and implicit rules and practices by which a board of directors makes sure that a firm's relationship with all its stakeholders is dealt with in a fair, accountable and transparent manner - is positively related to the efficiency of the firm's working capital management policy, eventually translating in a shareholder wealth increase, then one could set forth the hypothesis that establishing a corporate governance of the highest quality serves a firm to follow a WCM policy that is not only geared towards delivering higher returns to its shareholder, but also allows a sustainable approach to WCM.

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[111] The reader interested in the exact solution for the optimal batch sales volume, Q^*, and the optimal cash discount, d^*, as well as in their derivation is kindly referred to the appendix in Kim & Chung (1990, pp. 388-389).

[112] According to Kim & Chung (1990), taking an isolated view of inventory and accounts receivable management may be due to one of two reasons: Either the management of inventory could (i) be considered not to be under the direct supervision of the financial manager, or (ii) be done using the traditional cost minimizing EOQ method, since a large body of literature on inventory management, up until the publication of the article by Kim & Chung (1990), (falsely) suggested that the said method and the NPV maximizing method will lead to more or less the same results for *all* kinds of inventory systems (see, e.g., Hadley, 1964, Trippi & Lewin, 1974, Thompson, 1975, Gurnani, 1983).

This argument should also be placed in the current context of Germany, the geographical focus of my empirical study, where the topic of corporate governance, the soft legal framework of which is embedded in the German Corporate Governance Code (GCGC),[113] has gained significant attention over the last decade.

5.1. Setting the Corporate Governance Benchmark

Let me remind the reader at this point that corporate governance can be thought of as a *common agency problem* involving an agent, e.g. a firm's chief executive officer (CEO), and that agent's multiple principals, e.g. its shareholders, creditors, customers, employees, suppliers, and other third parties the CEO maintains a business relationship with on his firm's behalf. [114] This view is by all means compatible with Jensen & Meckling's (1976) definition of an agency relationship[115] and their description of a firm as "*one form of legal fiction which serves as a nexus for contracting relationships*." (Jensen & Meckling, 1976, p. 311) Thus, rules of corporate governance can be considered to result from the process of contracting between the CEO, as the agent, and the various principals involved in the *common agency problem*.

The main issue in corporate governance, as argued by Becht et al. (2003), then concerns itself with understanding which outcome this contracting process is likely to lead to, and whether this outcome will differ in practice from the efficient contracting benchmark.[116] Becht et al. (2003) discuss whether the notion of *shareholder value maximization*, a criterion

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[113] The German Corporate Governance Code presents essential statutory regulations for the management and supervision (governance) of German listed companies, which are mainly referring to the Aktiengesetz (AktG) – the German stock corporation act "*[and] clarifies the obligation of the Management Board and the Supervisory Board to ensure the continued existence of the enterprise and its sustainable creation in value*." (GCGC, 2015, p. 1) Although this code, through the annual declaration of conformity pursuant to §161 AktG, represents a legal framework, compliance to it is not mandatory as firms can opt to deviate from its suggestions (marked by the wording "should") and recommendations (marked by the wording "shall") when in the interest of good governance – though being obliged to disclose and justify any deviation from the recommendations (Comply or Explain). (GCGC, 2015)

[114] See Bernheim & Whinston (1985,1986a, 1986b)

[115] Jensen & Meckling (1976, p. 308) „*define an agency relationship as a contract under which one or more persons (the principal(s)) engage another person (the agent) to perform some service on their behalf which involves delegating some decision making authority to the agent.*"

[116] Becht et al. (2003) correctly distinguish between ex-ante and ex-post (or Pareto) efficiency: While a corporate charter is ex-ante efficient when it delivers the maximum joint surplus to all parties affected by the corporate action, a corporate charter is Pareto efficient when no other charter exists that makes any one of the parties involved better off without making at least one of the involved parties worse off. In the presence of unrestricted side transfers between the parties involved, a Pareto efficient charter is also surplus maximizing. However, in practice side transfers are not seldom restricted by wealth or borrowing limitations.

repeatedly defended as an efficient benchmark in articles on corporate governance,[117] and one that is of crucial interest in my study, can actually form the basis for such an efficient contracting benchmark:

Following the argumentation of Jensen & Meckling (1976) and assuming that (i) all contracts with principals other than shareholders which form the above mentioned nexus are complete, (ii) only contracts with shareholders are open-ended, thus only granting claims on residual returns to shareholders after fulfilment of all other contractual obligations, and (iii) agency problems are non-existent, it is straightforward that corporate governance rules should be devised with the exclusive objective of protecting and promoting shareholder value maximization.

However, managerial agency problems make such an exclusive focus on shareholder wealth maximization inefficient since it may, as noticed by Jensen & Meckling (1976), lead to manager taking excessive risks or even underinvest in consequence of a debt overhang, a problem first addressed by Myers (1977) and which may bring a firm on the edge of financial distress. Moreover, following Becht et al. (2003), taking into consideration the fact that relationships between a firm and its principals other than the shareholders are usually governed by incomplete contracts, corporate governance rules geared exclusively towards shareholder value maximization do not guarantee efficiency. Rather, they argue that explicitly accounting for the interests of the constituencies other than the shareholders of the firm when designing of such rules is more likely to guarantee efficiency. It is interesting to note here that, in the case of German corporations, the rules of corporate governance are designed in such a way as to balance the shareholders' and employees' interests.[118] Although it is still open to debate whether, in an environment of incomplete contracts, shareholder value maximization should be the exclusive focus when designing efficient rules of corporate governance or whether the interests of other constituencies than shareholders should be taking into consideration, Becht et al. (2003) argue that it is in the best interest of firms to

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[117] See, for instance, Williamson (1984, 1985), who argues that corporate governance rules should be geared primarily at protecting a firm's shareholders since these enjoy less protection than other of the firm's principals such as creditors and employees.

[118] The GCGC (2015, p. 1) states that "*[t]he Members of the Supervisory Board are elected by the shareholders at the General Meeting. In enterprises having more than 500 or 2,000 employees in Germany, employees are also represented in the Supervisory Board, which then is composed of employee representatives to one third or one half respectively. For enterprises with more than 2,000 employees, the Chairman of the Supervisory Board, who, for all practical purposes, is a representative of the shareholders, has the casting vote in the case of split resolutions. The representatives elected by the shareholders and the representatives of the employees are equally obliged to act in the enterprise's best interests.*"

design a corporate governance framework – one that is imposed by regulations[119] – that (i) overcomes the problem of collective action prevalent when ownership is dispersed[120] and (ii) that accounts for the interests of all relevant constituencies. Moreover, they identify five tools as mentioned below (see Becht et al., 2003, p. 18) which aim to mitigate collective agency problems, with emphasis on shareholders' collective action problems:

(1) Election of a board of directors representing shareholders' interests, to which the CEO is accountable

(2) When the need arises, a takeover or proxy fight launched by a corporate raider who temporarily concentrates voting power (and/or ownership) in his hands to resolve a crisis, reach an important decision or remove an inefficient manager

(3) Active and continuous monitoring by a large blockholder, who could be a wealthy investor or a financial intermediary, such as a bank, a holding company or a pension fund.

(4) Alignment of managerial interests with investors through executive compensation contracts.

(5) Clearly defined fiduciary duties for CEOs and the threat of class-action suits that either block corporate decisions that go against investors' interests, or seek compensation for past actions that have harmed their interests.

5.2. Linking Corporate Governance to WCM Efficiency

The previous subsection concerned itself with the question of how to design rules of corporate governance in an efficient way and thus allows to distinguish the characteristics

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[119] Becht et al. (2003, pp. 16-17) argue that regulatory intervention is necessary primarily since in the absence of regulations imposing governance rules, the founder of a firm or its shareholders, which could then "*design and implement any corporate charter they like, […] will tend to write inefficient rules since they cannot feasibly involve all the parties concerned in a comprehensive bargain.*" Besides, "*even if firms initially have the right incentives to design efficient rules, they may want to break or alter them later. A problem then arises when firms do not have the power to commit not to change (or break) the rules down the road. When shareholders are dispersed and do not take an active interest in the firm it is possible, indeed straightforward, for management to change the rules to their advantage* ***ex post***."

[120] Dispersed ownership is not limited to shareholders (similarly, bondholders or creditors can also be dispersed) and represents a major source of corporate governance problems. It arises, among shareholders, for a number of reasons: (i) an individual shareholder's wealth may be relatively insignificant, making it difficult to take a large stake in a firm, (ii) for risk diversification purposes, shareholder able to take a large stake in a firm may choose to invest less, (iii) a shareholder may face difficulties selling a large stake in the secondary market, and (iv) regulations may be in place in an effort to protect minority shareholders, which makes it costlier to hold large stakes in a firm. Due to these reasons, it may neither be realistic nor desirable to solve the problem of collective action prevalent among dispersed shareholders. (Becht et al., 2003)

of good governance when trying to establish its link with the efficiency of WCM. A few studies have attempted to establish such a link and suggest that efficient corporate governance rules influence the efficiency of a firm's management of its working capital.

Kieschnick et al. (2006), who address the question of whether US corporations over-invested in working capital and to what extent that over-investment would be caused by agency problems, provide evidence, using panel data from 1990 through 2004, of a significantly negative relationship between the market value of a firm, as defined by Fama & French (2002), and its corresponding investment in working capital, a result which is consistent with working capital over-investment for the US corporations under study.[121] Moreover, the results of their analysis of the factors influencing the management of working capital suggest that "*managerial incentives and the monitoring of management are significant influences on a firm's working capital management performance*."[122] (Kieschnick et al., 2006, p. 2) More specifically, the proportion of outside directors on the firm's board[123] as well as the CEO's current compensation and share ownership have significant influence on its working capital

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[121] In order to find out whether firms over-invest in working capital, Kieschnick et al. (2006) base their analysis on the DCF valuation framework presented by Kaplan & Ruback (1995), and write the current value of the firm, $PV_F(0)$, as:

$$PV_F(0) = CASH(0) + \sum_{t=1}^{\infty} \frac{CCF(t)}{(1+r)^t} = CASH(0) + \sum_{t=1}^{\infty} \frac{[OCF(t) - INV_L(t) - INV_S(t)]}{(1+r)^t}$$

where $CASH(0)$ is the current value of its cash assets, CCF the capital cash flows, INV_L the investment in long term assets, INV_S the investment in net working capital (equal to accounts receivable plus inventories less accounts payable and accrued expenses), and *r* the discount rate. If one assumes that investments in net working capital mainly affects the level of sales in the current period, then the value of a firm is maximized when an additional dollar invested in net operating capital generates the same dollar in sales. An over-investment in net working capital would obviously not lead to this result. Moreover, the present value of a firm a time *t*, $PV_F(t)$, can be re-written, assuming, as Kieschnick et al. (2006) do, that a firm's capital cash flows grow at a constant rate, *g*, as:

$$PV_F(t) = CASH\,(t) + \frac{[OCF(t+1) - INV_L(t+1) - INV_S(t+1)]}{(r-g)}$$

The marginal effect of an investment in net working capital on the present value can then be written as: $\frac{\partial PV_F(t)}{\partial INV_S(t)} = \left[\frac{\partial OCF(t)}{\partial INV_S(t)} - 1\right]\left(\frac{1}{r-g}\right)$. Kieschnick et al. (2006) estimate this marginal effect in one of their regression models of the market value of a firm on net working capital investment. Therefore, since $(r-g)^{-1}$ is positive and the level of net working capital investment is optimal if the estimated coefficient is insignificantly different from zero, a positive (negative) estimated coefficient implies an under- (over-) investment in net working capital. The above argumentation also holds true when Kieschnick et al. (2006) extend Kaplan & Ruback's (1995) concept of capital cash flows to include incremental investment in cash and marketable securities.

[122] Apart from these corporate governance related factors, Kieschnick et al. (2006) also show a firm's working capital management inefficiency to be positively correlated with its size and its expected sales growth and uncorrelated with its industry's concentration. These results suggest that firms are not using the full potential of their market power to render their working capital management practices more efficient, but rather follow those prevalent in their industry.

[123] According to Fama (1980), the inclusion of outside directors on the board reduces the likelihood of collusive arrangements between the inside directors on the board that would be detrimental to the wealth of security holders. In that sense, outside directors serve a management monitoring role.

policy: A larger proportion of outside directors on a firm's board as well as a larger total current compensation[124] of the CEO lead to a better performance of the firm's working capital management. However, that performance decreases with the size of the CEO's share ownerships. Interestingly, the evidence reported by Kieschnick et al. (2006) suggests neither the size of a firm's board,[125] measured by the number of directors, nor corporate charter provisions, measured by the governance index (GINDEX) developed by Gompers et al. (2003) and alternatively by several indices Kieschnick et al. (2006) created by grouping governance features by intended purpose,[126] to have a significant influence on its working capital management performance.

Coming back to the topic of CEO compensation and its relation to working capital efficiency, it is interesting to pinpoint a recent working paper by Aktas et al. (2015a), in which the authors investigate whether and to what extent firms provide the right compensation incentives to its executives (i.e. CEO, CFO and other executives), the aim of which is to mitigate managerial slack when deploying corporate resources to working capital. They estimate, using data covering a large sample of U.S. firms over the period 1992-2012, the sensitivity of different components of realized executive compensation to realized working capital performance.[127] They hereby consider, after adjusting for scale, a positive working

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[124] Kieschnick et al. (2006) measure of total current compensation includes CEOs' current period salary and bonus. The CEOs' stock compensation component, measured using the CEOs' unexercised stock option positions rather than the current period stock option grants, is also used in their attempt to apprehend the alignment of managerial incentive with the interests of shareholders. However, though a negative influence of the unexercised stock option holdings on the cash conversion cycle is evidenced, it is not significant.

[125] Kieschnick et al. (2006) expected a laxity of larger boards with respect to the monitoring of management, which in turn was expected to be associated with longer cash conversion cycles than those of industry peers.

[126] Kieschnick et al. (2006), in their effort to include corporate charter provisions in their regression model, first follow Harford et al. (2008) and include the Gompers, Ishii and Metrick's governance index (GINDEX) as an additional regressor and do not find it to significantly influence a firm's working capital management performance. However, Kieschnick et al. (2006) argue that using the GINDEX in their regression assumes all charter provisions to have the same influence on the cash conversion cycle, an assumption which has not gone uncriticised in recent literature on corporate governance (see Bebchuk et al., 2009). Therefore, Kieschnick et al. (2006), to assess whether the result they obtained using the GINDEX is correct, run the regression using several component indices they created, each characterising a specific kind of provisions (i.e. internal provisions, external provisions, compensation & liability provisions, minority voting provisions, and state laws) and find that "*none of the coefficients of the different corporate charter indices are statistically significant.*" (Kieschnick et al., 2006, p. 15)

[127] Aktas et al. (2015a) design two kinds of specifications providing estimates for (i) compensation incentives aimed at improving working capital performance as well as (ii) compensation incentives aimed at maintaining an already good working capital performance relative to industry peers. The first specification is estimated using a regression of the following form:

(i) $$Y_{ijt} = \alpha_j + \alpha_t + \beta \times NWC_{jt} + \gamma \times X_{jt} + \varepsilon_{ijt} ,$$

where the dependent variable Y_{ijt} represents the (ex-post observed) compensation that executive *i* receives from firm *j* for year *t* (the authors consider salary, bonus and equity-based pay in the form of stock and

capital performance to be either a reduction of working capital[128] from one year to the next or a low working capital level in any given year relative to industry peers. Their baseline argumentation goes as follows: A disciplined management of working capital, i.e. eliminating excess inventory, improving collections from customers, and negotiating favourable payment terms with suppliers, typically proves difficult.[129] This holds true not only because a disciplined working capital management demands serious attention and coordination among different functional group within an organization, as already mentioned earlier in this thesis. Another reason Aktas et al. (2015a) bring forward is that managing working capital in a disciplined manner barely draws media attention that is personally beneficial to those managers involved.[130] Given the above, and in accordance with the traditional recognition in economics and finance that managerial compensation represents an internal governance tool,[131] managers ought to be given the right incentives so that their interests are aligned with those of shareholders. Otherwise, the managers' preferences for the 'quiet life' may lead them to avoid personally challenging decisions and effort in managing resources.[132] This, following the results obtained by Aktas et al. (2015a), also holds true for corporate resources allocated to working capital. Indeed, the authors provide empirical evidence of a significant sensitivity of short-term bonus payments to working capital performance.[133] Interestingly, inventories and accounts payables are those

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options as the different components of compensation), α_j and α_t are, respectively, firm and year fixed effects. NWC_{jt} represents net working capital scaled by sales and adjusted for the median net working capital ratio in the industry, following the 49 Fama-French industry definitions. β measures the strength of compensation incentives for improving working capital performance: A negative value for β provides an indication that managers are rewarded for reductions in the level of working capital. X_{jt} represents a matrix of control variables that include time-varying firm characteristics as well as performance measures and ε_{ijt} represents an error term.
The second specification is estimated by replacing firm and year fixed effects by industry fixed effects, thus using a regression equation taking the form:

(ii) $$Y_{ijt} = \alpha_{kt} + \beta \times NWC_{jt} + \gamma \times X_{jt} + \varepsilon_{ijt},$$

where α_{kt} are industry fixed effects. In this setting, a negative value for the regression coefficient β indicates that managers are being rewarded for operating with a lower working capital level relative to industry peers faced with similar market conditions.

[128] Aktas et al. (2015a) use net working capital, defined as *Inventories + Receivables – Payables*, as they argue that "*shareholders care about net resource commitments to working capital*" (p. 8)

[129] See Ek & Guerin (2011)

[130] See Malmendier & Tate (2009). Moreover, Holmström (1999) argues that success or failure in the context of working capital management is unlikely to be a source of reputational motivation for managers.

[131] See Jensen & Meckling (1976)

[132] See Hicks (1935) and Bertrand & Mullainathan (2003)

[133] Salary and equity-based compensation, the other components of executive compensation considered by Aktas et al. (2015a), display little to no sensitivity to working capital performance.

components of working capital that account for the largest contribution on executive bonus payments. Other interesting results of the study of Aktas et al. (2015a) are that (i) executives of firms facing financial constraints are been given strong incentives to maintain working capital at a low level relative to industry peers. This result is consistent with large benefits from a disciplined management of working capital for such firms, and that (ii) the executives of firms facing a lower exposure to external threats of being taken over are being granted stronger working capital incentives. As an implication for policy, I can note that Aktas et al. (2015a) conclude their study by highlighting the importance of short-term bonuses in executive compensation and suggesting that "*[r]ewards based on performance metrics such as net working capital, which managers know with high precision how their actions will affect, may guide managerial behavior more efficiently than rewards based solely on stock prices*" (Aktas et al., 2015a, p. 22)

Another noteworthy article[134] relating working capital management efficiency to corporate governance is that of Gill & Biger (2013), in which the authors focus on empirically documenting the impact of corporate governance characteristics, such as CEO tenure & duality, board size, and audit committee on the efficiency of WCM[135] in the case of American manufacturing firms, while controlling for other firm-specific factors such as its sales growth pattern, its size, its performance, and whether it operates internationally.[136] Although the empirical approach used by Gill & Biger (2013) uncovers significant linkages between characteristics of corporate governance and different measure of working capital

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[134] Other empirical studies looking at the association of the quality of corporate governance with the efficiency of working capital management are those by Palombini & Nakamura (2012), Achchutan & Kajanathan (2013), Goel et al. (2015) and Jamalinesari & Soheili (2015), who focus on the Brazilian, Sri Lankan, Indian and Iranian markets respectively.

[135] Gill & Biger (2013) use the following commonly used variables to express working capital efficiency: (i) accounts receivable, measured as (accounts receivables/sales) x 365 days, (ii) inventory, measures as (inventory/costs of goods sold) x 365 days, (iii) accounts payable, measured as (accounts payable/costs of goods sold) x 365 days, (iv) the cash conversion cycle (CCC), measured as (i) + (ii) - (iii), (v) the cash holdings, measured as the log of average cash, (vi) the current ratio, measured as current assets/current liabilities, and (vii) the cash conversion efficiency, measured as cash flow from operations/sales.

