WORKING CAPITAL MANAGEMENT EFFICIENCY IN INDIA: AN EMPIRICAL ANALYSIS

Ph. D. Thesis

by

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CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the thesis entitled "**WORKING CAPITAL MANAGEMENT EFFICIENCY IN INDIA: AN EMPIRICAL ANALYSIS"** in partial fulfilment of the requirements for the award of the Degree of Doctor of Philosophy and submitted in the Department of Management Studies of the Indian Institute of Technology Roorkee, Roorkee, is an authentic record of my own work carried out during a period from January, 2013 to October, 2015 under the supervision of ***Dr. Anil K. Sharma***, Associate Professor, Department of Management Studies, Indian Institute of Technology Roorkee, Roorkee.

The matter presented in this thesis has not been submitted by me for the award of any other degree of this or any other Institute.

(UTKARSH GOEL)

This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

(ANIL K. SHARMA)
Supervisor

Date: October 14, 2015

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ABSTRACT

The global financial turbulence affected the business and increased the demand for efficiency, efficacy and productivity (Kumar and Vincent, 2011). Aftermath of deregulation, globalisation of economies, strong presence of capital market and global financial instability have created opportunities as well as many challenges in front of Indian firms to sustain its performance and competitiveness. Sound economic growth of any developing economy in general and success of any firm in specific depends on efficient handling of limited resources. A large and critical portion of a firm's resources is in the form of short term capital or working capital and it is thus crucial for firms to be efficient in managing working capital. The motivation of this study is to perform a robust performance evaluation of working capital management (WCM) efficiency in Indian firms.

The study aims to examine the efficiency of working capital management in Indian firms in the current scenario and analyse the trends. To achieve these objectives this study develops a new measure of WCM efficiency using frontier analysis technique 'Data Envelopment Analysis'. It also aims to explore the firm-specific and macro-economic variables that influence the efficiency of working capital management. Moreover, the objective of the study is also to examine the extent of influence of working capital management efficiency on accounting and market performance of firms. In addition, the study separately analyses the cash holding pattern and its impact, because of its uniqueness in comparison to other liquid assets.

This study follows a systematic approach to achieve its objectives and tries to link each step of analysis to the next one.

In the first stage, the study adopts a non-parametric frontier technique called Data Envelopment Analysis (DEA) to estimate efficiency of working capital management in Indian manufacturing firms and examines the efficiency scores obtained using this new technique. It compares the new DEA based WCM efficiency measure with the traditional measures and examines its advantages. The new measure is found to be an improvement over the traditional measures because of it benefits of having no mathematical fallacy, higher scale of measurement, capability of benchmarking analysis and ability to be flexible. The efficiency scores indicated that the average WCM efficiency is around 40%, and that there is a vast difference between

maximum and minimum efficiencies. This shows that in all industries, there are firms which are extremely inefficient in managing working capital.

This stage also analyses the trend in WCM efficiency over the ten year period (2004-2013) using both traditional measures viz. cash conversion cycle and net trade cycle along with new DEA based efficiency measure. Graphical and statistical analysis is carried out to understand the pattern of WCM efficiency and to examine whether the efficiency has undergone any change over the study period. Results suggest that though each industry has its own accepted norm for working capital levels and maintain its position relative to other industries, however the efficiency level is not constant across the years. The trend analysis indicated that efficiency levels of working capital management do vary with time which might be the result of several firm-specific and macro-economic factors.

In second stage of the analysis, present study examines the influence of various firm-specific and macroeconomic variables on the WCM efficiency of firms. The traditional WCM efficiency measures and new DEA measure are employed and both graphical and statistical analysis is carried out to analyse the effect of various variables. Analysis is carried out separately for each industryand the results from all the measures and industries are combined to identify the variables with significant influence. It is observed that age of firm,cash holdings, investments in fixed assets,return on assets and sales growth have positive effect on the WCM efficiency. On the other handleverage and size of firms were found to have negative influence. The study also found that the macroeconomic variables had inconsistent effect on WCM efficiency and thus their influence remains inconclusive.

Malmquist Productivity index (MPI) and its components pure efficiency, scale efficiency and technology change (as given by Färe et al.(1994) are used to examine the change in WCM efficiency of Indian manufacturing firms over the study period. The trend in pure and scale efficiency changes along with technology change is analysed over the ten years. It is found that the cumulative efficiency change has increased considerably in the ten years but most of this change has been due to change in technology. The analysis indicated that during the study period pure efficiency has almost doubled while the scale efficiency has improved only slightly. Moreover the influence of change in various firm specific and macroeconomic factors on MPI, pure efficiency and scale efficiency change are analysed using both graphical and statistical analysis. The relationships obtained were almost similar to those obtained previously (analysis of WCM efficiency determinants) and thus confirmed the earlier results.