[136] The regression equations take the form $X_{i,t} = \alpha + \beta_1 TN_{i,t} + \beta_2 CD_{i,t} + \beta_3 BS_{i,t} + \beta_4 AC_{i,t} + \mu_{i,t}$, where X is one of the seven variables defined in the previous footnote, *TN* is the CEO tenure, measured as the number of years serving as a CEO, *CD* is the CEO duality, taking the value 1 if the same person occupies the post of CEO and chairman of the board, 0 otherwise, *BS* is the board size, measured as the number of directors serving on the board, *AC* is the audit committee, measured as the number of audit committee members. The control variables are the sales growth, measured as (current year sales – previous year sales)/previous year sales, the internationalization of the firm, taking value 1 if the firm is international and 0 otherwise, the firm size, measured by the log of average assets, and the firm performance, measured as the net income after tax/revenue.

management efficiency[137], a limitation of their research design is that a clear causal inference (i.e. good corporate governance improves the efficiency of WCM) can not necessarily be established. They however offer the following conjectures as to the reasons that could justify such a causality: they argue that poor corporate governance leads to inefficient WCM policies, ultimately affecting shareholders' wealth negatively. It should be noted that Gill & Biger (2013), in contrast to Kieschnick et al (2006), consider the efficient use of cash for daily operational purposes as essential in the management of working capital, and that poor corporate governance may lead to the accumulation of unnecessary financial slack[138] and in turn not only adversely affects the cash management,[139] but ultimately the management of inventories, accounts receivable, and accounts payable, all of which are key components of WCM. This calls for a strong corporate governance to avoid this problem. More specifically, Gill & Biger (2013) emphasize the role of CEO duality,[140] board size,[141] and audit committee[142] in improving the efficiency of working capital management. For my own purposes, controlling for CEO duality is unnecessary as there is no such thing as CEO duality in Germany. Furthermore, since the size of a board of a German corporation is tightly regulated in the §7 MitbestG (Co-determination act), the direct implications for policy deriving from the study of Gill & Biger (2013) with regards to the board size are limited. Finally, forming audit committees as a governance tool geared, among other objectives,

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[137] Gill & Biger (2013) provide, among other (significant) results, significant evidence of: (i) a positive (negative) relationship between internationalization (board size) and the cash conversion cycle, (ii) a positive relationship between the current ratio and CEO duality, firm size and financial performance respectively and a negative relationship between the current ratio and board size, and (iii) a positive relationship between both CEO duality and financial performance on the cash conversion efficiency. Other results, though significant, are omitted here as I focus on an integrative view of working capital management.

[138] Maintaining unnecessary high levels of financial slack may be a result of a risk-aversion by a firm's management, thus leading to an agency problem as the interests of both the CEO and the board of directors are not geared towards the maximization of shareholders' wealth. (see Gill & Shah, 2012)

[139] Following Harford et al. (2008)

[140] Gill & Shah (2012) argue that CEO duality is useful in maintaining a convenient level of working capital and can thus enhance WCM efficiency: Although, as argued by Fama & Jenson (1983), a board's effectiveness in monitoring top management is thwarted when decision management and control are concentrated in one individual, Rechner & Dalton (1991) argue that when a CEO is also the board's chair, it gives him the opportunity to take decisions and undertake projects without being influenced excessively by bureaucratic structures. (see Gill & Biger, 2013)

[141] Both Lipton & Lorsch (1992) and Yermack (1996) suggest that a large board of directors is less effective in the decision-making process than a small board of directors. (see Gill & Biger, 2013)

[142] Kyereboah-Coleman (2007) argues that the role of an audit committee is to improve the quality of a firm's financial management by serving as an additional internal governance mechanism. Its independence is said to be improved when it is composed of at least three members. In turn, an independent audit committee, the function of which is to audit cash accounts, accounts receivable, accounts payable as well as inventory accounts, can reduce agency problems and costs and thus contribute to improving the efficiency of working capital management. (see Gill & Biger, 2013)

towards achieving more efficient WCM policies might be very useful when the goal is to achieve a sustainable working capital management that maximizes shareholder value. Köhler (2005, p. 230), in her survey-based study of characteristics of German audit committees, has noted that "*due to its institutional and legal setting*[143]*, audit committee formation in Germany is quasi mandatory […] in the sense that stakeholders of a company perceive noncompliance with the [German Corporate Governance] Code as an adverse signal. Therefore, […] Supervisory Board members have no 'free' choice*" with regards to the formation of an audit committee. She also draws the interesting conclusion that while German audit committees seemingly have a great potential to enhance both the efficiency and effectiveness of monitoring, they exhibit an extreme diversity with regards to their member characteristics as well as to their responsibilities. The question that follows from this conclusion is whether the mere fact of having an audit committee up and running sends the right signal to the capital market that an efficient decision-making process with regards to, among other aspects, working capital management, is in place, or rather whether audit committees, at their own discretion, should define specific duties and responsibilities geared towards, among other things, elaborating an integrative and sustainable working capital management framework the ultimate goal of which would be to contribute to shareholder value maximization.

6. Fathoming the Year-End Working Capital Decline[144]

Given that financial analysts monitor levels of working capital for the sake of foreseeing the future profitability of firms,[145] it is reasonable to expect an inclination from the part of managers to "*exert effort to reduce working capital at times where working capital levels draw the most attention*" (Frankel et al., 2016, p.1), especially since lower working capital levels, *ceteris paribus*, are generally understood as an indication of a firm's greater

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[143] Section 5.3.2 of the German Corporate Governance Code, (as amended on May 5, 2015, p. 10) states that *"[t]he Supervisory Board shall set up an Audit Committee which – in so far as no other committee is entrusted with this work -, in particular, handles the monitoring of the accounting process, the effectiveness of the internal control system, risk management system and internal audit system, the audit of the Annual Financial Statements, here in particular the independence of the auditor, the services rendered additionally by the auditor, the issuing of the audit mandate to the auditor, the determination of auditing focal points and the fee agreement, and compliance. The chairman of the Audit Committee shall have specialist knowledge and experience in the application of accounting principles and internal control processes. He shall be independent and not be a former member of the Management Board of the company whose appointment ended less than two years ago*"

[144] See Frankel et al. (2016)

[145] See Pulliam, 2004

operational efficiency. Besides, a handful of academic and anecdotal evidence exists[146] pointing to a greater attention on fiscal year rather than quarterly measurements. Taking that into consideration, Frankel et al. (2016) conjecture a higher focus by managers on levels of working capital at fiscal year-end compared to any other fiscal quarter-end. They provide evidence of a significant temporary decrease of fourth fiscal quarter levels of working capital, beyond what may be justified by seasonal changes in a firm's economic activity. This decrease is immediately being reversed in the first quarter of the following fiscal year. Their evidence also confirms that firms manage the fiscal year-end understatement in the level of working capital through the medium of actions geared at increasing year-end operating cash-flow (as opposed to actions aimed at reducing income through accruals).[147] Interestingly, Frankel et al. (2016, p. 20) show that "*[a] nontrivial portion of the temporary decrease and the subsequent reversal is explained by incentives originating in bonus contracts and the horizon of analyst cash flow forecasts and by firms' ability to extract the concessions from business partners.*"

6.1. Hypotheses Development

To help the reader better understand and interpret the last statement, I ought to provide a brief display of the model specified by Frankel et al. (2016). They begin by setting the following hypotheses:

Hypothesis H1 – Year-end working capital management:

"*Noncash working capital decreases significantly between the third and fourth quarters and subsequently increases significantly between the fourth quarter of a fiscal year and the first quarter of the following fiscal year.*" (Frankel et al., 2016, p. 4)

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[146] See, among others, Givoly & Ronen (1981), Jacob & Jorgensen (2007), Das et al. (2009), and Fan et al. (2010) for academic studies, and White et al. (2003), Palepu & Healey (2008), and Penman (2010) for popular texts relating to financial statement analysis in which quarterly numbers are seldom used. (Frankel et al., 2016)

[147] Frankel et al. (2016) identify two methods of reducing working capital levels: by the means of accrual based working capital management, i.e. a set of actions geared at reducing income through accruals, such as writing down inventories or overstating bad debt, and by the means of cash flow-based working capital management, i.e. a set of actions geared at increasing cash flow from operations, such as expediting the collection of account receivables from customers or putting off payments to suppliers. While the former results in a reduction of shareholder equity and therefore total assets (used as the denominator in measuring operational efficiency), the latter shifts funds from the working capital to the cash account and has no effect on total assets. Moreover, the cash flow-based method is more consistent with a perceived increase in efficiency.

Hypothesis H2A – Compensation contracts:

"*The temporary fourth-quarter decrease in noncash working capital is accentuated for firms that use cash flow/working capital based measures to evaluate managers' performance for compensation.*" (Frankel et al., 2016, p. 4)

Hypothesis H2B – Analysts cash flow forecast horizon:

"*The temporary fourth-quarter decrease in working capital is larger when the number of analysts issuing annual cash flow forecasts is greater than the number of analysts issuing quarterly cash flow forecasts for the firm*" (Frankel et al., 2016, p. 5)

Hypothesis H2C – Firm market power:

"*The temporary fourth-quarter decrease in working capital increases with the market power of the firm*" (Frankel et al., 2016, p. 5)

With regards to the rationale underlying the first above-mentioned hypothesis (H1), it is grounded on the results from previous research that identified instances of *window-dressing*, i.e. the manipulation of reported financial figures, through the management of reported cash flows, such as Brown & Caylor (2005), Lee (2012), and Gordon et al. (2013).[148] Specifically, Lee (2012) explores situations in which a firm might be exposed to – such as distress, having its debt rated near the investment-grade threshold, having its cash-flows forecasted by analysts or for which a high correlation is apparent between its stock performance and operating cash flows. He identifies such situations to represent incentives for managers to manipulate the reported operating cash flow levels. Besides, Frankel et al. (2016) interestingly expose the minutes of a conference call between Ed Pliner, CFO and senior vice president of Raytheon Company, and George Shapiro, analyst at Solomon Smith Barney,[149] which not only exemplifies the attention given by both managers and analysts to components of working capital as a tool to evaluate firm performance, but also underscores

[148] These studies provide evidence of the manipulation of reported figures *beyond* earnings. Other studies cited by Frankel et al. (2016) document the manipulation of earnings using either accruals, e.g. DeFond & Jiambalvo (1994), Jones (1991), McNichols & Wilson (1988), and Healy (1985), or through real activities, i.e. by linking actions that are likely inefficient to achieve earnings goals, e.g. Levy & Shalev (2016), Lemayian (2013), Cohen & Zarowin (2010), Cohen et al. (2008), Roychowdhury (2006), Bushee (1998), and Baber et al. (1991).

[149] See *FD Wire*, 2004

the prioritization on the fiscal year-end. Frankel et al. (2016, p. 3) summarize that exchange by stressing that "*[t]hough Pliner rejects Shapiro's characterization of Raytheon's activities as window dressing of working capital accounts, he acknowledges a recurring focus on year-end accounts receivable balances and […] that one of the reasons for this is to improve fourth-quarter cash flow performance.*"

With respect to the hypothesis H2A, Frankel et al. (2016) establish it as an explanation regarding why managers may have the incentive to increase the fiscal year-end levels of operating cash-flows. Such conjectures are realistic as, on the one hand, executive pay is customarily based on a firm's full fiscal-year performance.[150] On the other hand, an increasing tendency to use performance measures in CEO bonus plans linked to cash-flow figures[151] and even, for some firms, to changes in annual noncash working capital[152] has been documented. Taken together, since executive compensation contracts that include fixed and variable components are negotiated under the consideration of annual performance, managers may be inclined to curtail working capital levels or artificially inflate reported fourth quarter operating cash flow figures as this may induce higher current pay.

The rationale behind hypothesis H2B set forward by Frankel et al. (2016) is inspired by the results of the following few studies. First, DeFond & Huang (2003) document that the increasing popularity of operating cash flow in the evaluation of the performance of a firm leads more and more analysts to issue forecasts of cash flow. Although there is no consensus among academics as to the economic meaningfulness of cash flow forecasts,[153] Lee (2012) provides interesting evidence that the issuance of such analysts' forecasts for a firm is associated with a tendency of that firm to manage operating cash flow in an upward fashion. Given that, Frankel et al. (2016) suggest that if analysts' cash flow forecasts indeed serve as incentives to manage the cash flow from operations, such forecasts, when they are issued annually rather than quarterly, represent a stronger enticement for managers to aim their attention at the fiscal year-end. Hence, "*when analysts predominantly issue annual cash flow forecasts, firms are more likely to try to increase fourth fiscal quarter operating cash flow. These efforts to increase fourth fiscal quarter operating cash-flows result in a temporary decrease in fourth fiscal quarter working capital.*" (Frankel et al., 2016, p. 4)

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[150] See Holthausen et al. (1995)

[151] See Huang et al. (2014), Shalev et al. (2013), Perry & Zenner (2001), and Murphy (2000)

[152] See Banker et al. (2004)

[153] See Frankel et al. (2016)

Finally, the motivation Frankel et al. (2016) advance for their last hypothesis, H2C, is straightforward: any action geared towards reducing levels of working capital without altering income, such as speeding up the collection of receivables from customers, postponing the purchase of inventory and/or delaying settlement of payables to suppliers, forces costs upon business counterparts. These costs can be reflected in a reduction of these counterparts' cash flow, delays in the delivery of their products or involuntary changes in their schedules of production. It is therefore not unrealistic to assume that the more market power a firm enjoys, the more likely it will be able to disrupt its business counterparts when performing such actions. I can already mention at this point that Frankel et al. (2016), who measure a firm's dominance in its industry as the firm's share of the total sales of its four-digit Standard Industrial Classification (SIC) code industry, indeed provide evidence in corroboration of this hypothesis.

It is interesting to note that Frankel et al. (2016) define working capital rather broadly as current assets net of cash minus current liabilities net of current portion of long-term debt (i.e. current assets – cash – current liabilities + current portion of long-term debt).[154] They justify their choice of such a measure by contending that managers, in their efforts to persuade shareholders that their goal is the maximization of value creation, aim at minimizing the "excess" reported invested capital and at maximizing the cash flow from operations.

6.2. Defining the Baseline Regression Model

Let me now expose to the reader how Frankel et al. (2016) go upon to test their hypotheses. Their baseline regression model takes the following form:

$$\Delta WC_q = \beta_0 + \beta_1 Q4_q + \beta_2 Q1_q + \beta_3 NI_q + \beta_{4-10}\Delta SALES_{q-4,q+2} + \beta_{11-17}\Delta NI_{q-4,q+2} + \beta_{18-20}WC_{q-4,q-2} + \varepsilon_q,$$

where WC_q represents working capital in quarter q, as defined above and deflated by total assets at the end of quarter q, ΔWC_q represents the change in the ratio of working capital to total assets between quarter $q - 1$ and quarter q, $Q4_q$ and $Q1_q$ represent dummy variables

[154] This measure is analogous to that employed by Sloan (1996), with the difference that taxes payable, which can be interpreted as a kind of noninterest-bearing debt, are not being deducted by Frankel et al. (2016).

equal to 1 when the quarter is the fourth quarter and first quarter respectively, and 0 otherwise, NI_q represents the ratio of net income to total assets in quarter q, $\Delta SALES_q$ represents the change of the ratio of sales to total assets between quarter $q-1$ and quarter q, ΔNI_q represents the difference in the ratio of net income to total assets between quarter $q-1$ and quarter q, and ε_q represents the error term.

As can be seen from the regression equation set out above, Frankel et al. (2016) consider variables for lagged levels of working capital as well as both lead and lagged variables for net income and sales. This allows them to identify and isolate abnormal changes in levels of working capital at the end of the fiscal-year, i.e. only those changes that are not related to seasonality in a firm's levels of activity.[155]

6.3. Relevant Empirical Results and Economic Interpretation

6.3.1. Evidence of the Temporary Year-End Working Capital Decline

Let me now present some of the more relevant results obtained by Frankel et al. (2016): Including the dummy variables $Q4_q$ and $Q1_q$ in their regression model allow Frankel et al. (2016) to test and corroborate hypothesis H1: indeed, they estimate a combination of a significant negative coefficient β_1 together with a significant positive coefficient β_2. In other words, they document a significant decrease in the level of working capital between the third and the fourth quarter of a fiscal year together with a significant subsequent increase of the same between the fourth quarter and the first quarter of the following fiscal year. It should be noted that Frankel et al. (2016) observe this pattern (decrease in fourth quarter – increase in subsequent first quarter) in nearly 40% of the firms in their sample, a result that is, besides, significantly higher than would be expected by mere chance (25%).[156]

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[155] Frankel et al. (2016) provide the example of firms for which sales are concentrated in the fourth quarter. They argue that these firms will probably sustain higher levels of inventory at the end of the third quarter, whereas the levels of inventory at the end of the fourth quarter are likely to drop. *Ceteris paribus*, these changes in inventory levels would be reflected in an increase in the level of working capital from the ends of the second to the third quarters as well as a decrease in the level of working capital from the ends of the third to the fourth quarters. Though the relationship between levels of income and actions that trigger changes in working capital levels is less straightforward, the authors nonetheless consider the effect of changes in levels of activity on all earning components in their regression model. This, they argue, is indispensable when a vast range of seasonal effect is to be excluded in modelling working capital changes. Moreover, it enables to effectively control, though not in a perfect manner, for manipulations of working capital involving accrual-based actions such as the writing down inventory or the overstating of bad debt expense.

[156] Considering four possible sequences of changes in working capital levels in the fourth quarter and the first quarter of the following year, i.e. increase – increase, increase – decrease, decrease – increase, and decrease – decrease. (See Frankel et al., 2016)

Other results the authors obtain from estimating the baseline model suggest changes in the level of sales in current and subsequent periods to be significantly positively related to current period changes in working capital levels. Changes in the level of sales taking place in the preceding quarter, on the other hand, are significantly negatively related to changes in the current levels of working capital. These results are consistent with the expected actions of managers with respect to seasonal variation in economic activity, e.g. the building-up of inventory in the current quarter in response to an anticipation of higher sales in subsequent quarters. In contrast, Frankel et al. (2016) identify a negative relation between changes in net income and changes in working capital in lead quarters, implying that current quarter increases in levels of working capital are linked with a decline in profitability.

Frankel et al. (2016) dig even deeper in their aim at corroborating their prediction of managers' endeavour to manage year-end levels of working capital: They do so by decomposing the working capital in its components,[157] and estimating the model set out above (see subsection 6.2.) using the changes in the ratios of each component of working capital to total assets between quarter $q - 1$ and quarter q as dependent variables. The motivation behind this, Frankel et al. (2016, p.9) argue, is that managers who seek to manipulate year-end levels of working capital might presumably conceal their actions by "*diffusing adjustments across the working capital accounts. Small changes in each working capital account that subsequently reverse can elude detection by investors and may be perceived as inconsequential by managers.*" The results they obtain when decomposing working capital into its components and estimating the regression are significant, albeit small,[158] for all working capital accounts, except for *other current liabilities,* in the direction they expect.[159]

Hence, it appears that firms dedicate supplementary effort in the fourth fiscal quarter to collect receivables from customers while at the same time delaying payments to suppliers. Given that the latter is purportedly the most aggressive method associated with the highest

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[157] Namely accounts receivable, inventory, accounts payable as well as other noncash current assets and other current liabilities net of the current portion of long-term debt.

[158] Although the magnitude of the fourth-quarter effects obtained by Frankel et al. (2016) are relatively small (given that working capital as defined by the authors nets three asset accounts and two liabilities accounts), making even small alterations to individual working capital accounts aggregates to a significant effect.

[159] Estimating the regression model using changes in the ratios of components of working capital to total assets naturally changes the expected signs for the coefficients of the dummy variables $Q4_q$ and $Q1_q$ depending on whether changes in an asset or a liability is estimated. For instance, while Frankel et al. (2016) expect accounts payable to increase – leading to a decrease in working capital - in the fourth quarter and to decrease in the subsequent first quarter, they logically expect accounts receivable to decrease in the fourth quarter and increase in the subsequent first quarter.

cost with respect to suppliers, and that it is not possible to manage account payables rigorously through accruals, the results of the regressions using the change in the working capital accounts as dependent variables provided by Frankel et al. (2016) represent "*clear evidence that firms manage working capital downward through transactions that also increase operating cash flow.*" (Frankel et al., 2016, p. 9)

6.3.2. Identifying the Factors Influencing the Year-End Working Capital Decline

In a second step, Frankel et al. (2016) identify those factors (other than seasonality) they believe have an influence on the managers' tendency to follow actions that translate in temporarily decreasing the fourth fiscal quarter level of working capital. They then carry out cross-sectional analyses for the sake of corroborating their hypotheses H2A and H2B. Their attention is aimed at two kinds of incentives: The first is related to CEO bonus schemes and the second to analysts' cash flow forecasts horizon.

6.3.2.1. CEO Bonus Schemes

Following the rationale grounded in their hypothesis H2A, Frankel et al. (2016) investigate a subset of firms disclosing the weights assigned to cash flow- and/or working capital-based measures of performance in CEO bonus schemes.[160] They observe a steady increase over the period 1994 to 2010 in the number of firms that disclose such weights,[161] with a pronounced increase after 2007 due to the 2006 U.S. Securities and Exchange Commission executive compensation publication obligations. Additionally, they provide statistics of within-firm changes over time in the weight given to cash flow- and working capital-based measures of performance. This allows the authors to gauge if these changes over time raise or reduce a manager's incentive to borrow cash from the future. Indeed, as argued by Frankel et al. (2016, p. 12), since the fourth fiscal quarter reduction in working capital is being reversed in the subsequent first quarter, "*managers who actively increase cash-flow at year-end t simply borrow cash from year t+1. An incentive to borrow from the future exists because of the time value of money or because the manager may lose her job. […] Evidence that, conditional on a positive weight on cash flow/working capital at year t, the weight is more likely to go down (up) than up (down) at year t+1 would suggest an increased (reduced) incentive to borrow cash from the following year.*" Given that argumentation and from the

[160] Performance measures based on working capital may include such measures based only on a single account of working capital. (See Frankel et al., 2016)

[161] According to the statistics presented by Frankel et al. (2016), that number goes from 33 firms in 1994 to 669 firms in 2010.

observations of the authors,[162] they conclude that the highly probable weight decline coupled with the discrepancy in size between weight declines and weight increments could entice managers to switch future cash flows to the current period.

With respect to the regression analysis, Frankel et al. (2016) test and corroborate the hypothesis H2A by including a dummy variable in the baseline regression model taking the value 1 when a positive weight on cash flow/working capital-based performance measure is included in the bonus scheme of the CEO and 0 otherwise. Moreover, this binary variable is being interacted with the variables $Q4_q$ and $Q1_q$ and the two variables obtained from that interaction are added to the regression model. Doing so allows the authors to provide evidence that the inclusion of a performance measure based on cash flow or working capital is associated with a temporary decline in the fourth quarter level of working capital that is 75% greater than when no such measure is included. Furthermore, their results show that 43% of the temporary fourth quarter reduction in levels of working is explained by the presence of a cash flow- or working capital-based performance measure in the CEO bonus scheme in the subsample of firms which disclose performance-measure weights.[163]

6.3.2.2. Analysts' Cash Flow Forecast Horizon

To test and corroborate hypothesis H2B, Frankel et al. (2016, p. 12) use a subsample of firms for which cash flow forecasts exist and design a dummy variable taking "*the value 1 if the number of analysts issuing annual forecasts is equal to or greater than the number of analysts only issuing quarterly forecasts and 0 otherwise.*" The authors also interact this variable with the variables $Q4_q$ and $Q1_q$ and anticipate a more conspicuous temporary decline in the fourth quarter levels of working capital for the interaction variables. The results reported by the authors advocate that the magnitude of the decline in fourth fiscal

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[162] From the analysis of the observations on the change between year *t* and year *t+1* in the weight given to cash flow or working-capital conditional on positive weight on cash flow/working capital in year *t* (see Frankel et al., 2016, Panel B of Table 5, p. 11), the authors deduct that the likelihood of a reduction in the subsequent year of the weight on cash flow/working capital performance measures in bonus plans is more than twice that of an increase in the same.

[163] Given that measures of performance in CEO bonus schemes may be related to firm characteristics that correlate with changes in components of working capital over time, Frankel et al. (2016) follow the one-to-one nearest neighbour propensity-score matching technique developed by Heckmann et al. (1997) for the sake of matching each firm disclosing a positive weight assigned to cash flow/working capital performance measures (taken from the treatment group) with a firm disclosing zero weight (taken from the control group). The first-stage regression Frankel et al. (2016) estimate includes variables, i.e. firm size, leverage, market-to-book ratio and industry, that have been documented to explain disparities in compensation plans (e.g. De Angelis & Grinstein, 2015), as well as variables aimed at capturing the noise in earnings and cash flow, i.e. earnings volatility and cash flow volatility. Frankel et al. (2016) reasonably expect the latter variables to be linked to variations in working capital levels. The results Frankel et al. (2016) obtain are consistent with their previous finding.

quarter levels of working capital is lessened when analysts' cash flow forecasts shift toward a quarterly horizon.

6.4. Implications for Policy

The reason I have spilled much ink presenting the study of Frankel et al. (2016) is that its findings shed light on several issues that have been mostly ignored, let alone neglected in all previous studies of working capital management. Let me briefly recapitulate the main findings: First, levels of working capital decrease significantly in the last quarter of the fiscal year. This decrease goes beyond what may be explained by seasonal changes in a firm's economic activity. Second, there is a subsequent reversal of working capital levels in the first quarter of the following fiscal year. Third, this manipulation of working capital levels in the fourth fiscal quarter and subsequent first quarter of the following year is, for a non-negligible part, a result of incentives emanating from the design of CEO bonus schemes, the analysts' cash flow forecasts horizon as well as from the capacity of a firm to reap concessions from business counterparts. "*Finally*, *the relatively small temporary decrease exhibited by the major assets and liabilities composing a firm's working capital […] suggest that working capital management can go undetected by investors, even though the aggregate effect of the changes on working capital and operating cash flow can be significant*." (Frankel et al., 2016, p. 20)

Moreover, the findings enumerated above have profound implications for working capital management policy, specifically when the management of working capital is required to be sustainable, geared towards maximizing shareholder value and manipulation-proof: The most realistic way to achieve that goal would be to design CEO compensation contracts in such a way as to weaken the incentives to manipulate levels of working capital, for instance by considering such measures on a quarterly base. This policy implication is, by the way, also compatible with the findings of Aktas et al. (2015a) I presented in section 5.2. of this thesis. Au contraire, forcing the trend among analysts to switch their focus toward a quarterly horizon when forecasting cash flow or breaking up market power appears indeed quite unrealistic.

I should note here that although I have spent much time on sections 5 and 6 for the sake of completeness, the issues of corporate governance and managerial incentivization with respect to WCM will not be considered in the second part of this thesis, as doing so would go beyond the scope of my capabilities in terms of both workload and availability of data.

PART TWO

7. Working Capital Management and Profitability

As previously announced, I now turn the attention first to studies that investigate the relation between working capital management and profitability, be it only to get a better understanding of the research designs commonly used to that end and of their limitations. Since a plethora of studies covering that specific research area exist, I will focus only on the most prominent ones and decorticate the research designs adopted in these. Apart from the study by Shin & Soenen (1998), which is one of the first[164] and most cited studies investigating the link between efficient working capital management and corporate profitability,[165] and whose large data sample covers U.S. listed companies for the period 1975-1994, the other studies I present in this section exclusively work on samples covering financial data of companies headquartered in Europe, i.e. Belgium (Deloof, 2003), Greece (Lazaridis & Tryfonidis, 2006) and Spain (García-Teruel & Martínez-Solano, 2007, and Baños-Caballero et al., 2012 & 2014).

7.1. Shin & Soenen (1998)

7.1.1. Variables under Study

As already mentioned earlier in this thesis (See subsection 2.3.5.), Shin & Soenen (1998) employ the net trade cycle (NTC) as a measure of working capital management efficiency.[166] They measure a firm's profitability using operating income plus depreciation, whereas they scale it by total assets (i.e. IA = [operating income + depreciation]/total assets) as well as by net sales (i.e. IS = [operating income + depreciation]/net sales). Furthermore, they consider

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[164] An earlier study is that by Jose et al. (1996). In that study, the authors investigate, applying both nonparametric and multiple regression analysis on a large cross-section of firms over a twenty-year period, the link between alternative measures of profitability and the cash conversion cycle as proxy for the management of a firm's ongoing liquidity needs. Both industry and size are controlled for in their analysis. They provide strong evidence of a profitability enhancing effect of aggressive working capital policies, although documenting exceptions for specific firms and industries. However, given that it is not nearly as often referred to in subsequent research related to working capital management as is the study of Shin & Soenen (1998), I refrain from presenting it in detail.

[165] Another prominent study is that of Wang (2002), covering Japanese and Taiwanese firms, in which the methodology used by Jose et al. (1996) is applied. Specifically, operating returns on assets and pre-tax returns on equity are used as measures of operating performance. In addition, Wang (2002) uses Tobin's *q* as proxy for corporate value and controls for industry influences. Besides providing evidence of a significant negative relationship between both measures of operating performance and the cash conversion cycle, Wang (2002) documents aggressive liquidity management to be associated with higher corporate value.

[166] The reader should refer to subsection 2.3.5. of this thesis for the formal definition.

Jensen's Alpha (ALPHA)[167] as well as the Treynor Index (TI)[168] as risk-adjusted measures of stock returns. The current ratio (CR), the ratio of total debt to total assets (DR) as well as the sales growth (SG) are used as control variables. Calculating both Pearson's *r* correlation and Spearman rank correlation coefficients[169] for the level and first differences in variables allows Shin & Soenen (1998) to document a significant negative relationship between the net trade cycle and the measures of corporate profitability and risk-adjusted stock returns respectively. Therefore, this indicates that a shorter trade cycle is generally associated with a higher corporate profitability and suggests that reducing working capital leads to an increase in the risk-adjusted stock returns. As always, using correlation matrices, while documenting the nature of the relationship between two variables (positive, nil or negative), does not permit any causal inferences.

7.1.2. Regression model

To investigate deeper how both corporate profitability and risk-adjusted stock returns are respectively associated with the length of the net trade cycle, Shin & Soenen (1998) use regression analysis and design the following baseline model:

$$Profitability_t = \beta_0 + \beta_1 * NTC_t + \beta_2 * CR_t + \beta_3 * DR_t + \beta_4 * SG_t$$

Shin & Soenen (1998) first run a series of pooled and year-by-year cross-section regressions of the variable *Profitability* on NTC, CR, DR, and SG using measures of corporate profitability (IA and IS) as well as measures of risk-adjusted stock returns (ALPHA and TI) as dependent variables. They also examine, using first differences, whether year-on-year changes in corporate profitability and risk-adjusted stock returns are influenced by year-on-year changes in the net trade cycle and the other control variables. In a third step, Shin &

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[167] See Jensen, 1968

[168] See Treynor, 1965

[169] In contrast to the widely-used Pearson *r* correlation test measuring the degree of relationship between variables that are assumed to be linearly related, the Spearman rank correlation test, developed by Spearman (1904), is non-parametric in nature and does therefore not make any assumptions regarding the distribution of the data. It is the appropriate correlation analysis tool when the variables are measured on a scale that is at least ordinal. The following formula is used to calculate the Spearman rank correlation coefficient:

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

where ρ is the Spearman rank correlation coefficient, d_i represents the difference between the ranks of corresponding values X_i and Y_i, and n the number of observations in each dataset.

Soenen (1998) take into consideration the industry effect I discussed earlier and regress the risk-adjusted Jensen's ALPHA on the NTC for the eight industries characterized by the largest sample size.

7.1.3. Main Results of Regression Analysis

Shin & Soenen (1998) provide powerful evidence of a negative relationship between the net trade cycle and their proxies for profitability. Their results entail a firm with a relatively short net trade cycle to be both more profitable as well as having a greater risk-adjusted stock return per unit of total risk. Reducing the NTC for the sake of increasing working capital management efficiency, the authors argue, thus represents one potential way for a firm to achieve higher value for shareholders. Besides, the results they obtain hold true even after having the ratio of profits over sales controlled for, as the documented *"negative relation between profits on sales and NTC could be explained by market power or market share, i.e. a shorter NTC because of bargaining power with suppliers and/or customers as well as higher profitability due to market dominance.*" (Shin & Soenen, 1998, p. 41) Not surprisingly, the authors find the profitability to be significantly negatively related to the current ratio, a measure of a firm's liquidity. When regressing the first difference in profitability measures and the first difference in measures of risk-adjusted stock returns respectively on the first difference in the net trade cycle and all other control variables, Shin & Soenen (1998) show the coefficient on *NTC* to be significantly negative in all regressions. In other words, shortening the net trade cycle from one year to the next increases the profitability and the risk-adjusted stock return in the same period. Finally, when considering the industry effect in the regression of Jensen's ALPHA on NTC, the authors document a significant and negative relation between the length of the NTC and Jensen's ALPHA for five out of eight industries. Interestingly, it is the specificities of those three industries for which Shin & Soenen (1998) have found the net trade cycle not to be significantly related with Jensen's ALPHA that explain their results. The communications industry and the oil and gas extraction industry, for instance, display the shortest net trade cycle on average in the sample used by Shin & Soenen (1998). The authors explain this by the relatively low levels of inventory firms belonging to these industries require for their operations. At the same time, these low inventory levels restrain their capacity to shorten the net trade cycle. Similarly, firms belonging to the agricultural production industry are characterized by having, on average, the lowest accounts payable days, meaning that their capacity to shorten the net trade cycle using payables is also limited. In an earlier paper, Soenen (1993) has also demonstrated that the relationship between the net trade cycle and corporate profitability, as

measured by the return on assets, is not consistent for a wide range of industries. It therefore makes much sense to always consider the specificities of each industry with regards to working capital management benchmarks.

7.2. Deloof (2003)

Another often cited empirical study related to the role of working capital management in enhancing a firm's profitability is that of Deloof (2003), who investigates a sample of large Belgian firms. Deloof (2003), who recognizes that a level of working capital that maximizes the value of a firm may exist, summarizes perfectly well the trade-off, mentioned earlier in this thesis, faced by firms when trying to optimize their working capital management. Therefore, I allow myself to reproduce his summary hereafter:

"*On the one hand, large inventory and a generous trade credit policy may lead to higher sales. Larger inventory reduces the risk of a stock-out.*[170] *Trade credit may stimulate sales because it allows customers to assess product quality before paying […].*[171] *Because suppliers may have significant cost advantages over financial institutions in providing credit to their customers, it can also be an inexpensive source of credit to customers […].*[172] *The flip side of granting trade credit and keeping inventories is that money is locked up in working capital.*

Another component of working capital is accounts payable. Delaying payments to suppliers allows a firm to assess the quality of the products bought, and can be an inexpensive source of financing for the firm. On the other hand, late payment of invoices can be very costly if the firm is offered a discount for early payment." (Deloof, 2003, pp. 573-574)

7.2.1. Variables under Study

In contrast with the work of Shin & Soenen (1998), Deloof (2003) uses the cash conversion cycle[173] (CCC) as comprehensive measure of a firm's working capital management. He also

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[170] Stock-outs may cause walkouts, as documented by a study of survey data carried out by Gruen et al. (2003) covering the consumer products industry. In that study, the authors reveal five specific reactions of consumers to stock-outs: "*When they can't find the precise product they're looking for, consumers typically do one of five things. They find a substitute of the same brand, they substitute a different brand, they delay their purchase until the item's back in stock at that particular store, they don't buy the item at all, or, worse for retailers, they buy the item at another store. […] Depending on the product category, […] 21% to 43% [of consumers] will actually go to another store to buy the item*" (Corsten & Gruen, 2004, p. 26)

[171] Deloof (2003) refers here to Long et al. (1993) and Deloof & Jegers (1996)

[172] Deloof (2003) refers here to Petersen & Rajan (1997)

[173] Deloof (2003) performs all regressions using alternatively the net trade cycle as a measure of working capital management as in Shin & Soenen (1998). All results he obtains therewith allegedly confirm the estimation results obtained using the cash conversion cycle in the regressions. Furthermore, due to the unavailability

considers individually each component of the cash conversion cycle, namely the numbers of days accounts receivable, days inventories and days accounts payable[174] as measures of a firm's trade credit and inventory policies. As a measure of a firm's profitability and dependent variable, Deloof (2003) uses its gross operating income scaled by total assets net of financial assets.[175] Interestingly, he does not consider financial assets when scaling a firm's gross operating income. The reason behind this is that financial assets represent a significant chunk of the total assets of several firms in his sample. Considering these financial assets, respectively using return on assets as a measure of profitability, would be misleading as the operating activities of a firm with a relatively large portion of financial assets will not contribute much to the global return on assets. Furthermore, stock market valuation based measures of profitability, such as those used in Shin & Soenen (1998), are not being considered as only a few Belgian firms have their shares publicly listed.

As control variables in his regression analysis, Deloof (2003) considers the size of a firm, proxied by the natural logarithm of its sales, its one-year sales growth, the ratio of its financial debt to its total assets, the ratio of its fixed financial assets[176] to its total assets as well as the variability, or standard deviation, of net operating income [177] scaled by total assets net of financial assets, over the period 1991-1996.

Using Pearson *r* correlation test, Deloof (2003) documents a negative association between his chosen measure of corporate profitability, gross operating income, and all measures of working capital management, namely number of days accounts receivable, inventories and accounts payable as well as cash conversion cycle. Again, although this observation is consistent with the conventional wisdom that decreasing the time lapse between disbursement for raw material purchases and receipt of funds from the sales of finished products leads to an increase in profitability, it does not allow to discern causes from consequences. It may for instance be, as Deloof (2003) correctly points out, that profitability influences accounts payable, and not *vice versa*, in the case of less profitable firms who are believed to take longer to meet their payments obligations towards their suppliers

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of the necessary data, Deloof (2003) is not able to use the weighted cash conversion cycle developed by Gentry et al. (1990).

[174] The reader should refer to subsection 2.3.5. of this thesis for the respective formal definitions.

[175] Gross operating income = (sales – cost of sales + depreciation & amortisation).

[176] Deloof (2003) defined these assets as loans granted to or participations held in affiliated or other businesses for the sake of contributing on the longer term to the firm's main activities.

[177] Net operating income = (sales – cost of sales)

7.2.2. Regression Model

Deloof (2003) estimates the impact of working capital management on corporate profitability using fixed effects as well as ordinary least squares (OLS) regression models. Using a fixed effects regression model allows Deloof (2003) to seize the impact of those variables of interest that are firm-specific and stable over time, thereby focusing on differences within firms. In principle, estimating the fixed effects model is performed by first calculating each variable's mean for each firm, then subtracting from each variable the obtained firm means and finally running the regression on the mean-adjusted variables. Thus, estimation using fixed effects explains variations in the variables from their firm-specific means, not why firm means diverge from one another. Fixed effects estimation however comes with a disadvantage as it wipes out from the model anything time-invariant. Thus, the variability of net operating income over the period 1991-1996 cannot be considered in the fixed effects model.

On the other hand, using common OLS regressions in estimating the influence on profitability of working capital management allows Deloof (2003) to consider the standard deviation of net operating income over the period 1991-1996 together with all other variables already considered in the fixed effects model. In addition, Deloof (2003) includes 4 year dummies as well as 37 industry dummies in the OLS-regression.

7.2.3. Main Results of Regression Analysis

Table 1 on next page summarizes the estimation results Deloof (2003) obtains from the fixed effects and standard OLS regressions he runs. The standard errors, or *p*-values, given in parenthesis, are computed using White's heteroskedasticity correction in all his regressions. For the sake of completeness, I should note that the author uses balanced panel data consisting of 5,045 firm-year observations related to 1,009 large Belgian non-financial firms covering the period 1992-1996 period. I purposely present all the results of his regressions, as opposed to those of other studies, to illustrate to the reader how the choice of a regression technique can greatly affect the explanatory power of the underlying models. Indeed, the adjusted R^2 values of the fixed effects regressions are much higher than in the case of the OLS regressions, meaning that "*[t]he regression models explain a much higher portion of*

Dependent Variable:	*Gross Operating Income*							
Regression Model:	*Fixed Effects*				*OLS with Industry and Year Dummies*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ln (Sales)	0.045	0.048	0.044	0.051	0.006	0.007	0.007	0.006
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
Sales growth	0.016	0.015	0.017	0.015	0.052	0.053	0.053	0.052
	(0.005)	(0.008)	(0.004)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)
Financial debt	-0.151	-0.153	-0.175	-0.154	-0.030	-0.034	-0.041	-0.026
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Fixed financial assets	0.147	0.158	0.158	0.161	0.141	0.142	0.146	0.138
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Variability	-	-	-	-	0.277	0.322	0.321	0.305
					(0.000)	(0.000)	(0.000)	(0.000)
Days accounts receivable	-0.48	-	-	-	-0.44	-	-	-
	10^{-3}				10^{-3}			
	(0.000)				(0.000)			
Days inventories	-	-0.12	-		-	-0.25	-	-
		10^{-3}				10^{-3}		
		(0.015)				(0.000)		
Days accounts payable	-	-	-0.54		-	-	-0.22	-
			10^{-3}				10^{-3}	
			(0.000)				(0.000)	
Cash conversion cycle	-	-	-	-0.17	-	-	-	-0.27
				10^{-4}				10^{-3}
				(0.668)				(0.000)
Adjusted R^2	0.73	0.72	0.73	0.72	0.22	0.22	0.21	0.22

Table 1: The Determinants of Corporate Profitability (Source: Deloof, 2003, pp. 582-583)

*the variations in profitability **within** firms than **between** firms.*" (Deloof, 2003, p. 581)

The main findings in Deloof (2003) are that all the components of the cash conversion cycle display a significant negative relation with gross operating income when using both fixed effects and OLS regression. The coefficient on the cash conversion cycle, although being negative in both the fixed effects and the OLS regressions, is only significantly different from zero in the latter. Other noteworthy and highly significant results the author obtains are a positive association between gross operating profit and firm size (proxied by the natural logarithm of sales), sales growth and fixed financial assets respectively and a negative association between gross operating profit and financial debt. Although the regression methodology used in Deloof (2003) is straightforward and the results of his estimations seem to corroborate conventional wisdom concerning the profitability-enhancing effect of efficient working capital management,[178] the author properly addresses the issue of causality. Putting it in his own words, "*[i]t cannot be ruled out that the negative relation between WCM and profitability is to some extent a consequence of profitability affecting WCM, and not vice versa. Indeed, the most plausible explanation for the negative relation between accounts payable and profitability is that less profitable firms wait longer to pay their bills. A negative relation between inventory and profitability can be caused by declining sales, leading to lower profits and more inventory.*

An alternative explanation for the negative relation between accounts receivables and profitability could be that customers want more time to assess the quality of products they buy from firms with declining profitability. However, finance based models explaining trade credit (e.g. Schwartz, 1974) argue that firms able to obtain funds at a low cost will offer trade credit to firms facing higher financing costs. Emery (1984) sees trade credit as a more profitable short term investment than marketable securities. These models imply that higher profits should lead to more accounts receivable, because firms with higher profits have more cash to lend to customers." (Deloof, 2003, p. 584)

7.3. Lazaridis & Tryfonidis (2006)

Many subsequent studies follow closely the methodology used by Deloof (2003) when investigating the relationship between working capital management and corporate

[178] To avoid any confusion, allow me to remind the reader that an efficient working capital management is believed to be achieved when efforts are undertaken to reduce the chosen measure of working capital management, be it the cash conversion cycle, the weighted cash conversion cycle, the net trade cycle or the cash conversion efficiency.

profitability for firms both listed[179] and non-listed[180] firms in their respective geographical markets of interest. All those studies come to the same conclusion that corporate profitability, however it may be measured based on the balance sheet specificities of the firms in the underlying sample, is significantly negatively associated with working capital management as measured by the cash conversion cycle and/or its components. One such study is that by Lazaridis & Tryfonidis (2006), who base their work on a sample of 131 companies listed in the Athens Stock Exchange and covering the period 2001-2004. Interestingly, their choice to focus on listed firms in Greece, a member country of the European Union, pinpoints to an unusual incentive related to working capital management and to the reliability of financial statements for listed firms. They argue that to increase the attractiveness of their shares, firms listed in the Athens Stock Exchange are inclined to present profits should those exist. In contrast, Greek firms which are not listed "*have less of an incentive to present true operational results and usually their financial statements do not reflect real operational and financial activity. Hiding profits in order to avoid corporate tax is a common tactic for non listed firms in Greece which makes them less of a suitable sample for analysis where one can draw inferences, based on financial data, for working capital practices.*" (Lazaridis & Tryfonidis, 2006, p. 27) Unfortunately, the authors do not make full use of the potential of their sample and focus only on an accounting measure of corporate profitability. They do not consider, as they could easily have done, stock market valuation based measures of profitability as in Shin & Soenen (1998).