In the final stage of WCM analysis the relationship between WCM efficiency and performance of firm is explored. Again both traditional measures (CCC and NTC) and the new DEA based measure are used to examine the effect of WCM efficiency on firm performance. Firm performance is measured using a variety of measures including accounting based, valuation based and wealth creation measures. Each performance measure is used in combination with each of the three WCM efficiency measure (CCC, NTC and DEA based measure) for robust analysis. It is found that many of the performance measures were positively related to the WCM efficiency which suggest that improvement in the efficiency of liquidity management tends to improve the financial performance of firms. Accounting performance measure: return on sales, market performance/valuation measure Tobin's Q, wealth creation measure market value added (MVA)exhibited positive relationship with WCM efficiency measures This suggested that increase in WCM efficiency is valued by the investors and that the improvement in the efficiency of working capital management improves the overall functioning of firms and hence it leads to creation of value/wealth. Overall it can be inferred that an increase in the WCM efficiency is an essential ingredient for improvement in the performance of firm.

In the last section of this study, a different aspect of working capital management i.e. cash holding pattern is analysed. The study found that mean cash holding level in Indian firms was much lower than the values reported in developed countries. The study analysed the movement in the cash holding of firms and investigates whether the pecking order theory or trade-off theory is more applicable with respect to cash holdings in the Indian scenario. The results are more or less in agreement with trade-off theory and it was observed that cash holdings have mean reversion property i.e. as the cash holdings deviate from a target level, firms try to reverse the change and bring the holding back to the desired level. Based on past studies, the study modelled optimal/target cash holdings using various firm-specific variables and found that in general the deviation from the target is around 50% of its value in the previous year, indicating that firms move towards the target and reduce the gap in subsequent years. The study examines the impact of change in cash holdings on the market performance of the firm. The results suggested that a positive change in cash holdings did have a positive effect on stock returns i.e. the investors attach more value with a firm that has more cash. However, beyond a level, any increase in cash holdings (increase in excess cash) is considered unnecessary hoarding and the value of the firm starts declining.

The study examines the WCM efficiency of Indian manufacturing firms in an entirely new perspective. Valuable insights and analysis opportunities provided by the proposed new DEA

based WCM efficiency measure will aid financial managers, analysts and other stakeholders to better evaluate and benchmark firms' liquidity management. The findings of this study will help financial and operational managers to make better decisions in order to achieve the target of maximizing shareholder wealth through proper liquidity management.

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ABBREVIATIONS

ANOVA	Analysis of Variance
BCC	Banker, Charnes and Cooper
CCC	Cash Conversion Cycle
CCR	Charnes, Cooper and Rhodes
CFO	Cash Flow from Operations
CMIE	Centre for Monitoring Indian Economy
CRS	Constant Return to Scale
DEA	Data Envelopment Analysis
DMU	Decision Making Unit
EMS	Efficiency Measurement Software
GDP	Gross Domestic Product
MPI	Malmquist Productivity Index
MVA	Market Value Added
NTC	Net Trade Cycle
PE	Pure Efficiency
PE	Price Earnings Ratio
RBI	Reserve Bank of India
ROA	Return on Assets
ROE	Return on Equity
ROS	Return on Sales
SE	Scale Efficiency
TC	Technology Change
VRS	Variable Returns to Scale
WC	Working Capital
WCM	Working Capital Management

CHAPTER 1
INTRODUCTION

Preview

This chapter introduces the study by providing a background of the research area, description of the problem and its rationale. It first provides a brief overview of working capital management, its efficiency and its relevance in the Indian context. It then describes the problem and discusses data envelopment analysis (DEA) as an efficiency measurement tool. The chapter then discusses the rationale, scope and objectives of the study along with brief outline of research design and methodology. Lastly it presents the chapter plan of the study.

CHAPTER 1

INTRODUCTION

1.1 Background

1.1.1 Introduction

Changing business environment, deregulations and liberalization have altered the face of business competition. With the globalisation of markets, none of the economies have remained untouched from fierce global competition and the developing economies are no exception. The global financial turbulence has significantly affected the business and has increased the demand for efficiency, efficacy and productivity (Kumar and Vincent, 2011). Emerging economies are playing a vital role internationally due to globalisation of economies in recent years (Arora, Jain and Das, 2009). Sound economic growth of any developing economy in general or for any firm in specific depends on efficient handling of limited resources. Limited funds are available to firms and thus success of a business depends on how efficiently these funds are utilised (Vashisht et al., 2011). This requires effective decision making by the management and involves analyses of all the financial choices that the firm faces and then deciding on the course of action that should be taken. One of the critical issues in corporate financial decision making is efficient handling liquid assets i.e. management of working capital.