7.4. García-Teruel & Martínez-Solano (2007)

The studies presented above have focused their attention on samples of large firms. In contrast, García-Teruel & Martinez-Solano (2007) undertake their analysis of the effect of the cash conversion cycle on corporate profitability using a sample of small and medium-sized enterprises (SMEs). Efficient working capital management is of notable importance for SMEs[181] given the relative high portion of their current assets to their total assets. What is more, SMEs current liabilities represent an essential point of supply of external financing given the financing constraints[182] and the difficulties SMEs face in getting long-term capital

[179] E.g. Mathuva (2010) covering Kenyan listed firms or Raheman & Nasr (2007) covering firms listed in the Karachi Stock Exchange (Pakistan).

[180] E.g. Padachi (2006) covering small manufacturing firms in Mauritius

[181] As argued by Peel & Wilson (1996)

[182] As argued by Whited (1992) and Fazzari & Petersen (1993)

funding.[183] The other remarkable aspect that differentiates the study of García-Teruel & Martinez-Solano (2007) from previous studies presented in earlier sections is the application of robust tests as part of the authors' effort to tackle possible endogeneity problems. This allows them to make causal inferences from the negative association they empirically find between corporate profitability and the cash conversion cycle. It therefore makes much sense to get a closer look at the research methodology they employ.

7.4.1. Sample Selection and Variables of Interest

García-Teruel & Martinez-Solano (2007) use a sample covering the period 1996-2002 and consisting of small and medium sized enterprises from Spain, a country characterized by less developed capital markets[184] and the high significance of financial intermediaries in channelling financial resources.[185] The authors selected the firms in their sample following the criteria established by the European Commission's recommendation 96/280/CE, dated April 3rd, 1996, on the definition of small and medium enterprises. Thus, in a first step, only firms that for at least three years had fewer than 250 employees, annual sales of no more than €40 million and whose total assets did no exceed €27 million were selected to be included in the sample. In a second step, the sample was trimmed, i.e. observations from firms displaying anomalies in their accounts and those exhibiting unrealistic signs were thrown out of the sample. In addition, 1 % of extreme observations in were also eliminated from the sample. They classify firms in their sample as belonging to one of eight distinct industries.[186]

As their dependent variable and measure of corporate profitability, García-Teruel & Martinez-Solano (2007) choose the ratio of return on assets (ROA)[187] to total assets. Measures of working capital management include the number of days accounts receivable (AR), the number of days inventory (INV), the number of days accounts payable (AP) and the cash conversion cycle (CCC). Furthermore, the authors control for firm size (SIZE), sales growth (SGROW) and leverage (DEBT) using as proxies the logarithm of assets,[188] the

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[183] As argued by Petersen & Rajan (1997)

[184] As per La Porta et al. (1997)

[185] As per Pampillón (2000)

[186] These are the agriculture, mining, manufacturing, construction, retail trade, wholesale trade, transport & public services, and services industries.

[187] Defined as earnings before interest and tax.

[188] The results García-Teruel & Martinez-Solano (2007) obtain do not change when using the logarithm of sales instead.

yearly growth in sales and the ratio of debt to liabilities respectively. They also consider the annual growth in Spain's gross domestic product (GDPGR) to control for the effect of the economic cycle on corporate profitability. In contrast to the study of Deloof (2003), García-Teruel & Martinez-Solano (2007) do not consider the ratio of fixed financial assets to total assets nor the ratio of gross operating income to total assets net of financial assets – instead using the ROA - as (fixed) financial assets do not represent a significant part of total assets for SMEs in their sample.

The correlation matrix presented by the authors reveals, in line with expectations and previous studies' results, a significant negative correlation between the measure of profitability, ROA, and each of the individual components of CCC as well as CCC itself. The authors also rightly test for potential multicollinearity issues between pairs of independent variables, finding high values merely between CCC on the one hand and AR and INV respectively.

Interestingly, unlike prior studies relating working capital management to corporate profitability, García-Teruel & Martinez-Solano (2007) include an intermediate step in the analysis of their data. Before running their regressions, they conduct a univariate analysis for the sake of determining whether significant differences were apparent in the variables under study between the most and least profitable firms in their sample. To do so, they calculate in a first step average values of the variables of interest for each quartile of variable ROA and carry out a student's *t* parametric difference of means test to check for significant difference between average values of the first and fourth quartiles. The results they obtain suggest the mean values of the variables under study to be significantly different between the most and least profitable firms, meaning that relative to the least profitable firms in the sample, a shorter number of days accounts receivable, days inventory, days accounts payable and cash conversion cycle are observed for the most profitable firms in the sample. Although the results are consistent with those obtained from their correlation analysis, variations in average values for many of the variables under study do not appear monotonic when moving from one quartile to the next. Thus, merely carrying out a univariate analysis turns out to be insufficient to clarify the link between return on assets and the independent variables under consideration, calling instead for regression analysis.

7.4.2. Regression Model

Using panel data methodology to measure the direction and amplitude of the linkages between corporate profitability and working capital management, García-Teruel & Martinez-Solano (2007) estimate the following baseline model:

$$ROA_{i,t} = \beta_0 + \beta_1 X_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 SGROW_{i,t} + \beta_4 DEBT_{i,t} + \beta_5 GDPGR_{i,t} + \eta_i + \lambda_t + \epsilon_{i,t}$$

In the above equation, X represents the independent variable, being either AR, INV, AP or CCC in each of the four models estimated by the authors. η_i represents a time-invariant unobservable heterogeneity measure of characteristics specific to firm i. Furthermore, the time dummy variable λ_t captures variations over time that are equal for all firms in every year under consideration in their study. I allow myself to note that including the time dummy variable λ_t in the regression model makes the use of the annual variable GDPGR redundant as it is not firm-specific.

The methodology used by García-Teruel & Martinez-Solano (2007) presents several remarkable benefits: "*These include the fact that panel data methodology assumes that individuals, firms, states or countries are heterogeneous. Time-series and cross-section data studies not controlling for this heterogeneity run the risk of obtaining biased results. Furthermore, panel data give more informative data, more variability, less collinearity among variables, more degrees of freedom and more efficiency.*"[189] (García-Teruel & Martinez-Solano, 2007, p. 171)

There are however a few requirements that need to be taken into consideration when efficient estimation of the model set out above is to be achieved, particularly so in the presence of endogeneity concerns. As the authors rightly point out, it should be determined whether the unobservable heterogeneity measure η_i of each firm correlates with the model's explanatory variables. If that is the case, consistent estimation is achieved through the medium of (fixed effects) within-group estimators.[190] Otherwise, it is preferable to aim for a (random effects) estimator, obtained when using the generalized least squares (GLS) regression method.

[189] Referring to Baltagi (2001)

[190] Using the ordinary least squares (OLS) regression method

Whether the effects are random of fixed can be determined with the help of the Hausman (1978) test under the null hypothesis $E(\eta_{i,t}|X_{i,t}) = 0$. The effects are considered fixed (random) when the null hypothesis is rejected (accepted).

García-Teruel & Martinez-Solano (2007) also take into consideration differences that may arise in operational financing requirements from one industry to another. However, given their use of panel data methodology, they are unable to introduce industry dummies in their regression analysis. Instead, the independent variables used to measure working capital management, namely AR, INV, AP, and CCC, were adjusted to their respective industry means.

7.4.3. Main Results of Regression Analysis

In line with Deloof (2003) and other studies previously mentioned, the results of the regressions run by García-Teruel & Martinez-Solano (2007) suggest a reduction in ROA to be associated with a lengthening of AR, INV, and AP. The coefficients obtained for all other control variables are significant and in line with the authors' expectations, and controlling for industry effects does not change the results they obtain. Besides, cutting down the cash conversion cycle is, in contrast with the finding of Deloof (2003), found to increase the profitability of SMEs.

A remarkable aspect of the study of García-Teruel & Martinez-Solano (2007) is that they specifically control for endogeneity problems that might be present by running their regressions using the first lag of AR, INV, AP, and CCC respectively as instrumental variable. The results therefrom confirm the results obtained without using instrumental variables save for the relationship between AP and ROA, which keeps the sign but loses its significance.

In conclusion of this section, it is noteworthy to highlight the importance for any researcher of controlling for possible endogeneity concerns when aiming to make causal inferences about working capital management.

7.5. Baños-Caballero et al. (2012)

Contrary to the studies presented in sections 7.1. to 7.4., in which the relationship between a firm's investment in working capital and its profitability was assumed to be linear in nature, the authors of the last study I would like to present to the reader in this chapter hypothesize a concave rather than linear association between those two. Indeed, Baños-Caballero et al. (2012), who focus on Spanish non-financial SMEs in the period 2002-2007 and employ a

similar sample selection method[191] than that adopted in García-Teruel & Martinez-Solano (2007), take into consideration the higher risk of loss of sales and interruptions in the production process associated with an overly aggressive working capital management policy, and argue that a departure of a firm's working capital from its optimal level may result in deteriorating of its profitability.

Their argument goes as follows: Given that supplementary investment in inventories or receivables is generally associated with greater sales, a positive association among working capital and profitability might be anticipated. A firm holding larger inventories may avert interruptions in the process of production as well as loss of business owed to a shortage of product at hand, while at the same time decreasing supply costs and lowering price fluctuations for its customers.[192] It thus not only enables its customers to enjoy a better service, but also results in lower production costs by reducing fluctuations in production.[193] Likewise, a firm that grants more trade credit gives its sales a stimulus as it allows enough time for its customers to assess the quality of products and services before paying for them,[194] therefore lowering asymmetric information among buyer and seller. It also provides, in periods of depressed demand, an incentive for its customers to purchase its products or services,[195] and bolsters its relationship with its customers.[196]

On the other hand, the costs of a greater investment in working capital may in some instances exceed its benefits, thus negatively affecting a firm's operating performance. For instance, the costs of holding larger inventories, e.g. warehouse rent, insurance and security expenses, could rise[197] to a level where the firm's solvency may be reduced, and its risk of bankruptcy heightened,[198] leading its own suppliers to cut back their supply of raw materials.[199]

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[191] The selection of the firms to be included in the sample follows the criteria defining small and middle enterprises which are established in recommendation 2003/361/EC issued by the European Commission on the 6th of May 2003. Specifically, only those firms with fewer than 250 employees, a turnover of not more than 50 million € and total assets not exceeding 43 million € were considered. In addition, those firms with missing information over at least five consecutive years, with erroneous accounting data, lost or extreme values in all variables were rejected from the sample.

[192] As argued by Blinder & Maccini (1991)

[193] As argued by Schiff & Lieber (1974)

[194] As argued by Smith (1987), Long et al. (1993), and Long & Stowe (1993)

[195] As argued by Emery (1987)

[196] As argued by Ng et al. (1999) and Wilner (2000)

[197] As argued by Kim & Chung (1990)

[198] As argued by Soenen (1993)

[199] As argued by Cuñat (2007)

The argumentation brought forward by Baños-Caballero et al. (2012) thus suggests that the relationship between working capital investment and corporate profitability may be characterised by a (non-monotonic) concave function, and that there exists an optimal level of working capital that maximizes a firm's profitability. Expressly, the authors expect a rise in profitability along with working capital increases up until an optimal level, and a decrease in profitability beyond that optimal level. In other words, at the optimum level of working capital, the marginal benefit of a change in working capital is offset by the marginal costs of that same change. Given these arguments, the link between working capital management and corporate profitability may thus be apprehended in a more appropriate way by a quadratic rather than a linear function.

7.5.1. Variables under Study

As their measure of choice for working capital management, Baños-Caballero et al. (2012) use the cash conversion cycle (CCC). They include its square value (CCC^2) in their analysis to test the trade-off presented earlier between risk and return associated with working capital management. Following Deloof (2003), they use two measures as proxies for corporate profitability, namely the gross and net operating income, which they name PRO_1 and PRO_2 respectively. The authors use these profitability measures as they reflect a firm's operational activities in a better way than the overall return on assets, and because they relate these to the cash conversion cycle, which is also an operating variable. Moreover, they control, as in Deloof (2003) and García-Teruel & Martinez-Solano (2007) among others, for the size of a firm (SIZE), the growth of its sales (GROWTH) as well as its leverage (LEV) by using the natural logarithm of sales, the year-on-year growth in sales and the ratio of debt to total assets respectively as proxies. Finally, eight industry dummies are considered to control for industry-specific effects.

Let me shortly present some descriptive statistics regarding the sample used by Baños-Caballero et al. (2012). First, they document, using a *t*-statistic on the difference in means between the length of the cash conversion cycle of firms in 2002 and 2007 – under null hypothesis: equal means – that the working capital investment had increased significantly during this period. Correlation analysis further highlights, in line with previous studies, a negative correlation between profitability on the one hand and cash conversion cycle,[200]

[200] Consistent with the conventional wisdom that shortening the cash conversion per se leads to an increase in corporate profitability.

leverage[201] and size[202] respectively on the other hand. Moreover, Baños-Caballero et al. (2012) also formally test for and exclude multicollinearity for each independent variable of the sample under study using the Variance Inflation Factor (see Studenmund, 1997).

7.5.2. Regression Model and Research Methodology

To test their hypothesis of an inverted U-shaped relationship between a firm's profitability and working capital investment, Baños-Caballero et al. (2012) assume profitability to be persistent over time and thus employ, as in Goddard et al. (2005) and Feeny et al. (2005), a dynamic panel data model, i.e. one that contains one or more lagged dependent variables as explanatory variables on the right-hand side of the regression equation. Specifically, their regression model takes the following form:

$$PRO_{i,t} = \beta_0 + \beta_1 PRO_{i,t-1} + \beta_2 CCC_{i,t} + \beta_3 CCC_{i,t}^2 + \beta_4 SIZE_{i,t} + \beta_5 GROWTH_{i,t} + \beta_6 LEV_{i,t} + \lambda_t + \eta_i + \varepsilon_{i,t}$$

The parameter λ_t in the above equation represents a time dummy variable designed to capture the time-variant influence of exogenous factors affecting the profitability of all firms, η_i stands for the unobservable heterogeneity capturing firm-specific characteristics, and $\varepsilon_{i,t}$ represents the random error term. Due to the quadratic nature of the above equation, its breakpoint can easily be determined by differentiating the profitability variable with respect to the CCC variable and setting the first derivative equal to zero. Thus, the breakpoint can be formulated as $CCC_{i,t} = (-\beta_2/2\beta_3)$. This breakpoint is a maximum, thus verifying the hypothesis formulated by Baños-Caballero et al. (2012) that the relationship between

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[201] This result may be explained, as argued by Baños-Caballero et al. (2012), by the fact that the increased informational asymmetries (Jordan et al., 1998), the increased informational opacity (Berger & Udell, 1998) as well as the increased risk of bankruptcy inherent to SMEs are reflected in higher borrowing costs. A similar explanation is given by Benito & Vileghe (2000) who argue that the greater financing constraints faced by highly leveraged firms may hamper their undertaking of valuable investments, and thus negatively affect their profitability.

[202] Baños-Caballero et al. (2012) provide a twofold explanation for this result, which besides is in line with that found by Goddard et al. (2005): Firstly, the greater diversification apparent in larger firms may result in a lower profitability. Secondly, given that larger firms provide greater benefits to its managers (Stulz, 1990), both in terms of higher remuneration (Conyon & Murphy, 2000) and other possible private benefits, such as higher prestige (Dyck & Zingales, 2004), managerial decisions may be taken by these managers not to the end of increasing the firm's profitability but in response to their own pecuniary and non-pecuniary interests.

profitability and working capital is concave, if and only if the second partial derivative of profitability with respect to CCC, $2\beta_3$, is negative, hence when β_3 is negative.

Like García-Teruel & Martinez-Solano (2007), Baños-Caballero et al. (2012) employ panel data methodology given the heterogeneous nature of firms and possible endogeneity issues related to unobservable firm-specific features than can influence profitability and which are not considered in the models. The risk of obtaining biased estimates may hence be alleviated.[203] In addition, the authors consider first differences to get rid of the individual effect and employ the instrumental variable estimation methodology to tackle endogeneity concerns, which they contend may be of relevance in their sample. Particularly, they adopt the two-step generalized method of moments (GMM) estimator as recommended by Arellano & Bond (1991) which is more efficient than the estimator of instrumental variables in one stage in instances where heteroskedasticity is a concern.

The empirical results obtained by Baños-Caballero et al. (2012) from the above-mentioned regression model indeed indicate that the relationship between working capital investment and corporate profitability is of concave nature, in other words that there exists an optimal level of working capital that maximizes profitability. Moreover, this result is maintained when regressions are run taking subsamples by size and age as well as by industry - although it is not significant for one of the four industries considered with similar mean CCC, namely the Agriculture and Mining industry, perhaps due to the low numbers of firms belonging to that sector.

7.5.3. Robustness Analysis

Although the estimation results of the first model described in the previous subsection corroborate the hypothesis posed by Baños-Caballero et al. (2012), it is useful to check, as they do, the robustness of their regression analysis. To do so, the authors apply a two-staged model inspired by Tong (2008) and assume any deviation from a firm's optimum working capital level to negatively affect its profitability. In the first stage, the authors define, following Baños-Caballero et al. (2009), the benchmark regression for the factors influencing the length of the cash conversion cycle as follows:

[203] As argued by Hsiao (1985)

$$CCC_{i,t}^{*} = \delta_0 + \delta_1 CFLOW_{i,t} + \delta_2 LEV_{i,t} + \delta_3 GROWTH_{i,t} + \delta_4 SIZE_{i,t} + \delta_5 AGE_{i,t} + \delta_6 FA_{i,t} + \delta_7 ROA_{i,t} + \varepsilon_{i,t}$$

In the above equation, $CCC_{i,t}^{*}$ represents the optimal cash conversion cycle for firm i at time t, CFLOW its cash flow computed as the ratio of net profit plus depreciation to total assets, SIZE its size, computed as the natural logarithm of assets, AGE its age, computed using the natural logarithm of age, FA the investment in fixed assets, computed as the ratio of tangible fixed assets to total assets and ROA the return on assets, computed as the ratio of earnings before interest and taxes to total assets. The variables LEV and GROWTH are the same than those used in the first model (see subsection 7.5.2.).

Establishing their approach on the idea that the current cash conversion cycle of firms may not necessarily represent their desired optimum level,[204] the authors obtain the residuals from the above benchmark regression and use these to proxy for variations from the optimal cash conversion cycle length.

In the second stage, Baños-Caballero et al. (2012) then go about to analyse how these residuals, which can take positive as well as negative value, impact a firm's profitability. Specifically, they define the variable $Deviation_{i,t}$ as the absolute value of the residuals obtained in the first stage, as well as a dummy variable, $AOD_{i,t}$, which takes the value 1 for positive residuals, i.e. when the actual CCC is greater than optimal CCC, and 0 otherwise. The following two profitability equations are then considered to test the effect of deviations from the optimum:

$$PRO_{i,t} = \alpha_0 + \alpha_1 PRO_{i,t-1} + \alpha_2 Deviation_{i,t} + \alpha_3 SIZE_{i,t} + \alpha_4 GROWTH_{i,t} + \alpha_5 LEV_{i,t} + \lambda_t + \eta_i + \varepsilon_{i,t}$$

[204] Baños-Caballero et al. (2012) provide three reasons why this may be the case: First, as argued by Nadiri (1969), firms face a lot of unknowns in their efforts to accurately plan their sales as well as their purchases, they face difficulties in anticipating variations in the opportunity costs of trade credit and in managing default and bad debts on their trade credit accounts, and they may have to deal with a disequilibrium in other assets such as inventories. Similarly, Sartoris & Hill (1983) also point to the uncertainties which can arise when a firm modifies its credit policy, particularly with regards to the timing of payments, the proportion of sales paid at a discount or sales unpaid, or the sales volume. The second reason brought forward by the authors is that the hardship a firm may encounter when trying to access capital markets or its lack of bargaining power with both its customers and suppliers may force it to choose a level of working capital below or above the optimum, respectively. The third reason the authors advance relates to the conflicts of interests that exist between different major stakeholders, which could result in a suboptimal level of current working capital.

$$PRO_{i,t} = \gamma_0 + \gamma_1 PRO_{i,t-1} + \gamma_2 Deviation_{i,t} + \gamma_3 (Deviation * AOD)_{i,t} + \gamma_4 SIZE_{i,t} + \gamma_5 GROWTH_{i,t} + \gamma_6 LEV_{i,t} + \lambda_t + \eta_i + \varepsilon_{i,t}$$

In the first of the two equations, the sign of the coefficient α_2, which indicates in which direction a deviation from the optimal CCC affects firm performance, is expected to be negative. In the second of the two equations written above, both γ_2 and (γ_2+γ_3), which represent the influence of below-optimal and above-optimal deviations respectively, are expected to be negative.

The empirical testing of this two-staged model in the authors efforts to check the robustness of the results of their first model (see subsection 7.5.2.) confirms their expectations, and thus corroborates their hypothesis that both below-optimal and above-optimal deviations from the optimal level of working capital reduce corporate profitability.

In conclusion of this section, let me highlight an important policy implication derived from this utmost significant study in the research area of working capital management: For the sake of maximizing corporate profitability, CFOs as well as other managers involved with working capital management ought to maintain as near as possible a cash conversion cycle to the optimal level and avoid deviating either positively or negatively from that level.

On a side note, I wish to inform the reader of the fact that the methodology used in the study of Baños-Caballero et al. (2012) has been refined in a later study by Baños-Caballero et al. (2014) covering a sample of UK companies. Specifically, the net trade cycle was considered instead of the cash conversion cycle, and financing constraints were explicitly accounted for in the model (see subsection 3.3.2.). I will however refrain from presenting the refined model in all its details as it would amount to a mere repetition. Nonetheless, it should be mentioned, for the sake of completeness, that the findings of Baños-Caballero et al. (2014) also provide strong evidence of a concave relationship between working capital investment and firm performance, pointing to the existence of a profitability-maximizing optimal level of working capital investment. What is more, the authors show this optimal level to be lower for firms which are more likely to be confronted with financial constraints.

8. Working Capital Management and Stock Performance

After having presented the main research covering the link between working capital management and profitability in section 7, I now turn the reader's attention to two studies that explore how working capital management affect stock performance. On a side note, I should mention that the study by Shin & Soenen (1998) presented in the previous section already brushed this topic by using risk-adjusted measures of stock returns as measures of corporate profitability. Nonetheless, the studies presented here, namely that of Kieschnick et al. (2013)[205] and that of Aktas et al. (2015b) – both investigating samples of U.S. publicly listed corporations, exclusively aim attention at how a firm's shareholders value its investments in working capital. Indeed, although consensus prevails among researchers of a significant effect of working capital management on corporate profitability, or, to the least, of a significant association between the two, it cannot necessarily be inferred from the result of these studies, as argued by Kieschnick et al. (2013), that firm value can be maximized, let alone enhanced, by means of WCM.[206] To be able to make such an inference thus requires further analysis, as "*the linkage between […] working capital management and firm value can differ from that between […] working capital management and firm profitability*" (Kieschnick et al., 2013, p. 1832).

8.1. Kieschnick et al. (2013)

Kieschnik et al. (2013) consider their study to be the first piece of empirical research investigating the relationship between shareholder wealth and working capital management. Their work relies on the valuation framework used in Faulkender & Wang (2006),[207] who argue that measuring valuation effects using an excess stock returns approach is more suitable than using the market-to-book ratio methodology developed by Fama & French (1998).[208] Specifically, Kieschnik et al. (2003), using a free cash flow (FCF) valuation

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[205] In their conference paper, Autukaite & Molay (2011) also investigate the question of how shareholders of French public listed companies value their cash holdings and working capital management. Since their methodology is based on the study by Kieschnik et al. (2013) and the evidence they provide is consistent with the results obtained by Kieschnick et al. (2013), I will refrain from presenting it in detail in this thesis.

[206] To strengthen their point, Kieschnick et al. (2013) use the standard free cash flow valuation model already described in subsection 4.2.2. of this thesis. I therefore refer the reader to the said subsection.

[207] Faulkender & Wang (2006) lay out what can be considered a hedonic price equation that relates the value of a firm to its shareholders, proxied by its excess stock returns, to those of its characteristics that influence shareholders cash flow.

[208] Faulkender & Wang (2006) give two reasons as to why their methodology represents an enhancement over that of Fama & French (1998). First off, their methodology controls for both the time-varying risk factors

approach slightly modified from that presented in subsection 4.2.2. of this thesis, assume that shareholders may value their equity based on the equity residual cash flow (ERCF) generated by the firm they hold shares of. Formally speaking, the FCF valuation model can be modified as follows to express shareholder value:

$$V_{equity} = \sum_{t=1}^{\infty} \frac{ERCF_t}{(1 + r_e)^t},$$

where $ERCF_t$ = FCF_t – Net Cash Flow to non-equity holders, and r_e represents the cost of equity capital. Kieschnick et al. (2013) further argue that if this framework holds true, shareholder wealth is increased only if the firm generates excess returns to its equity. Hence, the effects on shareholder value of net operating working capital investments can be assessed by looking at the effects on the excess returns to holders of equity.

8.1.2. Regression Models and Variables under Study

As mentioned earlier, Kieschnick et al. (2013) ground their analysis on the valuation framework used by Faulkender & Wang (2006), which they formally spell out as follows (Model 1):

$$r_t - R_t^B = \beta_0 + \beta_1 \Delta C_t + \beta_2 C_{t-1} + \beta_3 \Delta E_t + \beta_4 \Delta NA_t + \beta_5 \Delta RD_t + \beta_6 \Delta I_t + \beta_7 \Delta D_t + \beta_8 L_t + \beta_9 NF_t + \varepsilon_t,$$

where $r_t - R_t^B$ represents the excess, or benchmark-adjusted, stock return of a firm over the fiscal year t, r_t the realized return of the firm's stock over the fiscal year t, and R_t^B the benchmark return for the stock, i.e. the return of a portfolio sorted by size and book-to-

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as well as the cross-sectional variation in exposure to these risk factors in their estimation by using a stock's benchmark return. In contrast, the methodology used by Fama & French (1998), notwithstanding the fact that firm-specific characteristics affecting expected cash flow are controlled for, does not incorporate measures capable of seizing variations in sensitivities to risk factors, and hence variations in discount rates. Secondly, Faulkender & Wang (2006) argue that equity returns, contrary to the market-to-book ratio, are easily measurable and interpretable. Fama & French (1998) have themselves argued that they lack the necessary data to measure assets at replacement costs, which, to them, would be more desirable. Subsequently, "*part of the variability in market-to-book may result from the cross-sectional differences in accounting for the book value of assets relative to their true replacement cost. If accounting methods across firms are correlated with liquidity, this correlation might bias the estimates of the marginal value of cash.*" (Faulkender & Wang, 2006, p. 1966)

market to which the stock belongs, during fiscal year t.[209] Furthermore, C represents the firm's holdings in cash and marketable securities, E its earnings before interest and extraordinary items, NA its total assets net of cash, RD its research & development expenditures (0 if missing), I its interest expense, D the total dividends it paid, L its market leverage,[210] and NF its net financing,[211] ΔX is used to denote unexpected changes[212] in X over the current year. In addition, all independent variables X_t, except L_t, are being scaled by the firm's market value of equity at the start of the fiscal year (MVE_{t-1}). This scaling thus permits a straightforward interpretation of the regression coefficients, namely as "*a gage for how investors perceive each $1 investment in X; measured relatively to how* $\beta * \Delta X$ *is able to explain the unanticipated change in a company's valuation* $\left((r_t - R_t^B) * MVE_{t-1}\right)$." (Kieschnick et al., 2013, p. 1834)

It is worthy to note that when developing the valuation framework presented here, Faulkender & Wang (2006) acknowledged that both common risk factors and variations in firm-specific characteristics affect stock returns. Although firm-specific factors are highly noisy, Faulkender & Wang (2006), whose aim is to answer the question of whether shareholder wealth is affected by changes in cash holdings, need to investigate individual stocks and can therefore not diversify these firm-specific factors away by using portfolios as is common in the asset pricing literature. It is therefore necessary, as they argue, to control for other factors that may be correlated with variations in cash that may also have an impact on shareholder value. Hence, the excess stock returns are not only regressed on "*the change in cash holdings, but also on changes in a firm's profitability, financing policy, and investment policy.*" (Faulkender & Wang, 2008, p. 1966)[213]

Let me remind the reader that Kieschnick et al. (2013) are interested in evaluating the effect of net operating working capital investment (denoted ΔNWC_t) on shareholder wealth,

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[209] Kieschnick et al. (2013) construct their benchmark portfolios following the method adopted by Daniel & Titman (1997) and Grinblatt & Moskowitz (2004). Specifically, from data obtained by merging CRSP stock return data and COMPUSTAT accounting data, they classify stocks monthly into size and book-to-market quintiles to form 25 benchmark portfolios and their returns.

[210] Market leverage is expressed as the ratio of total debt over total debt plus market value of equity.

[211] Net financing is computed as total equity issuance minus repurchases plus debt issuance minus debt redemption.

[212] As the unexpected change in a variable is unobservable, Faulkender & Wang (2006) first consider, focusing on their main variable of interest, cash, its realized change under the assumption of no expected change. In a second step, they conduct several robustness tests with changing estimates of unexpected cash variations. They find that using actual changes in cash appears to provide relatively unbiased results.

[213] For further motivations regarding the motivations of Faulkender & Wang (2008) regarding their choice of control variables, I refer the reader directly to their article.

particularly while accounting for the prior level of net operating working capital (denoted NWC_{t-1}). The baseline model laid out above is therefore adjusted to incorporate for these variables as follows (Model 2):

$$r_t - R_t^B = \beta_0 + \beta_1 \Delta C_t + \beta_2 C_{t-1} + \beta_3 \Delta E_t + \beta_4 \Delta NNA_t + \beta_5 \Delta RD_t + \beta_6 \Delta I_t + \beta_7 \Delta D_t + \beta_8 L_t + \beta_9 NF_t + \beta_{10} NWC_{t-1} + \beta_{11} \Delta NWC_t + \varepsilon_t,$$

where NNA represents total assets net of cash and marketable securities, account receivables and inventories, and NWC is computed as accounts receivable plus inventory minus accounts payable.

Kieschnick et al. (2013) further expand their analysis by investigating the interaction between the variables NWC_{t-1} and ΔNWC_t, thus laying out, though not explicitly, the following regression equation (Model 3):

$$r_t - R_t^B = \beta_0 + \beta_1 \Delta C_t + \beta_2 C_{t-1} + \beta_3 \Delta E_t + \beta_4 \Delta NNA_t + \beta_5 \Delta RD_t + \beta_6 \Delta I_t + \beta_7 \Delta D_t + \beta_8 L_t + \beta_9 NF_t + \beta_{10} NWC_{t-1} + \beta_{11} \Delta NWC_t + \beta_{12} (NWC_{t-1} * \Delta NWC_t) + \varepsilon_t,$$

In a final step in their research design, Kieschnick et al. (2013) are interested in answering the question of how other factors related to working capital, such as those presented in the first part of this thesis, may influence the value shareholders place on additional working capital investments. Specifically, they consider a firm's expected sales growth, its debt load, its risk of going bankrupt, the financial constraints it faces, as well as macroeconomic and financial market conditions as factors potentially affecting the incremental value to shareholders of investments in net operating working capital and expand their second regression model as follows (Model 4):

$$r_t - R_t^B = \beta_0 + \beta_1 \Delta C_t + \beta_2 C_{t-1} + \beta_3 \Delta E_t + \beta_4 \Delta NNA_t + \beta_5 \Delta RD_t + \beta_6 \Delta I_t + \beta_7 \Delta D_t + \beta_8 L_t + \beta_9 NF_t + \beta_{10} NWC_{t-1} + \beta_{11} \Delta NWC_t + \varepsilon_t,$$

where $\beta_{11} = \alpha_1 F_1 + \cdots + \alpha_j F_j$, and $F_1, \ldots, F_j$ the additional factors (or their proxies)[214] under consideration.

It is worthy to note that all models are estimated, following both Faulkender & Wang (2006) and Dittmar & Mahrt-Smith (2007), as random effects models,[215] and that sample data is being winsorized at the 1% and 99% level rather than trimmed[216] as is common practice in other studies.

8.1.2. Main Results

Kieschnick et al. (2013) provide several valuable empirical results that highlight the significance of efficient working management policies to stockholders: First off, the authors report significant evidence that, for the average firm in their sample, an additional dollar invested in net operating working capital turns out to be worth about $0.52 to its shareholders, hence less than the dollar so invested and substantially less than an additional dollar held in cash, which shareholders value at around $1.49. Another intriguing result from their study is that the value of an incremental net operating working capital investment is lessening with increasing levels of prior net operating working capital. This result leaves out the possibility of the existence of an optimal level of (net operating) working capital and thus stands in contrast with the results provided by Baños-Caballero et al. (2012 and 2014) who uncovered an inverted U-shaped relationship between a firm's profitability and its investment in working capital. I allow myself to carefully speculate that, if such an optimum indeed exists, the negative relationship between $r_t - R_t^B$ and $NWC_{t-1} * \Delta NWC_t$ obtained by Kieschnik et al. (2013) may perhaps stem from a high concentration of firms in their sample characterized by excessively high levels of working capital. This explanation is quite plausible given that their study covers the period 1990 through 2006 and that the same authors (See Kieschnick et al., 2006) reported significant evidence of an overinvestment in working capital, on average, by U.S. corporations in the period 1990 through 2004. It may thus be interesting to modify the model used by Kieschnik et al. (2013) to incorporate for a non-monotonic concave relationship between shareholder value and working capital investment. Nonetheless, the authors provide insightful and significant evidence of the

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[214] I refer the reader at this point to the original article of Kieschnick et al. (2013) for details regarding the measures the authors use to proxy for those factors.

[215] Using the Hausman (1978) test, Kieschnick et al. (2013) tested whether using a random effects model over a fixed effects model was appropriate and failed to dismiss its appropriateness.

[216] Kieschnick et al. (2013) consider trimming not to be appropriate when the concern is over data entry mistakes.

influence of a firm's future sales expectations, its debt load, the ease with which it has access to external capital markets, and its bankruptcy risk on the value its shareholder places on an additional dollar in net operating working capital investment. Finally, they document that "*[o]f the different components of net operating working capital, additional investments in providing credit to one's customers appears to have the greater effects on shareholder' wealth for the average firm.*" (Kieschnick et al., 2013, p. 1851)

8.2. Aktas et al. (2015b)

Let me now turn to the empirical study of Aktas et al. (2015b) I need to present to the reader before I go on with presenting my own empirical research. To the best of my knowledge and belief, that study is the most recent study that considers the question of whether working capital management is value-enhancing. Besides, it addresses the weaknesses of the researched carried out by Kieschnick et al. (2013) and to which I have pointed in the previous subsection (8.1.2.). In line with Baños-Caballero et al. (2012 and 214), Aktas et al (2015b, p. 99) recognize that due to the potential costs and benefits associated with investment in working capital, its relationship with firm performance ought to be non-linear in nature, "*with the expected relation being negative for firms with high level of working capital (i.e. overinvestment in NWC) and positive for firms with low level of working capital (i.e. underinvestment in NWC)*." Furthermore, they advocate corporate investment to be the driving force behind the performance-enhancing feature of working capital management for firms characterized by excessive levels of working capital. Specifically, they argue that cutting back superfluous working capital leads to increased firm performance through the reallocation of underemployed resources to usages that have a superior value. Besides, it increases a firm's financial flexibility both in the short run because of cash being freed that was previously unnecessarily tied-up in working capital, as well as in the long run because of comparatively fewer financial needs of operation. This increased financial flexibility, Aktas et al. (2015b) continue to argue, in turn provides the firm with a better capacity to undertake potentially profitable investments, as documented, among others, by Denis & Sibilkov (2010) and Duchin et al. (2010b). On the other hand, firms characterized by an excessively low level of working capital will find it futile to source corporate investment by cutting back their level of working capital. Hence, Aktas et al. (2015b) anticipate the relation between working capital and corporate investment to be negative only for firms overinvesting in working capital.

8.2.1. Preliminary Analysis

First off, it is worthy to note that Aktas et al. (2015b) conduct their research using an exhaustive sample of accounting and stock prices data of U.S. listed non-financial firms covering the period 1982 through to 2011, thus including the period of severe downturn economic environment suffered by the global economy from 2007 onwards that is also of interest for my empirical analysis. To derive their independent variable of interest, they start their analysis by looking at aggregate accounting figures such as assets, sales, cash holdings, net operating working capital (NWC) and its components, namely inventories, accounts receivable, and accounts payable for each sample year, as well as the average yearly growth rate of the variables under consideration. This allows them to identify several noticeable trends: First, "*while the aggregate cash tied up in NWC is more than three times of the aggregate cash holdings at the beginning of the sample period, cash holdings become as important as the aggregate investment in NWC towards the end of the sample period.*" Second, the aggregate figures provide an indication "*that firms hold on average relatively less working capital through time, and in particular inventories.*" (Aktas et al., 2015b, p. 102) Moreover, by plotting the cross-sectional average and median of the ratio of NWC-to-sales per year as well as the progression through time of average inventories, accounts receivable and accounts payable, respectively, scaled by sales, the authors are able to identify a significant downward trend in the NWC-to-sales ratio as well as in the ratios of each of the three components of NWC to sales, with a relatively more pronounced downward trend for the average ratio of inventories to sales.[217] By the same token, the authors carry out an industry analysis for the sake of checking whether the downward trend in NWC-to-sales ratio over time is common to all industries or restricted to specific industries. The authors hereby reveal the relative decline in NWC to commonly occur across a vast array of industries, and that, although different working capital practices are documented among industries, "*the heterogeneity in terms of working capital management has also decreased through time in most industries*." (Aktas et al., 2015b, p. 104)

8.2.2. Variables Under Study

The preliminary analysis described in the previous subsection leads the authors to choose the industry-median adjusted NWC-to-sales ratio as their main independent variable of

[217] Aktas et al. (2015b) note that the considerable scaling back of inventories relative to sales is frequently linked to the endorsement of the Just-in-Time (JIT) inventory system, as documented, among others, by Chen et al. (2005).

interest and measure of the funds unnecessarily tied up in working capital. This variable, denoted excess NWC, is obtained by subtracting the ratio of the median firm in the corresponding industry/year from the NWC-to-sales ratio of a given firm. It can take both positive and negative values, indicating an over- and underinvestment in working capital, respectively. An implicit assumption is hereby made by the authors that the industry-median NWC level represents a firm's efficient level of NWC "*(i.e. the NWC level adopted by a shareholder value maximizing manager who trade-offs benefits and costs of investment in working capital)*" (Aktas et al., 2015b, p. 104).