The overall objective of this study is to carry out a robust analysis of working capital management in terms of efficiency and productivity in Indian manufacturing firms in the context of today's globalised Indian economy. To achieve this, the study attempts to develop a new measure for effective measurement of working capital management efficiency. The study aims to analyse the factors influencing WCM efficiency and also examine the empirical association of WCM efficiency with performance. Moreover, this study also aims analyse the cash holdings of firms and examine its relationship with firm's performance.

1.1.2 Working Capital

Working capital can be understood as a metric that measures a company's operating liquidity. It is the relation between resources in the form of cash or easily convertible into cash and liabilities for which cash will be required soon. There are thus two constituents of working capital namely current assets and current liabilities.

Current assets are those assets or resources of firm which are held only for a short period of time. In general all those assets which will be liquidated and converted into cash within one year or one operating cycle (whichever is longer) are called current assets. Current assets constitute:

Cash and cash equivalents: These constitute cash in the form of physical currency or bank deposits and also include cash equivalents which can be readily convertible into cash such as commercial paper, money market holdings, treasury bills etc.

Inventory: These refer to stock of goods held by firms for further processing or sale. Inventory can be broadly of three types:

a) Raw materials: These are items that have been procured by firm in order to convert them into semi-finished and finished goods through production process. Raw materials are unprocessed material waiting to be put into production process.
b) Work in progress: These are semi-finished goods which are in the process of converting into finished or final product. All items from the raw materials that has just realised for processing up to the material that is almost completely processed come under this heading.
c) Finished goods: These are items that have passed through all the stages of production and are now completely processed. Finished goods are items that are waiting for orders from customers.

Receivables: If the goods are sold to customers on credit then the money owed by the customers to the firm is call receivables or accounts receivables. They are simply the rights to receive money from entities to whom goods have been sold or services have been provided.

Motives for holding current assets

There are a number of motives behind making investments in current assets. These include:

Transaction Motive: Firms keep cash in order to meet day to day expenses and to make payments. Raw material is held by firms to maintain smooth production as they may not be available as and when required. Finished goods are stored for uninterrupted sale as demands may not be able to keep pace with production at all times.

Precautionary Motive: Keeping cash helps firms in making payments for unexpected and unplanned expenses. While holding inventory helps in meeting unforeseen fluctuations in

supply of raw materials due to strike, natural calamity etc, on the other hand holding finished goods helps in meeting variations in demand of goods.

Speculative Motive: Sometimes firms hold cash so that they are able to take advantage of favourable market conditions like bargain price for raw materials or favourable market exchange rates etc. Similarly firms may hold inventory more than they require if they fear that there may be a steep rise in their prices in future.

Current liabilities are those liabilities or obligations that need to be settled within one year. In other words, the money owed by the firm for a short period that needs to be repaid through current assets or through creation of another current liability is called current liabilities. Current liabilities include tax payables: tax owed to government, interest payables: interest owed to lenders, accrued expenses: expenses that have been incurred but not paid, short term loans: loans that are to be repaid in a year, customer deposits: advance payments from customers and accounts payables. Accounts payables or trade credit is the most important part of current liability (García-teruel & Martínez-solano, 2010). It is the money payable to suppliers for the purchases made on credit. Thus current liabilities are sources of short term financing. They finance a portion of the firm's current assets and hence reduce the amount of firm's own funds that need to be tied up in current assets.

There are two main notions of working capital viz. the gross concept and net concept. The gross concept measures the gross working capital by measuring the total amount of current assets held by the firm. On the other hand the net concept measures net working capital by calculating the excess of current assets over current liabilities. It measures the portion of current assets financed from long term sources. Working capital can also be divided into permanent and temporary working capital. Permanent working capital is the minimum amount of current assets that always need to be maintained irrespective of the volume of sales. On the other hand temporary working capital is the fluctuating or seasonal capital required over and above the permanent working capital. Overall, working capital characterizes the liquidity position of a firm and thus is also sometimes known as 'circulating capital or current capital'. Figure 1.1 shows the circulating/cyclical nature of working capital.

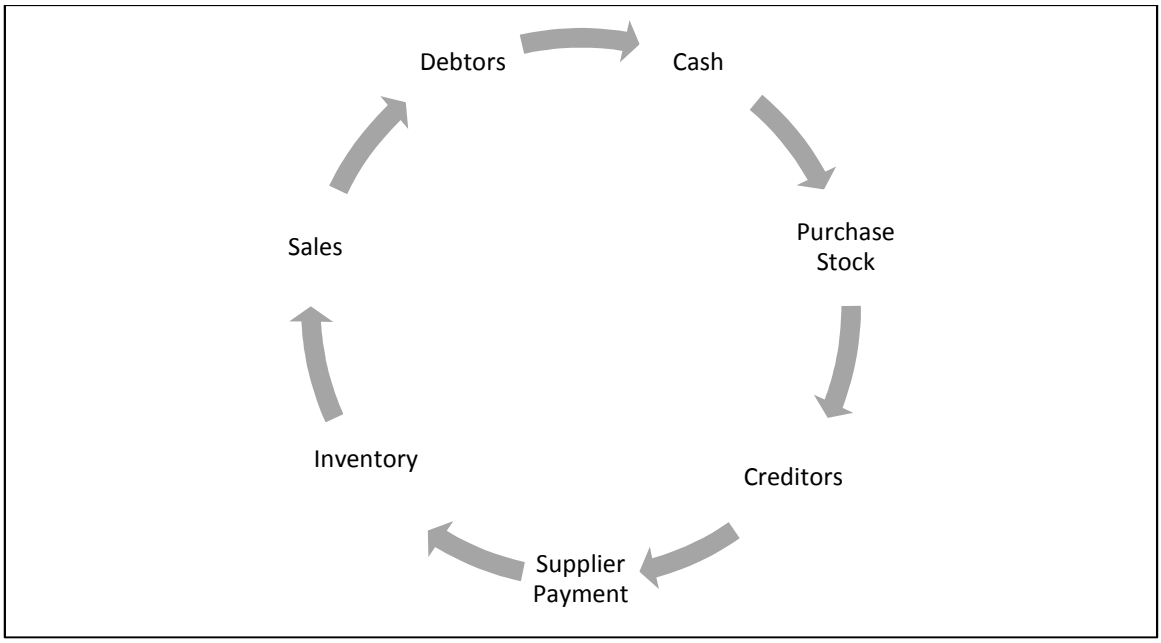


Figure 1.1: Cyclical Nature of Working Capital

1.1.3 Working Capital Management

Working Capital management (WCM) deals with managing short-term financing and short-term investment decisions of the firm (Sharma & Kumar, 2011). It is the management of current assets, current liabilities and the inter relationship between them. The objective of working capital management is to maintain balance among the working capital components (Filbeck & Krueger, 2005). There are two main facets of working capital management: first, to estimate the amount of various current assets to be held by the firms and second, to determine the extent of their financing through different current liabilities. There are two main objective of working capital management:

- To make sure that the firm has sufficient liquid resources to function smoothly
- To minimise the investment in working capital in order to maximise the profitability

The importance of trade-offs between the two goals of working capital management, i.e., liquidity and profitability has always been stressed in literature since both are essential for continuance of business. Here liquidity means whether or not a firm is able to meet its short term obligations as and when they are due. The overall goal of working capital management is that a firm should be able to continue its operations by managing the inter-relationship between current assets and current liabilities.

Working capital management involves decisions regarding:

- Inventory levels: Deciding between high costs of stockholding due to inventory pile up vs. cost of stock outs as a result of keeping low inventory (Mishra and Raghunathan, 2004). Deciding between liquidity benefits of holding inventory vs. liquidity benefits of free funds.
- Receivable levels: Deciding between allowing high levels of receivables to promote sales vs. liquidity benefits of cash. Deciding between cost of slow cash inflow due to large and long receivables vs. cost of lower sales.
- Creditor levels: Deciding between availing liquidity benefits by delaying the payments of purchases vs. benefits of maintaining good reputation and better relations with the suppliers.
- Cash Levels: Deciding between liquidity benefit of holding cash vs. opportunity cost of idle cash.

There can be broadly three approaches to working capital management (Andrew and Gallaher, 1968) namely aggressive, moderate and conservative. These three approaches differ from each other in their liquidity vs. risk characteristics. An aggressive approach involves keeping low level of current assets and high level of current liabilities. This results in low liquidity and high risk characteristics. However it frees up more funds which can be invested more profitability elsewhere. On the other hand conservative approach involves keeping high level of current assets and low level of current liabilities. This results in high liquidity and low risk characteristics. However this also leads to higher blockage of funds in current assets and thus reduces the total returns on investment. In other words, in case of aggressive approach, a large portion of permanent current assets are financed from short term sources. This increases risk but improves profitability. On the other hand in conservative approach, permanent current assets and even some portion of temporary current assets are financed from long term sources of funds. This reduces risk but at the cost of profitability. The moderate approach follows a mid-level path in between aggressive and conservative approach and tries to keep a balance among liquidity, risk and profitability. Here long term sources finance permanent assets and short term sources finance temporary current assets. The WCM decisions affect number of other managerial decisions which in turn affect performance of firm (Mishra and Vaysman, 2001) (Banker et al., 2002).