In their study, the authors perform regressions using as dependent variables both the excess stock return adjusted for firm size and market-to-book, following Barber & Lyon (1997), as a measure of stock performance, and, following Bates et al. (2009), the capital expenditures (CAPEX) and cash outflows linked to acquisitions, as measures of corporate investment.[218]

Regarding the excess return for time t, it is defined "*as the difference between the return of the buy-and-hold investment in the sample firm i less the return of the buy-and-hold investment in a benchmark portfolio*" (Aktas et al., 2015, p. 104), and formally expressed as follows:

$$Excess\ return_{i,t} = \prod_{m=1}^{T}\left(1 + R_{i,m}\right) - \prod_{m=1}^{T}\left(1 + R_{p,m}\right),$$

where $R_{i,m}$ represents the return of firm i, $R_{p,m}$ the return of the benchmark portfolio for month m, and T the investment horizon expressed in number of months. Aktas et al. (2015b) compute excess returns underlying a 1-year horizon (i.e. T = 12). They further construct,[219] as their benchmark portfolios, twenty-five Fama-French value-weighted portfolios sorted independently by size (proxied by the market value of equity, ME) and book-to-market (defined as the ratio of book value of equity to market value of equity, BE/ME) characteristics, and allocate each firm in their sample to both a size and a market portfolio with the help of Fama-French ME and BE/ME breakpoints.

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[218] Aktas et al. (2015b) also perform regressions using operating performance, proxied by the return on assets (ROA), and firm risk, proxied by the annualized standard deviation of daily stock returns, following Coles et al. (2006) and Armstrong & Vashishtha (2012). These two regressions serve as complementary tests to gauge the robustness of corporate investment as the main driver behind the value-enhancing feature of working capital management.

[219] Following Daniel & Titman (1997)

Regarding the measures of corporate investment, the variables Aktas et al. (2015b) use are divided by total assets at the beginning of the period. Furthermore, given that only the unexpected part of an investment is anticipated to be related to superior performance of stocks when capital markets are efficient,[220] the authors consider the change in investment as their dependent variable in the investment regressions. Besides, the argue that "*the use of the change in investment as dependent variable controls to some extent for the maintenance investment (i.e., the investment which is necessary for the firm to keep functioning at current levels of growth in a competitive environment), and allows focusing only on the part of the investment devoted to firm growth*" (Aktas et al., 2015b, p. 104)

8.2.3. Regression Methodology

Aktas et al. (2015b) start by laying out the following linear regression model in their effort to scrutinize to what extent firm performance and investment are impacted by excess net operating working capital:

$$V_{i,t} = \alpha_t + \eta_i + \beta_1 Excess\ NWC_{i,t-1} + \beta_2 Controls_{i,t-1} + \varepsilon_{i,t},$$

where V is one of the dependent variables used as proxies for either firm performance or investment, and α_t and η_i represent respectively year and firm fixed effects. The inclusion of year and firm fixed effects in all their regressions allow the authors to control, respectively, for changes in overall economic and financial conditions as well as for time-invariant firm characteristics, thus alleviating the issue of omitted variables. Industry fixed effects, for their part, are indirectly controlled for by using industry median-adjusted values of excess NWC.

Given that the sample data used in the study is organized in a panel structure, the coefficient β_1 in the above regression equation can be interpreted as the sensitivity of either firm performance or investment to a marginal change in excess NWC. Specifically, a decrease in excess NWC in one period, in other words the adoption of a more aggressive working capital management policy, leads to an increase (decrease) in firm performance or corporate investment in the next period when the coefficient β_1 is negative (positive).

Furthermore, the authors draw upon a second, asymmetric regression model to answer the question of whether the link between the main independent and the dependent variables under consideration is non-linear in nature. To that end, they introduce a dummy variable D

[220] Aktas et al. (2015b) here refer to McConell & Muscarella (1985)

being equal to 1 for positive observations of excess NWC and 0 otherwise. This permits to obtain different slope coefficients of the regression model under consideration depending on whether excess NWC is positive or negative. The authors formally express the corresponding non-linear asymmetric model specification as follows:

$$V_{i,t} = \alpha_t + \eta_i + \gamma_1[Excess\ NWC_{i,t-1} \times D] + \gamma_2[Excess\ NWC_{i,t-1} \times (1 - D)] + \gamma_3 Controls_{i,t-1} + \varepsilon_{i,t},$$

It is worthy to note that in both the linear and asymmetric regression equations mentioned above, the right-hand side variables are lagged by one period. This, Aktas et al. (2015b) argue, mitigates the possibility of having all three variables of interest, namely net operating working capital, firm performance and corporate investment determined simultaneously in equilibrium. Besides, the authors consider in all their regressions several control variables that are known to influence the dependent variable(s) as well as levels of working capital. This addresses endogeneity concerns related to unconsidered factors that may correlate with the main independent variable.

The array of control variables under consideration and common to both the investment and performance regressions is quite ample: They follow Hill et al. (2010) and employ a firm's sales volatility, its 1-year sales growth rate, its operating cash flow and a dummy variable for financial distress as control variables. Other control variables include firm age,[221] and cash reserves.[222] With regards to the performance regressions, Aktas et al. (2015b) extend the set of control variables to further include the market value of equity - as proxy for firm size, leverage, risk, intangible assets,[223] research & development (R&D) expenditures,[224] and fixed asset growth.[225] With regards to the investment regressions, the authors consider the

[221] Following the argumentation by Damordan (2012) that a relatively lower level of working capital per unit of sales is necessary for mature firms

[222] The choice of Aktas el al. (2015b) to consider cash reserves as a control variable is motivated by their desire to mitigate the substitution effect that exists between working capital and cash reserves through time as documented by Bates et al. (2009)

[223] Following, among others, Coles et al. (2008) and Duchin et al. (2010a)

[224] As R&D expenditures are associated to future stock performance, as shown for instance by Chan et al. (2001)

[225] Contrary to Cooper et al. (2008) or Lipson et al. (2011) among others, Aktas et al. (2015b) consider fixed asset growth instead of total asset growth to exclude elements of working capital that are accounted for in the latter.

log of Tobin's q[226], known to interact with growth opportunities, in addition to firm size, leverage and risk.

Aktas et al. (2015b) do not limit their analysis to the running of the two regression models outlined above. They also run two alternative regressions using as dependent variable a measure of operating performance (proxied by the return on assets) and a measure of risk (proxied by the annualized standard deviation of firm daily returns in year t) respectively. Moreover, in a final effort to cross-check the results of their main tests, they endorse an alternative two-staged regression-based approach to estimate excess NWC. Specifically, they estimate, in a first stage, a firm's working capital requirements drawing upon variables known to influence the ratio of NWC-to-sales. This is done by regressing for each industry/year the ratio of a firm's NWC-to-sales on the volatility of its sales, its sales growth, its free cash flow, its age, and a financial distress dummy. In a second stage, they use the residuals from the first stage regression as measure of the firm's excess NWC in both the performance and investment regressions.

8.2.4. Summary of Main Results

The very exhaustive study by Aktas et al. (2015b) presented above can not only be considered to position itself at the cutting edge of research on working capital management with regards to the econometric methods grounded therein. It also provides comprehensive and significant evidence that has far-reaching implications for corporate policy. Expressing it in their words, the authors "*document the existence of an optimal level of working capital investment. Firms that converge to that optimal level, either by increasing or decreasing their investment in working capital, improve their stock and operating performance over the subsequent period. [They] also uncover that corporate investment is the channel through which efficient [working capital management] translates into superior firm performance. [Their] results emphasize that firm appear to redeploy underutilized working capital resources to more efficient uses, such as funding growth investment. [Their] study implies that efficient [working capital management] is highly valuable, particularly in periods of expanding investment opportunity set. [They] also rule out the possibility that the results are driven by increasing firm risk following the adoption of aggressive working capital policy.*" (Aktas et al., 2015b, p. 111)

Given both these results and the large chunk working capital accounts represent relative to

[226] Following Lang et al. (1996)

a firm's assets, Aktas et al. (2015b) summon managers of corporations to give higher priority to the maximization of the utility of working capital for their shareholder's benefit. Particularly, they advise corporate managers to refrain themselves from holding too high levels of cash uselessly tied up in working capital and to focus on aiming for the optimum level of working capital. Following this advice would eventually lead to increased efficiency in the management of working capital, in turn opening sources of financing generated within the firm which could ultimately be put to work in more valuable investment opportunities for the benefit of the firm's shareholders.

9. Empirical Study

The following empirical study will be based on the methodology adopted by Aktas et al. (2015b) presented in the previous section. However, due to the unavailability of certain data required to perform the investment regressions, I will limit my empirical work to the performance regressions, the aim of which is twofold. The first set of regressions enables me to evaluate the impact on both stock and operating performance of a firm's adjustment of its level of net operating working capital towards the median level of the industry the firm belongs to. The second set of regressions allows me to assess whether, as in Aktas et al. (2015b) and Baños-Caballero et al. (2012 and 2014), an inverted U-shaped relationship exist between an investment in working capital and a firm's stock performance and profitability, respectively, for German publicly listed firms.

9.1. Sample Construction

To construct my sample, I use unbalanced panel data covering the period 2005 to 2014 and related to 112 unique (non-financial) firms that were included in the German DAX, MDAX, SDAX and TecDAX indices at the beginning of the second half-year of 2005 (i.e. June 1st, 2005), with 1025 firm-year observations in total. The firms under study are classified, using the Industry Classification Benchmark[227] supersectors, into the following 15 industries:

. Automobiles and Parts	. Health Care	. Retail
. Basic Resources	. Industrial Goods and Services	. Technology
. Chemicals	. Media	. Telecommunications
. Construction & Materials	. Oil & Gas	. Travel & Leisure
. Food & Beverage	. Personal and Household Goods	. Utilities

All accounting and earning related figures used in my study have been hand-picked by myself from the annual financial reports of the firms under consideration. Data related to stock prices have been drawn from the *Bloomberg Professional* terminal. Firms for which required data was not available from Bloomberg in one or more years, firms for which data

[227] See www.icbenchmark.com for details regarding the industry classification taxonomy.

was available for less than four years, and firms that reported their financial figures in another currency than the € were not included in the sample.

9.2. Refining the Measure of Net Operating Working Capital

The measure of working capital I employ in my study differs slightly from that employed by Aktas et al. (2015b). Indeed, I consider an alternative measure of working capital, which I denote by NWC* and which, in addition to the individual components of NWC, namely inventories (INV), accounts receivable (AR) and accounts payable (AP), accounts for the receivables and liabilities from construction contracts[228] (RCC and LCC, respectively) as well as for the advance payments (AdvP) firms receive from their customers. The alternative measure of working capital I use can thus be expressed as follows:

$$NWC^* = INV + (AR + RCC) - (AP + LCC + AdvP)$$

The rationale for the inclusion of the two components related to construction contracts as components of the net operating capital is straightforward. While in most industries, business processes follow cycles spanning a relatively short period, in other industries, such as most of those considered in my sample, it is common for the duration of an activity undertaken in construction contracts to extend beyond one year, thus leading the date of entrance into contract activity to fall into a different accounting period than the date of completion of the activity. The main accounting issue, in that case, is most certainly concerned with the attribution of contract revenue and costs to the periods in which construction work has been performed.[229] IAS 11 (2014), which prescribes how revenue and costs associated with construction contracts ought to be treated for accounting purposes, specifically proposes to treat receivables from construction contracts as the difference between the amount billed to the customer as progress billing and the progress payments received from the customer. Note here that, following the accruals concept, any advance payment received from the customer in respect of contractual work to be performed at a future date is not included as receivables from construction contracts but rather should be recognized as a liability – hence the term

[228] IAS 11 (2014) defines a construction contract as "*a contract specifically negotiated for the construction of an asset or a combination of assets that are closely interrelated or interdependent in terms of their design, technology and function or their ultimate purpose or use.*" (IAS 11, 2014, p.1)

[229] See IAS 11 (2014)

liabilities from construction contracts[230] – until the work in respect of which the advance was given has been performed.

Accounting for customer's advance payments – which are generally stated as a current liability on a firm's balance sheet - as a component of net operating working capital also makes much sense as firms may rely on advance payments requests for the sake of working capital management. Payments in advance of goods being delivered or services being provided may be effected for several reasons. A firm may for instance be unable or unwilling, due to the financial constraints or even distress itself or its customers, respectively, may be facing, to grant trade credit. Another reason may be that the product a customer orders from a firm is customized to such an extent that the firm may find it difficult to sell it to anyone else should the ordering customer be unable or unwilling to pay. A firm may also choose to request advance payments from its customers to reserve its annual production capacity, in which case advance payment requests can be considered as a tool serving the management of inventory. The reasons mentioned above are without any doubt of greater relevance in times of deteriorating economic conditions, as was the case in the wake of the 2007-2008 global financial crisis.

It will be shown in the next section why the use of the alternative measure of net operating working capital (NWC*) I propose is superior to that used in Aktas et al. (2015b), at least when investigating firms for which accounting for construction contracts is a relevant issue.

[230] In this thesis, what I denote as liabilities from construction contracts should not be confounded with construction contractual liabilities arising when the contract terms are not being abided to by the contractor or his or her subcontractors. Though the latter are of great relevance in terms of a contractor's insurance coverage, I define liabilities from construction contracts merely in accounting terms as advance payments effected in respect of contractual work to be performed at a future date.

9.3. Summary Statistics

9.3.1. Looking at the Big Picture

Year	N	Assets	Sales	Cash	INV	AR	AP	RCC	LCC	AdvP	NWC	NWC*
2005	101	943	654	52	81	83	77	10	6	23	87	68
2006	106	1097	790	59	96	93	88	11	10	26	101	76
2007	111	1454	1009	78	124	118	106	12	14	32	136	103
2008	112	1610	1110	73	140	129	113	14	7	34	155	128
2009	107	1413	1011	105	127	115	108	13	16	37	133	94
2010	104	1525	1114	109	141	135	127	14	17	40	149	106
2011	103	1664	1284	106	166	148	140	15	18	48	173	122
2011	103	1765	1418	112	170	148	143	17	19	48	175	124
2013	97	1797	1437	119	170	151	142	19	18	48	178	130
2014	94	1957	1451	115	184	159	151	17	19	47	191	143
Growth rate	N/A	9.0%	9.7%	10.4%	10.2%	7.9%	8.1%	6.2%	21.4%	8.5%	9.9%	9.9%

Table 2: Aggregate Values by Year

Table 2 above reports yearly aggregate values for total assets, sales, cash holdings,[231] both measures of net operating working capital (NWC and NWC*), inventories, accounts receivables, receivables from construction contracts, liabilities from construction contracts, and advance payments received from customers at order placement for all the firms in the samples and covers the period 2005 to 2014. All € values are in billion € and adjusted to 2015 € by the HCIP index for Germany. N is the number of firms. It is lower than the number of unique firms in the years prior to 2008. Notwithstanding the mandatory rule for all publicly listed firms to report financial figures following the IFRS accounting standards from 2005 onwards, some firms in the samples have used the transitional period to change to IFRS accounting rules granted by the European Commission[232] to those publicly listed firms who already issued, in or prior to 2005, their financial statements based on US-GAAP. Therefore, the actual number of unique firms considered prior to 2008 is lower than 112.[233] Thereafter, the number of firms decreases as some firms leave the sample either because they went into bankruptcy, were taken over by other firms, or have been delisted. The last row displays the average annual growth rate of the corresponding variables. Between 2005 and 2014, an increasing trend can clearly be observed in all the variables under consideration. While

[231] Figures include cash and equivalents.

[232] See EU regulation Nr. 1606/2002

[233] One firm in the sample, INFINEON, has only adopted IFRS standards in their 2007/2008 annual report given that its fiscal year-end is not the calendar year-end.

aggregate total assets and sales have grown at a yearly rate of 9.0% and 9.7% respectively over the period 2005-2014, the aggregate amount held in cash and equivalents has increased at a higher rate (10.4%). This pattern is consistent with those observed by both Aktas et al. (2015b) and Bates et al. (2009). In contrast to the observations by Aktas et al. (2015b), the aggregate investment in net operating working capital, as proxied by both NWC and NWC*, has increased by 9.9%, which is more relative to the annual growth of aggregate assets and aggregate sales and less relative to the annual growth of cash holdings. Among the six components of NWC*, receivables from construction contracts have grown at the lowest rate over the period under consideration in the sample, followed by accounts receivable (8.1%), advance payments (8.5%), inventories (10.2%), and liabilities from construction contracts (21.4%). It is noteworthy to point out to the significant drop in aggregate NWC* (-26.6%) in 2009 relative to 2008, which hints to the firms' adoption of more aggressive working capital policies in direct reaction to the financial crisis of 2007-2008. More specifically, while the levels of inventories, accounts receivables, receivables from construction contracts and accounts payable dropped by -9.3%, -10.3%, -7.1% and -4.4%, respectively, advance payment increased by 8.8% and liabilities from constructions contracts increased by a staggering 128.6%. Moreover, during the same time, aggregate sales dropped by -8.9%, and cash holding increased by 43,8%. Let me remind the reader that what I denote as liabilities from construction contracts represent advance payments received from customers in respect of contractual work that has not yet been performed. Hence, the colossal increase in LCC from the years 2008 to 2009 can be the result of either customers postponing the completion and delivery of their orders or of firms requesting higher payments in advance from a customer in respect of contractual work to minimize the risk of having goods and services left unpaid by the customer upon completion of the construction contract.

9.3.2. Comparative Cross-Sectional Time-Series Analysis

The aggregate observations described above clearly highlighted the necessity to refine the measure of net operating working capital to also account for receivables and liabilities from construction contracts as well as advance payments, as well as the importance of their functions in the management of working capital. Beyond these observations, analysing, following Aktas et al. (2015b), the times series of summary statistics for both the NWC-to-Sales ratio (see Fig. 12) and the NWC*-to-Sales ratio (see Fig. 13) leads me to assert that using the alternative measure of net operating working capital is superior to that adopted by Aktas et al. (2015b).

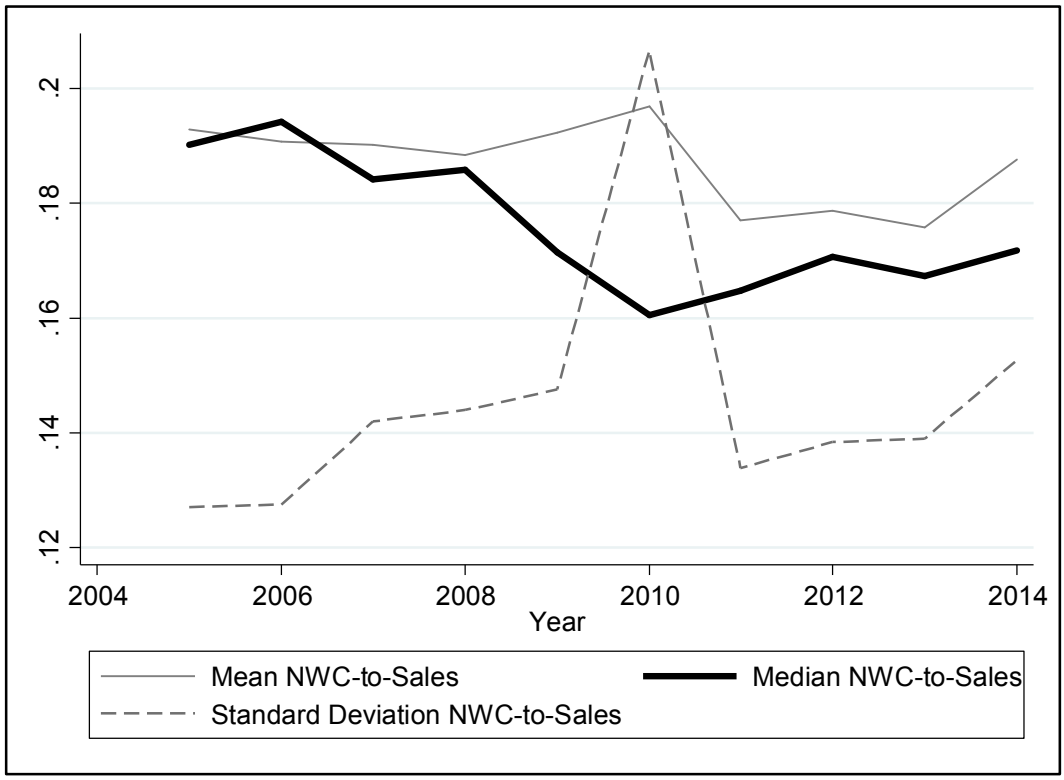

Figure 12: Time Series of Summary Statistics for NWC-to-Sales Ratio

Indeed, although a slightly downward trend in the mean and median NWC-to-Sales ratio can be observed in Fig. 12, which plots the cross-sectional statistics of NWC-to-Sales ratio for German firms by year from 2005 to 2014, one can notice from Fig. 13, which plots the cross-sectional statistics of NWC*-to-Sales ratio for German firms by year from 2005 to 2014, that the downward trend becomes clearly apparent for both the mean and median NWC*-to-Sales ratio relative to the mean and median NWC-to-Sales ratio. Performing regressions of both the mean and median NWC*-to-Sales ratio, respectively, on a constant and time measured in years, allows me to assess whether the observed time trend is statistically significant. The coefficient on the time trend for the mean (median) NWC*-to-Sales ratio corresponds to a yearly decrease of -0.26% (-0.46%), has a p-value of 0.002 (0.000), and an R^2 of 73% (82%), hence pointing to a significant decreasing time trend in NWC*-to-Sales ratio over the sample period.[234]

[234] The full results of these regressions, though not reported here in a table, are available on request.