1.1.4 Importance of Efficient Working Capital Management

Working capital management plays an important role in a firm's profitability, risk as well as in its value (Smith, 1980). Working capital is the circulating capital and therefore it has also been termed as the life blood of business. Its flow and circulation is essential for continuance of

business. It is sometimes said that a firm can survive without being profitable but improper working capital management may result in bankruptcy and closing down of business. Even a profitable firm can fail and become bankrupt if there is mismanagement in working capital. Smith (1973) argues that a large number of business failures have occurred due to improper management of working capital. Berryman (1983) also states that improper working capital management is the primary reason for small business failures. There are two main reasons for the importance of working capital management:

i) A significant percentage of a firm's total investment is in the form of current assets.

ii) The levels of both current assets and current liabilities change rapidly and suddenly.

The importance of working capital management also arises because of the two types of risks that are inherent in it viz. opportunity cost risk and liquidity risk. The opportunity cost risk is risk of unavailability of funds or assets to seize the opportunity when it arises. Liquidity risk is the risk of shortfall or unavailability of funds in case of any liability falling due. Both the risks can seriously affect the performance and in long run the existence of firm.

Improper cash management resulting from payment commitments without proper cash flow forecasts can lead to financial distress. Similarly keeping large amount of slow moving inventory or simply ineffective inventory management system can increase cost of holding, insurance, interests etc., ultimately leading to losses. Improper tracking of receivables can lead to costs of litigation and risk of serious bad debts. Again ineffective management of payables can lead to failure in meeting payment commitments and thus loss of supplier trust. Excessive working capital can have a number of fallouts like problem of overcapitalisation, uncontrolled purchases of inventory leading to waste and theft, tendency to engage in speculative activities, too liberal credit resulting in delay of cash inflow and overall carelessness. Excessive working capital may have a negative effect on a firm's profitability, whereas a low level may lead difficulties in maintaining smooth operations (Van Horne and Wachowicz, 2008). An effective working capital management ensures that the firms is able to grasp all the profitable opportunities that arise in the business and helps in reducing liquidity risks.

The importance of efficiency of working capital management can be understood by the statement "Efficient working capital management is an integral component of the overall corporate strategy to create shareholder value" (Shin & Soenen, 1998). It is very important for working capital management to be effective because it affects the performance and liquidity of the firms (Taleb et al., 2010). The viability of business relies on the ability to effective manage receivables, inventory and payables (Filbeck & Krueger, 2005). Minimization of investments in

the short term assets relative to the level of a firm's operations is a crucial element in the total management of operating funds (Helfert, 2004). To maintain competitiveness, companies should improve their performances in terms of WCM efficiency and it is important for firms to correctly measure the level of their efficiency and identify the benchmark firms.

Working capital management is somewhat similar to fixed asset management but for WCM there needs to be more active involvement since the strategy varies with sales. However, working capital management has often been ignored in financial decision making because it involves investment and financing for short term period whereas the concentration of managers are generally more on long term fund management. Short-term management is a difficult problem since usually companies do not employ working capital managers (Bolek, 2013). In today's competitive world of high capital costs (due to paucity of funds) and high costs attached to holding of funds, working capital management is gaining attention of managers. Increase in sales, declaration of dividends (Gupta et al., 2011), plants expansion, launch of new products, rising prices and hike in salaries and wages put addition pressure on firm's health and hence effective working capital management becomes critically important. Kulkarni (1985) says that working capital management is looked upon as the driving seat of a financial manager. The study of working capital management and it efficiency is thus vital for all stakeholders of the firms and is especially critical in manufacturing firms as they require large investments in short term assets.

1.1.5 Indian Manufacturing Sector

Just like any other global economy, manufacturing sector plays a crucial role in the economy of India (Nandan and Mishra, 2009). Its contribution in Indian GDP is approx. 15.2% and the growth rate of the sector is healthy at around 8.5%. The growth in Indian economy as a whole and manufacturing sector in particular has attracted many domestic and international investors (Agarwal, 1997) and Indian securities market is poised for development and growth (Dixit et. al., 2010). A report by Mckinsey states that the Indian manufacturing sector could reach US$ 1 trillion by 2025. The report further states that the sector has potential to reach 25-30 percent of India's GDP and can create 90 million jobs.

The contribution of manufacturing though a significant figure is still very small in comparison to service sector. This has been a cause of concern for policy makers since according to economists, for a growing economy, higher growth and contribution of service sector before sufficient development of manufacturing sector is not a healthy sign. Since major portion of

India's population is educated below high school level therefore such an economy cannot flourish on service sector for a long period.

One of the main reasons for subpar performance of Indian manufacturing sector is that a large part of the sector is unorganised (Agarwal, 2000). In addition lack of efficient transport infrastructure, high power cost and high capital cost also have a negative impact on the growth and competitiveness of Indian manufacturing sector (Puntambekar and Nandan, 2006a & 2006b).

Stable socio-political environment (Gounder, 2002a and 2002b) and efforts by government are required to improve the infrastructure, finance facilities and framing favourable fiscal policies to create positive atmosphere for development of manufacturing sector. One of such steps is the 'Make in India' program. In addition to government efforts, it is extremely important for firms to make internal changes in order to reduce costs, improve efficiency, improve service quality (Gupta et al., 2005)and increase global competitiveness (Rao, 2014). These changes might include upgradation of production technology, establishment of professional and accountable management, emphasis on attraction and retention of talent, more export oriented production, reengineering core business processes to align them with industry best practices and focussing on quality and customer satisfaction (Rao, 1985) (Prakash et al., 2010). Under the World Trade Organisation system there has been descent of import tariffs and removal of quantitative restrictions and therefore it becomes more imperative for the Indian manufacturing industry to improve its competitive edge.

1.1.6 Working Capital Management in India

According to a report by Ernst & Young ("Working capital management 2014: all tied up India - EY - India", 2014), India stands among the bottom of global working capital performance in comparison to peers like Europe, USA, Japan and other Asian countries. While some of this may be explained due to difference in business models and geography, there is a large role of management orientation and effectiveness in managing working capital efficiently. The report also reveals that Indian firms have US$ 97 billion tied up in working capital which is roughly 12% of gross sales. This tied up capital could have then been utilised for financing expansion or for repaying debt, which would have solved many of the firms' problems.

The report further suggests that there has been some improvement in the recent year but the small improvement is grossly insufficient to make up for the downward slide that the Indian firms have witnessed in the last three four years. The improvements by Indian firms are all the

more undermined since the improvements by firms in other countries are much higher. Some of the poor performance may also be attributed to exchange rate fluctuations, volatile commodity prices, volatile regulatory environment, variation in interest rates, etc. but still poor management practices followed by Indian firms are largely responsible to a large extent for the dismal performance. According to E&Y report, main factors include lack of collaborative and cooperative relationship with suppliers, poor due diligence of customers' background before granting credit and poorly documented contracts. Most of the firms still not consider working capital management as an operational issue and do not try to adapt to the rapidly changing global business environment.

At regulatory level the government needs to improve the logistics and transportation infrastructure. This will aid firms in improving their supply chain management and hence working capital performance. At firm level the firms too need to pull up their socks. There is a large disparity in the working capital management practices among firms within same industry. While a few of them follow industry leading standards for working capital management, on the other hand majority of the smaller firms are stuck with age old practices. There is need to increase improvement in the payment practices as most of the transactions still happen in cash or in cheques, instruments which are becoming obsolete in developed world. Switching to bank and card based transfer may reduce the payment related delays and improve performance. There needs to be increased management's focus on cash and process related efficiency. The firms need to implement industry best practices in working capital management strategies and processes so as to reduce the working capital cycle. This may involve substantial capital expenditures, but in the long run it would result in substantial savings.

Thus it becomes necessary to effectively measure working capital management efficiency, analyse the trends in working capital management practices, understand the factors that affect the efficiency of working capital management and examine the impact on performance of firms.

1.2 Description of Problem

1.2.1 Working Capital Management Efficiency: Measurement and Analysis

Ratios such as current ratio and quick ratio have traditionally been employed to gauge the working capital position of firms (Shin and Soenen, 1998). The current ratio measured liquidity position as ratio of current assets to current liabilities. The ratio was measured at the end of a quarter or year and presented a snapshot of working capital position on that date. Due to the

static nature of these ratios, many authors like Emery (1984) and Kamath (1989) have questioned and criticised their adequacy.