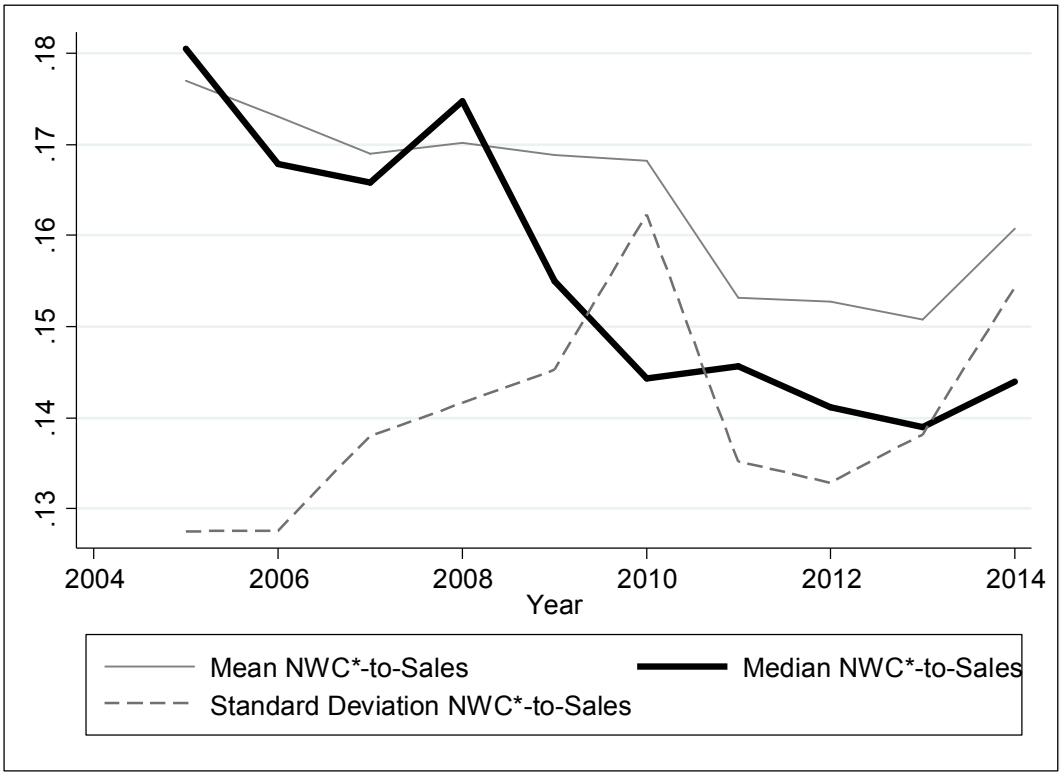

Figure 13: Time Series Summary Statistics for NWC*-to-Sales Ratio

However, in contrast to the observations of Aktas et al. (2015b), the cross-sectional standard deviation of both the NWC-to-Sales and NWC*-to-Sales ratios, also depicted in Fig. 12 and Fig. 13, tend to follow an upward trend over the sample period, with values peaking in the year 2010, perhaps due to some firms in the sample only considering the short-term utility of working capital management as a means to weather a financial crisis, assuming it will not last too long, while other firms either recognize that the effects of the financial crisis might be long-lasting, or acknowledge the importance of adopting sustainable working capital policies.[235] In any case, these observations indicate an increase in firm heterogeneity in terms of both the NWC-to-Sales and NWC*-to-Sales ratios over the entire sample period.

Following here again the procedure adopted by Aktas et al. (2015b) in their study, I plot in Fig. 14 the cross-sectional averages of all individual components of NWC* scaled by sales, allowing to assess which one of the six components of NWC* contributed the most in the decrease of the NWC*-to-Sales ratio over the sample period.

[235] It is noteworthy in this respect to point out that from 2010 onwards, the decreasing trend in the mean NWC*-to-Sales ratio observed until 2010 tends to accelerate while the mean NWC*-to-Sales ratio tends to stagnate.

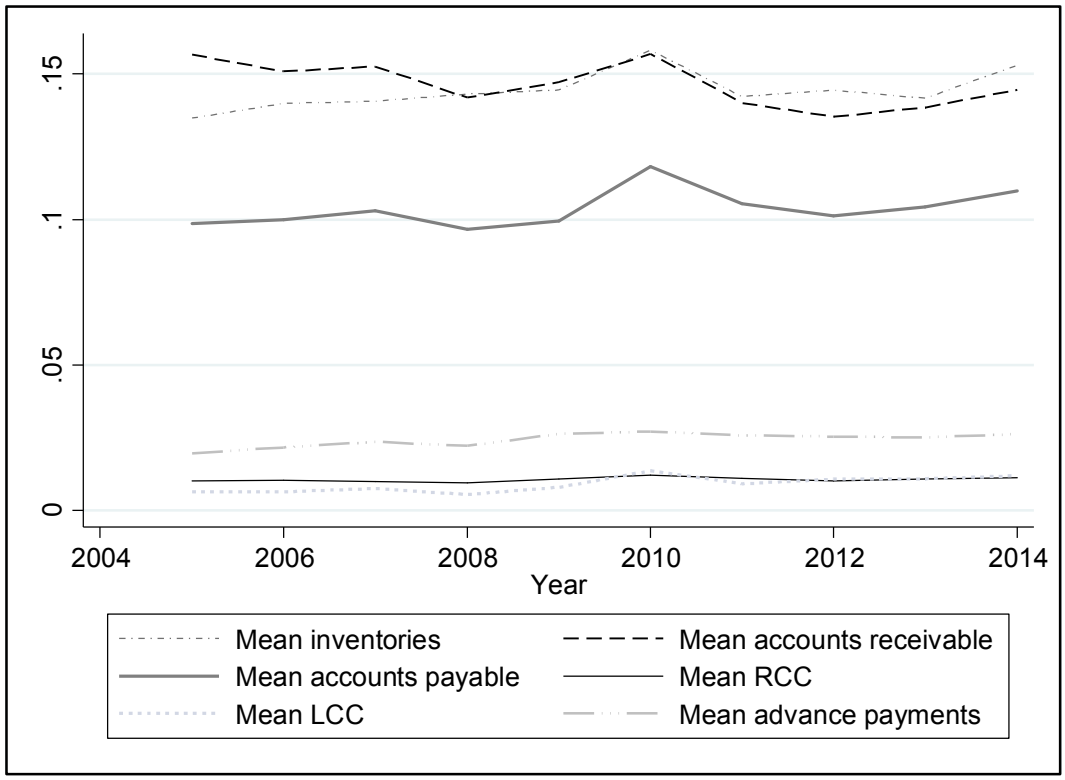

Figure 14: Yearly Average of NWC* Components

Surprisingly, the patterns displayed in Fig. 14 are inconclusive and do not allow to discern which component of NWC* contributes the most to the decrease of the NWC*-to-Sales ratio over the sample period. While mean RCC, on the one hand, and mean LCC and mean advance payments, on the other hand, appear to represent the tiniest components of NWC* relative to sales, their effects on receivables management and payables management, respectively, should not be underestimated. Indeed, combining these three components with accounts receivable and accounts payable provides a better picture of the average receivables management and payables management of the sample firms over the period 2005 through 2014, as can be seen from Fig. 15, in which I display the evolution through time of the mean inventories, mean grouped receivables, which I define as accounts receivables plus receivables from construction contracts, and mean grouped payables, which I define as accounts payable plus liabilities from construction contracts plus advance payments, all scaled by sales.

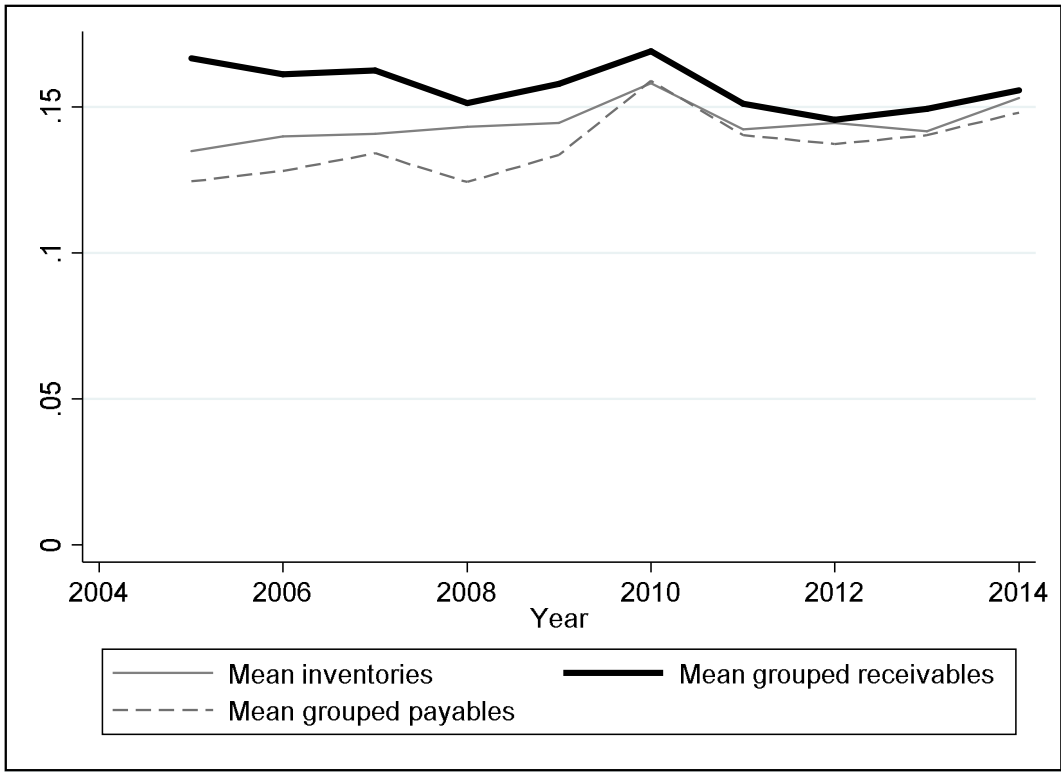

Figure 15: Yearly Average of Grouped NWC* Components

9.3.3. Adaptive Working Capital Management in the Wake of Financial Turbulence

Analysing the patterns displayed in Fig. 15 provides several interesting observations: While the mean of the grouped receivables relative to sales displays a downward trend up until 2008, it increases again in 2009 until it reaches its peak in 2010 only to drop to its lowest level in 2012 and increase again thereafter until 2014. In contrast, the mean level of inventories relative to sales increases steadily until 2010, drops sharply in 2011 to the level it held in 2009 and returns to its upward trend until 2014. Finallly, the mean level of grouped payables relative to sales increases until 2007, decreases in the subsequent year only to increase significantly until its peak in 2010. Thereafter, it follows a similar path than the levels of mean inventories and mean grouped receivables, decreasing until 2012 and moving upwards again until 2014. Even though the patterns observed do not allow me to isolate whether inventory, receivables or payables management contributed most to the statistically significant downward trend in NWC*-to-Sales observed in Fig. 13, they nevertheless allow to visualize the response of German firms to the financial crisis of 2007-2008 and its aftermath with respect to their working capital management. For instance, given that the aggregate level of sales grew constantly from 654 billion € in 2005 to 1110 billion € in 2008 (see Table 2), one can argue that firms had built up high levels of inventory in expectance of ever growing sales. Moreover, given that sales were booming and money was far from being

tight, collecting grouped receivables must not have represented much of a challenge for firms in the sample; one can assume that the prevalent conditions up until 2008 in the real economy, as opposed to the monetary economy, have led the mean level of grouped receivables to decrease relative to sales in an automated manner. One noteworthy observation is that between 2008 and 2010, the average firm in the sample appears to have invested in inventories and grouped receivables while at the same time building up grouped payables, either by postponing payments to suppliers or by accumulating advance payments from customers both in relation to construction contracts and regardless of construction contracts. The situation appears to have been reversed after 2010 until 2012, where investment in all components of net operating working capital decreased, thus pointing to the adoption by the average firm in the sample of aggressive inventory and receivables reduction policies, while at the same time no longer being able to postpone payments to suppliers as well as collecting advance payments for customers as every firm seemed to be focusing on reducing their level of working capital. Finally, a renewed reversal is apparent after 2012, in which the average firm invests again in inventories and receivables and increases group payables. The analysis I provide in this subsection suggests that the average firm in my sample was compelled to continuously adapt its working capital management in the strong wake turbulence that ensued the 2007-2008 global financial crisis.

9.3.4. Industry Analysis

Following Aktas et al. (2015b), I also perform industry analysis to investigate whether the decreasing trend in net operating working capital through time, as proxied by the NWC*-to-Sales ratio, can be generalized or whether it is just limited to a subset of specific industries. Table 3 below provides summary statistics for the NWC*-to-Sales ratio by industry. For each industry/year in my sample period, I compute the median and standard deviation of the NWC*-to-Sales ratio.[236] Columns 1 and 2 report the corresponding median and standard deviation for the years 2005 and 2014. N denotes the number of observations. Besides, for each industry and using all the 10 yearly observations over the period 2005-2014, I regress the median and standard deviation of the NWC*-to-Sales ratio on a linear time trend and

[236] Values for the Travel & Leisure industry are not considered in the table as only one firm in the sample belongs to this industry.

report the slope coefficient in column 3 and 4 respectively. Slope coefficients in bold are statistically significant at the 10%-level (or below).

	(1) 2005			(2) 2014			(3)	(4)
	Median	St. Dev.	N	Median	St. Dev.	N	Slope Median	Slope Std. Dev.
Automobiles & Parts	15.3%	8.9%	6	13.2%	10.3%	6	**-0.0041858**	**0.00321**
Basic Resources	20.2%	7.2%	3	19.5%	10.3%	2	0.0032753	**0.0029183**
Chemicals	21.3%	6.2%	9	21.6%	8.5%	8	0.0005803	0.0012599
Construction & Materials	12.6%	10.8%	6	9.6%	8.6%	4	-0.0003619	**-0.0033599**
Food & Beverage	21.6%	14.4%	2	20.5%	10.5%	2	-0.003093	-0.0041634
Health Care	18.2%	15.5%	9	23.2%	24.3%	9	**0.0041964**	0.0032728
Industrial Goods & Services	22.2%	16.2%	31	16.4%	18.2%	28	**-0.0069092**	0.0013567
Media	1.9%	8.3%	2	4.2%	7.4%	2	-0.0039729	-0.0021281
Oil & Gas	18.3%	13.5%	2	15.0%	0.0%	1	**-0.0278509**	-0.0058591
Personal & Household Goods	22.1%	8.3%	9	16.8%	6.7%	8	**-0.0077321**	-0.0011024
Retail	12.9%	10.2%	9	13.0%	19.1%	9	-0.0011182	**0.0088148**
Technology	17.5%	12.0%	8	14.4%	12.0%	9	0.0006712	-0.0006766
Telecommunications	2.9%	0.0%	1	3.9%	0.4%	2	-0.0000435	0.0000912
Utilities	11.1%	5.3%	3	8.2%	13.9%	4	**-0.0036717**	0.0006814

Table 3: Summary Statistics for NWC*-to-Sales Ratio by Industry

In line with the results obtained by Aktas et al. (2015b) in their industry analysis, the distribution of the median and standard deviation of the NWC*-to-Sales ratio points to the existence of a great heterogeneity with respect to working capital practices across industries (see also Fig. 16). Moreover, a look at the coefficient estimates of the time trend variable indicates that the time trend is negative for 10 out of 14 industries and statistically significant for 5 of those industries. In contrast to Aktas et al. (2015b), the regression estimates of the time trend variable for the standard deviation is only negative for less than half of those industries (6 out of 14) and only statistically significant for one industry. Interestingly, the Industrial Goods & Services industry, to which the highest number of firms in my sample belong and for which it makes much sense to use the alternative measure of net operating working capital, NWC*, rather than that employed by Aktas et al. (2015b), displays a statistically significant downward time trend in its NWC*-to-Sales ratio. I ought to sound a note of caution regarding these results as the number of industry/year observations is relatively small for most of the industries under consideration in my sample. The results might have borne more similarity to those obtained by Aktas et al. (2015b) had I used a larger sample covering a longer period; nevertheless, the results obtained in Table 3 concerning the median and standard deviation of the NWC*-to-Sales ratio indicate that the decrease in

NWC* over the sample period is widely spread across many industries under consideration here, and that the heterogeneity in terms of working capital management has increased rather than decreased through time in most industries.

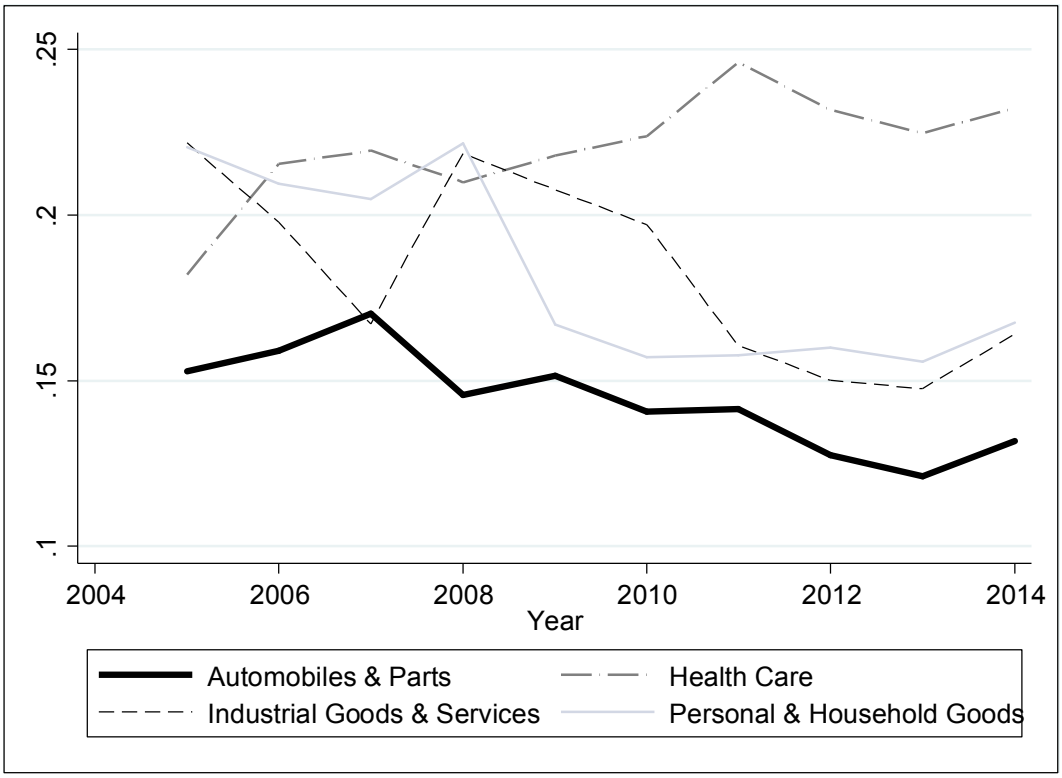

Figure 16: Yearly Industry-Median NWC*-to-Sales Ratio for Selected Industries

Fig. 16 above, which plots the yearly industry-median NWC*-to-Sales ratio for those industries where I identified a statistically significant time trend and for which at least 6 industry/year observations were available, illustrates the high heterogeneity with respect to working capital management practices across industries mentioned earlier.

9.4. Regression Analysis

9.4.1. Independent Variable of Interest

As is apparent from Table 3 and Fig. 16 above, working capital requirements and management practices differ from one industry to another, an outcome which is in line with the existing body of literature.[237] Similarly to Aktas et al. (2015b), it is therefore necessary to control for varying industry characteristics in my study. I do so by using an independent variable, which I denote by *excess NWC**, and which is obtained by subtracting from the NWC*-to-Sales ratio of a given firm the ratio of the median firm in the corresponding

[237] See for instance Hill et al. (2010) for analogous reasoning and evidence.

industry and year. This variable measures the unnecessary cash locked up in working capital for every firm in each year. Following the interpretation provided by Aktas et al. (2015b), an overinvestment in working capital is reflected in a positive *excess NWC**, implying "*that there is room for the firm to increase the efficiency of its WCM across time by adopting a relatively more aggressive working capital policy (such as by reducing inventories and payment delays granted to customers). A negative excess [NWC*] indicates that the firm is currently adopting an extremely aggressive working capital policy, which potentially increases the risk of sales loss essentially due to potential stock-outs and customer dissatisfactions driven by aggressive receivables collection*" (Aktas et al., 2015b, p. 104). In such a case, then, a supplementary working capital investment is predicted to enhance value.