Next, the cash cycle concept was introduced by Gitman (1974) who proposed to measure the time period from the time payment is made for raw materials to the time goods are sold. Later this measure was extended by Richards & Laughlin (1980) who incorporated account payables to give the concept of Cash conversion cycle (CCC) sometimes also called Net working capital cycle (NWC). CCC/NWC is a WCM efficiency measure which measures the efficiency in terms of days. CCC is calculated by adding inventory and receivable days and then subtracting payable days from the result. CCC is an efficiency measure that measures the working capital management efficiency of a firm. A smaller value of CCC indicates lower level of working capital investment as percentage of sales and hence higher WCM efficiency. The cycle concept of working capital can be understood from Figure 1.2.

However, some studies, like Shin and Soenen (1998) and Bhattacharya (2004) have criticised CCC for being mathematically flawed. They point out that CCC is calculated through addition of three ratios, i.e., by adding three different types of days (receivable days, inventory days and payable days) and since all the ratios (days) have different denominators hence this makes the measure mathematically flawed. Moreover, some studies like Gentry et al (1990) criticise CCC for not focusing on the amount of funds tied up and only focussing on the length of time funds are tied. Since some firms may find it easier to liquidate inventory while others may find it more convenient to recover receivables therefore there is also concern regarding assignment of equal weights to each component of working capital which may lead to biased results. This will depend upon the nature of business and the firm’s relations with other stakeholders. However, CCC is the most popular measure for measuring WCM efficiency and most of the studies related to working capital use CCC as the main measure.

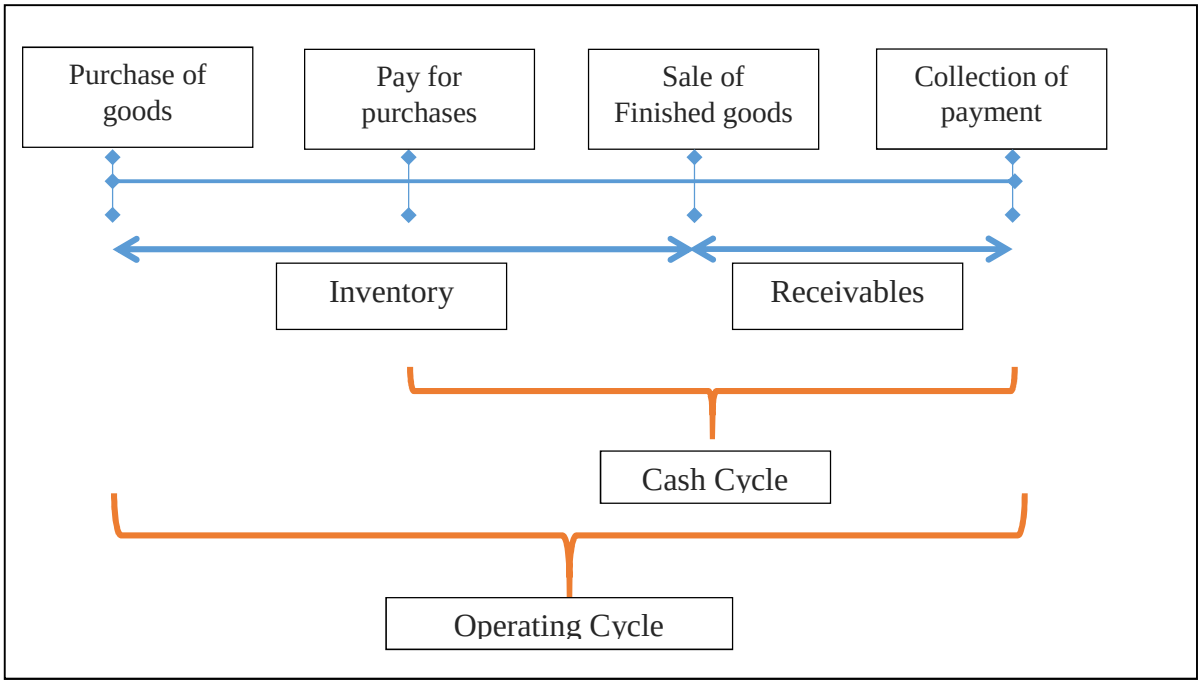


Figure 1.2: Operating Cycle and Cash Cycle

Gentry et al (1990) have used a variation of CCC, i.e., weighted cash conversion cycle (WCCC). WCCC assigns weights to the working capital components based on the amount of funds tied up with it. However, the measure is of limited usage for analysts as the weights cannot be calculated by an analyst outside of the firm's management as the required data is not available publicly (Shin and Soenen, 1998). Talonpoika et al. (2014) give an improved variation of CCC that takes into account the advanced payments, but the previous problems still remain.