9.4.2. Dependent Variables of Interest

Following the methodology adopted by Aktas et al. (2015b), I measure stock performance using the excess return adjusted for firm size and market-to-book, as described in subsection 8.2.2. However, as my study focuses on the German stock market, I do not use the twenty-five Fama-French value-weighted portfolios following Daniel & Titman (1997), as do Aktas et al. (2015b). Indeed, as shown by Brückner et al. (2015), despite the success of the Fama-French three-factor model and the wide use of factor sets based thereon for non-US stock markets, it is inappropriate to simply export a specific factor model from the US to another country as Germany. Therefore, I construct sixteen Fama-French value weighted portfolios by independently sorting stocks on size and book-to-market (BM) using the monthly TOP shares Size-BM dataset for Germany developed by Brückner et al. (2015). Each firm in my sample is then assigned to size and book-to-market portfolio using the Size and BM breakpoints obtained by Brückner et al. (2015)[238] It should be noted here that due to unavailability of the data covering the year 2014 in those datasets at the time my sample was drawn, I am only able to perform the regression analysis up until the year 2013.

Furthermore, as in Aktas et al. (2015b), I conduct alternative regressions using as dependent variable the return on assets (ROA), which serves as a measure of a firm's operating performance.

[238] The German TOP shares Size-BM factor dataset and the Size and BM breakpoints dataset are available at https://www.wiwi.hu-berlin.de/de/professuren/bwl/bb/data/fama-french-factors-germany.

9.4.3. Control Variables

Due to unavailability of the required data, I am not able to use all the control variables considered by Aktas et al. (2015b) in their performance regressions. The reader should therefore keep in mind that the omission of some of the control variables raises concerns about missing factors correlated with the main independent variable, namely *excess NWC**, which may lead to somewhat biased results. The firm-specific characteristics I employ as control variables are the 1-year growth of sales, a dummy variable for financial distress,[239] cash reserves,[240] the market value of equity as proxy for firm size, leverage,[241] research & development expenditures,[242] and fixed asset growth. I also consider in my preliminary analysis of the summary statistics the values of Tobin's *q*.

9.4.4. Regression Models

As already mentioned earlier, I follow the methodology employed by Aktas et al. (2015b) to investigate the relation between *excess NWC** and firm performance. Specifically, I will run regressions of *excess NWC** on the 1-year excess return and 1-year ROA using both the linear regression model as well as the non-linear, asymmetric regression model set out in subsection 8.2.3. For the asymmetric regressions, I thus create a dummy variable, D, which takes value 1 if the corresponding *excess NWC** is positive and 0 otherwise.

9.4.5. Summary Statistics of Regression Variables

Table 4 below reports a range of summary statistics for the period 2005-2013 and referring to the dependent, independent, and control variables I use in my regression. Q1 and Q3 denote the first and third quartiles, respectively. The values for total assets, sales, and market value of equity are expressed in million € and adjusted to 2015 € by the HCIP index for Germany. N is the number of firms.

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[239] Following Aktas et al. (2015b, p.112), the financial distress dummy I employ relies on Hill et al. (2010), who argue that "*a firm is financially distressed if two criteria are met: (1) the firm faces difficulty to cover its interest expenses and (2) the firm is overleveraged. The firm faces difficulty to cover its interest expenses if its interest coverage ratio (i.e. operating income before depreciation divided by interest expense) is below one for two consecutive years or less than 0.8 in any given year. The firm is considered to be overleveraged if it is in the top two deciles of industry leverage in a given year.*"

[240] Cash and equivalents scaled by total assets.

[241] Total debt scaled by total assets.

[242] Scaled by total assets. (*zero* if research & development expenditure is not reported)

Variable	Mean	Median	Q1	Q3	St. Dev.	N
NWC*-to-Sales	16.52%	15.60%	8.70%	24.46%	13.81%	918
Excess NWC*	-0.10%	0.00%	-6.26%	5.71%	13.40%	918
1-year excess return	1.92%	-3.83%	-22.84%	19.39%	47.77%	918
1-year ROA	2.39%	3.65%	1.20%	6.62%	11.80%	918
Total assets	1406895	150383	45589	709962	3472334	918
Sales	1034449	152870	51230	742759	2210014	918
MVE	670924.9	120113.5	34364	502592	1370361	918
Tobin's Q	1.586535	1.2884	1.0799	1.6873	0.9861932	918
R&D	3.11%	1.54%	0.03%	4.14%	5.07%	918
Fixed asset growth	7.84%	2.41%	-4.18%	9.89%	37.70%	808
Sales growth	5.97%	5.20%	-2.62%	12.73%	35.15%	808
Leverage	22.59%	19.96%	9.73%	32.11%	17.93%	918
Cash reserves	10.22%	7.85%	4.02%	13.79%	8.82%	918
Financial distress dummy	3.05%	0.00%	0.00%	0.00%	17.21%	918

Table 4: Summary Statistics of Regression Variables

It is interesting to note that the average NWC*-to-Sales ratio for the sample firms in the period 2005-2013 is 16.52%, which is lower than the 19.99% and 19.79% NWC-to-Sales ratio reported by Aktas et al. (2015b) and Hill et al. (2010) respectively. The industry-median adjusted NWC*-to-Sales ratio, i.e. *excess NWC**, displays a mean of -0,10%, implying that, on average, the firms in my sample are slightly underinvesting in working capital, and a median of 0.00% by construction. Moreover, regarding the dependent variables, the median firm in my sample has a 1-year excess stock return of -3.83%, while the mean 1-year excess stock return is 1.92%, consistent, as is Aktas et al. (2015b) and, among other, Barber & Lyon (1997), with the distribution of excess returns being positively skewed. The 1-year ROA displays a mean value of 2.39% and a median of 3.65% in my sample, which points to the distribution of ROA to be negatively skewed, in line with the results by Aktas et al. (2015b).

Furthermore, Table 5 below reports the mean and median values of my dependent and control variables for subsamples based on the sign of the *excess NWC**, thus allowing for a comparison of sample characteristics of firms with negative *excess NWC** with those of firms with positive *excess NWC**. The last two columns display the *p*-values from a *t*-test of mean differences and a Mann-Whitney two-sample rank-sum test[243] of median differences between negative and positive *excess NWC** subsamples, respectively. Values in bold are

[243] The Mann-Whitney two-sample statistic tests the hypothesis that two independent samples, i.e. unmatched data, are from populations with the same distribution. It is also known as the Wilcoxon rank-sum test. See Wilcoxon (1945) and Mann & Whitney (1947).

statistically significant at the 10% (or lower) level. Here again, the values for total assets, sales, and market value of equity are expressed in million € and adjusted to 2015 € by the HCIP index for Germany.

Variable	Negative excess NWC*		Positive excess NWC*		*p*-value for positive - negative	
	Mean	Median	Mean	Median	Mean	Median
1-year excess return	5.61%	-0.90%	-2.25%	-6.17%	**0.0127**	**0.0182**
1-year ROA	2.48%	3.34%	2.30%	3.99%	0.8199	**0.0771**
Total assets	1512624	142927	1287428	154665	0.3270	0.6148
Sales	1124012	151596	933248.6	160216	0.1920	0.7508
MVE	738837.9	112476	594187.8	126604	0.1105	0.7729
Tobin's Q	1.572704	1.2594	1.602164	1.3216	0.6517	0.6263
R&D	2.70%	0.44%	3.58%	2.28%	**0.0089**	**0.0000**
Fixed asset growth	6.24%	2.42%	9.66%	2.35%	0.1985	0.9678
Sales growth	8.57%	5.20%	3.03%	5.21%	**0.0253**	0.1193
Leverage	22.93%	21.50%	22.21%	18.48%	0.5450	0.3855
Cash reserves	10.62%	8.32%	9.77%	7.57%	0.1432	0.2096
Financial distress dummy	0.0287474	0	0.032483	0	0.7429	0.7427

Table 5: Sample Characteristics - Negative vs. Positive excess NWC*

In line with the results reported by Aktas et al. (2015b), firms with positive *excess NWC** had on average a significantly lower stock performance and invested slightly more in research & development relative to firms with negative *excess NWC**. However, in contrast to Aktas et al. (2005), they tend to have experienced on average a lower growth rate in their pattern of sales. Unfortunately, the tests of mean and median differences reveal that only a few of the mean and median of the firm characteristics under consideration here are significantly different between the two subsamples. This may be due to the relatively small number of observations composing my sample. It nonetheless remains important to control for all the firm characteristics – except for Tobin's *q* which Aktas et al. (2015b) only use in their investment regressions and which, as I have noted earlier, is prone to high measurement error[244] – in the multivariate regressions which are presented in the next subsection, as again omitting variables from my regression analysis may lead to biased results.

9.4.6. Empirical Evidence

In this subsection, I present the empirical evidence I obtained - using STATA® - from the analysis of my panel data of the relationship between *excess NWC** and stock performance and operating performance respectively. Since I use lagged variables and that some of my

[244] See subsection 3.3.3.

variables are growth variables, I am only able to use the data in my sample covering the period 2007 through 2013. The number of firm-year observations is hence reduced to 698. Moreover, in contrast to Aktas et al. (2015b), I perform random effects (RE) regressions in addition to firm-year fixed effects (FE) regressions and conduct a Hausman test to check which model is more appropriate for the regression analysis of the panel data under consideration in my study.

9.4.6.1. Working Capital Management and Stock Performance

Table 6 on next page presents the fixed effects (FE) and random effects (RE) stock performance regressions. Following Aktas et al. (2015b), the dependent variable is the 1-year excess return and all the independent variables are lagged by one year relative to the dependent variable. Columns 1-2 (1'-2') report the estimation of the linear FE (RE) model, and columns 3-4 (3'-4') the estimation of the asymmetric model. The proxy used for firm size is the natural logarithm of the market value of equity.

The relation between *excess NWC** and stock performance is negative in column 1 as well as in column 1'. It is statistically significant at the 5%-level in column 1' and the Hausman test indicates that using the random effects model is more appropriate when considering only the *excess NWC** as dependent variable, though the R^2 is not as large than in the fixed effects model (0.006 vs. 0.043). In line with the results of Aktas et al. (2015b), this negative relation is not robust to the inclusion of the control variables in the fixed effects regression model (See column 2), which, following from the results of the Hausman test, is more appropriate to use than the random effects model.

Since I also expect, as Aktas et al. (2015b), the cutback of only the unnecessary portion locked up in working capital to result in an increase in performance of the firms in my sample, the regression specifications I consider in Columns 3, 3', 4, and 4' include two interaction variables, [*excess NWC** x D] and [*excess NWC** x (1-D)], which interact the *excess NWC** with the dummy variables D and (1-D) identifying firms in my sample with positive and negative *excess NWC**, respectively. Unfortunately, and in contrast to Aktas et al. (2015b), the results of the fixed effects regressions reported in columns 3 and 4 – which are to be chosen over the random effects regressions following the Hausman tests – indicate that for firms in my sample characterized by a positive (negative) *excess NWC**, an increase (decrease) in *excess NWC** leads to an increase in stock performance. Moreover, this result is statistically significant only for firms in my sample displaying levels of net operating working capital below the median level of the industry it belongs to.

Variable	(1) FE		(1') RE		(2) FE		(2') RE		(3) FE		(3') RE		(4) FE		(4') RE	
	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value
Excess NWC*(t-1)	-0.554	0.11	-0.308	0.05	-0.471	0.17	-0.355	0.03								
Excess NWC*(t-1)*D									-0.118	0.78	-0.520	0.04	0.095	0.82	-0.627	0.02
Excess NWC*(t-1)*(1-D)									-1.737	0.02	-0.064	0.81	-2.028	0.01	-0.035	0.90
Firm size					-0.444	0.00	-0.029	0.02					-0.445	0.00	-0.030	0.02
Leverage					0.046	0.85	0.282	0.05					0.119	0.63	0.275	0.06
R&D					-0.937	0.36	0.082	0.87					-1.503	0.15	0.167	0.74
Fixed assets growth					-0.063	0.21	-0.076	0.11					-0.078	0.12	-0.713	0.13
Cash Reserves					0.700	0.07	0.447	0.10					0.661	0.09	0.480	0.08
Financial distress dummy					-0.329	0.02	-0.345	0.01					-0.338	0.02	-0.343	0.01
Sales growth					-0.029	0.58	-0.075	0.13					-0.019	0.71	-0.080	0.11
R^2 within (FE)/R^2 overall (RE)	0.043		0.006		0.187		0.027		0.049		0.009		0.195		0.032	
Fisher statistic (FE)/Wald chi^2 (RE)	3.77	0.00	3.85	0.05	9.4	0.00	24.76	0.00	3.7	0.00	5.06	0.00	9.24	0.00	26.38	0.00
Number of observations	698		698		698		698		698		698		698		698	
Result of Hausman test	chi^2=1.46, Prob>chi^2=0.2269 RE model more appropriate				chi^2=54.66, Prob>chi^2=0.00 FE model more appropriate				chi^2=8.73, Prob>chi^2=0.01 FE model more appropriate				chi^2=86.61, Prob>chi^2=0.00 FE model more appropriate			

Table 6: Excess NWC* and Stock Performance

Hence, this result does not allow me to infer that an optimal level of working capital exist that maximizes shareholder value. Perhaps this result is obtained due to the lack of sufficient control variables, as hinted by the relatively low value for R^2 in column 4 (0.195), although the model including the control variables in use in my study (column 4) provides a better fit to my data than that in which the control variables are not included (column 3 with R^2 value of 0.049). This result may also suggest, following Frankel et al. (2016), that managing working capital goes undetected by shareholders. Another possible explanation for this result might be that shareholders, adhering to the conventional wisdom that reducing working capital levels is always a good strategy to follow, inherently consider investment in working capital to be detrimental to shareholder value. This view is supported by the results obtained for the control variables, per which only the coefficient estimates of firm size, cash reserves and the financial distress dummy are statistically significant at the 10% level or lower and display signs consistent with existing literature and as intuitively expected. Specifically, the positive sign obtained for the coefficient estimate of the cash reserves (0.661) corroborates the substitution effect documented by Bates et al. (2009) between cash reserves and working capital levels through time.

9.4.6.2. Working Capital Management and Operating Performance

Like Aktas et al. (2015b), I perform regressions of my measure of excess net operating working capital, *excess NWC**, on a firm's operating performance, which I measure using its return on assets (ROA), computed as profit attributable to shareholders from continuing operations[245] divided by total assets. Table 7 on next page reports the results of both the firm and year fixed effects as well as the random effects regressions on operating performance. As in the stock performance regressions presented in the previous subsection, the independent variables are lagged by one period with respect to the dependent variable. Moreover, I use the same econometric methodology and the same set of control variables as in Table 6.

Following the argumentation brought forward by Aktas et al. (2015b), I expect that for firms with a negative (positive) *excess NWC**, an increase (decrease) in *excess NWC** in one period leads to an increase (decrease) in those firms' operating performance in the next period and that therefore, an optimal level of working capital exists that maximizes operating performance. Column 1' in Table 7 reports a statistically highly significant negative

[245] Ergebnisanteil der Aktionäre aus fortgeführten Aktivitäten.

coefficient estimate of *excess NWC** in a linear random effects regression on *ROA* – which, for my sample, is more appropriate than a fixed effects regression. This result is consistent with that obtained by Aktas et al. (2015b).

Variable	(1) Fixed		(1') Random		(2) Fixed		(2') Random		(3) Fixed		(3') Random		(4) Fixed		(4') Random	
	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value	Coef.	*p*-value
Excess NWC*(t-1)	-0.255	0.00	-0.171	0.00	-0.194	0.00	-0.097	0.04								
Excess NWC*(t-1)*D									-0.423	0.00	-0.419	0.00	-0.358	0.00	-0.335	0.00
Excess NWC*(t-1)*(1-D)									0.198	0.16	0.234	0.01	0.257	0.07	0.254	0.00
Firm size					0.048	0.00	0.021	0.00					0.049	0.01	0.020	0.00
Leverage					0.275	0.00	0.124	0.00					0.254	0.00	0.110	0.00
R&D					0.049	0.81	-0.228	0.09					0.213	0.29	-0.142	0.28
Fixed assets growth					-0.009	0.34	-0.004	0.69					-0.005	0.61	0.001	0.92
Cash Reserves					0.201	0.01	0.253	0.00					0.212	0.01	0.270	0.00
Financial distress dummy					-0.048	0.08	-0.046	0.09					-0.046	0.09	-0.045	0.09
Sales growth					0.013	0.21	0.021	0.04					0.010	0.32	0.016	0.10
R^2 (within)	0.053		0.013		0.138		0.115		0.074		0.079		0.158		0.165	
Fisher statistic (FE)/Wald chi^2 (RE)	4.68	0.00	12.35	0.00	6.59	0.00	71.49	0.00	5.82	0.00	41.05	0.00	7.14	0.00	99.71	0.00
Number of observations	698		698		698		698		698		698		698		698	
Result of Hausman test	chi^2=2.73, Prob>chi^2=0.10				chi^2=111.93, Prob>chi^2=0.00				chi^2=0.08, Prob>chi^2=0.9612				chi^2=89.22, Prob>chi^2=0.00			
	RE model more appropriate				FE model more appropriate				RE model more appropriate				FE model more appropriate			

Table 7: Excess NWC* and Operating Performance

With respect to the asymmetric fixed effects model, the coefficient estimates for positive (negative) *excess NWC** reported in columns 3' and 4 are -0.419 (0.234) and -0.358 (0.257), with all values being statistically significant at the 1%-level (or lower). These results are in line with those obtained by Aktas et al. (2015b) and Baños-Caballero et al. (2012 & 2014). They allow me to infer that for the firms in my sample, there exists an optimal level of net operating working capital. The implication for policy that follows from this result is that, following the argumentation provided by Aktas et al. (2015b), managers of German corporations that aim to get near that optimal level of net operating working capital, either by increasing or decreasing their investment therein, will eventually enhance the operating performance of their firms. Finally, regarding the control variables, firm size, leverage, and cash reserves carry a positive and statistically significant coefficient estimate at the 1%-level, while the financial distress dummy, as intuitively expected, is negatively associated with a firm's operating performance as measured by the *ROA* at the 10% significance level.

10.Conclusion

The review of literature presented in the first part of this thesis (Sections 2 through 8) has highlighted the progress that has been achieved in both the theoretical and empirical research area of working capital management since the publishing of the article by Walker (1964), in which, I remind the reader, the author asked himself whether it was possible to develop a theory of working capital, pointing to the dearth of pertinent literature available at the time. Contemporary researchers as well as practitioners in the field of working capital management can now draw upon a clearer picture of the factors that influence working capital management. In addition, this allows corporate managers to move away from adhering to the conventional wisdom with regards to working capital management towards adhering to a sustainable approach in which specific factors such as corporate governance as well as the right managerial incentivization - allowing, among other things, to fathom the year-end decline in working capital - should play a greater role in achieving this goal.

In the second, empirical part of this thesis, I first gave the reader on overview of the methodologies applied in existing research articles relating working capital management to both a firm's profitability as well as the value to its shareholders. This allows me to clearly identify a change of paradigm from a state in which decreases in levels of working capital lead to an increase in firm valuation (e.g. Deloof, 2003) to a state in which an industry-

specific optimal level of working exists that maximizes firm valuation (e.g. Aktas et al., 2015b, and Baños-Caballero et al., 2012 & 2014), and that corporate managers should aim to attain and maintain this optimal level or eventually follow it as it changes over time. With regards to my own empirical study, in which I use an alternative and, for my purposes, superior measure of net operating working capital, the results I obtain are not entirely in line with those obtained by Aktas et al. (2015b), specifically with regards to the stock performance regressions. Although this might be due to the lack of sufficient control variables in use in my study, I bring forward another plausible explanation stating that shareholders of German corporations, who perhaps still adhere to the conventional wisdom that reducing working capital levels is always a good strategy to follow, inherently consider investment in working capital to be detrimental to shareholder value. Besides, it may also be an indication that a firm's management of its working capital goes undetected to its shareholders, as argued by Frankel et al. (2016). Nonetheless, the results obtained from my operating performance regressions are clearly in line with those obtained by Aktas et al. (2015b) and Baños-Caballero et al. (2012 & 2014) and point to the existence of an inverted U-shaped relationship between working capital investment and a firm operating performance as well as to the existence of an optimal working capital level that maximizes operating performance for German corporations. Besides, I provide, using descriptive statistics, empirical evidence of how the firms in my sample adapted their working capital policies to the downturn economic environment they faced. As it turns out, the average firm in my sample was compelled to continuously adapt its working capital management in the strong wake turbulence that ensued the 2007-2008 global financial crisis.

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