Some researchers like Shin and Soenen (1998) and Erasmus (2010) propose an alternative measure Net Trade Cycle (NTC) ((Inventories + Receivables - Creditors)*365 / Sales). NTC is a WCM efficiency measure which measures the net current assets as percentage of sales i.e. lower is the net working capital per unit of sales, better will be the efficiency. NTC overcomes the first shortcoming of CCC as it is comprises of just one ratio and not three different ratios like CCC. However, similar to CCC it assigns equal weight to all components of working capital (inventory, receivables and creditors) which may make the efficiency calculation biased.

Overall CCC and NTC despite of their few shortcomings are most widely used efficiency measures for working capital management and other measures have still not been widely accepted. Financial innovations improve market efficiency (Dixit et al., 2009) which is vital for thriving economy (Agarwal and Tandon, 2003) (Dixit et al., 2010) and therefore there is need for innovations in WCM efficiency measurement. Hence there is need of a new measure which

can effectively gauge the efficiency of working capital management and should be as far as possible free from the problems of existing measures.

Moreover, because of a lack of effective measure of WCM efficiency, comprehensive analysis of WCM efficiency and its pattern in Indian manufacturing firms has not been carried out by previous studies. In order to better understand the management effectiveness of working capital in Indian firms and its trend in the recent years, it is essential to carry out a complete analysis of WCM efficiency levels, their variations across industries and their trend over the years.

1.2.2 Determinants of Working Capital Management Efficiency

Working capital management and its efficiency is affected by a large number of factors. One of the most important of these is the nature of industry to which the firm belongs. Each industry has its own needs and accepted practices for holding liquid assets. In addition to industry other factors specific to firm might include:

- Type of operations: whether the business is seasonal in nature
- Scale of operations: large multi plant business or a small enterprise
- Firm's credit policy: whether firm is risk averse or risk taking while granting credit
- Dividend policy: whether firm is declaring dividend in current year
- Reputation in market: whether firms is well established and has earned trust of market
- Growth or expansion firm: whether firm is in growing or expansion phase
- Firm's management: the ability of firm's management to efficiently manage

Both the internal and external factors effect a firm's operations. They change the way a firm and its management performs and the extent to which they are able to achieve firm's objectives. In other words, both the firm specific micro-economic variables and macro-economic conditions influence the efficiency and productivity of an organisation.

It is well understood that macroeconomic factors affect a country's business conditions (Cerra et al., 2008) (Chipalkatti and Rishi, 2001). Moreover many studies have also found that macroeconomic factors like change in technology, government import export policies, taxation policies, condition of market, condition of economy, availability of bank finance facilities, interest rates etc. also have impact on the efficiency of working capital management. The investigation of these influencing variables plays an important role in assessment of WCM efficiency and examining its change.

A number of studies have tried to analyse the factors that determine working capital levels in firms across countries. However there are number of shortcomings/gaps in these studies. These include: not considering macroeconomic factors as determinants of working capital, using a small sample size, not controlling for industry effect, using only one of the components of working capital and using only cash conversion cycle or its constituents as efficiency measure which may give suboptimal results. Moreover, only a small number of studies have been conducted in the Indian context. There is thus need to comprehensively analyse the determinants of working capital management efficiency in Indian firms and examine the extent of their influence.

1.2.3 Effect of Working Capital Management Efficiency on Performance:

Effective management of working capital is essential for the good financial health of firms. The way working capital is managed can have a significant impact upon both the liquidity and profitability of the company (Shin and Soenen, 1998). As discussed earlier, both excessive and deficient working capital is harmful and can seriously affect the survival and growth of firm. Working capital management efficiency is therefore expected to significantly affect the performance of firm and ultimately its value. There are two contrasting views on the impact of working capital management on firm's performance. Some of the authors suggest that as the liquidity levels increase (efficiency decreases), the firm is able to do business in a better manner and thus the performance improves. On the other hand others argue that as a firm becomes more efficient and needs lesser investment in working capital for its operations, its performance improves.

A large number of studies have examined the effect of different working capital policies on firm's financial performance in various countries. Most of these studies have used profitability as main indicator of performance and CCC as indicator of working capital management efficiency. However since a firm's aim is to maximise shareholder's wealth, therefore market performance too should be included as one of the performance indicators. In addition the analysis should also focus on the impact on value of firm due to changes in working capital management policies. Moreover, only cash conversion cycle should not be relied upon to test this relationship especially when there are question marks on the correctness of CCC. Thus there are few shortcomings in the earlier studies which include using small sample size, using only cash conversion cycle or other possibly suboptimal measures of working capital, not controlling for industry effect and not analysing effect on market performance. There are very few studies in the area on Indian firms which consider sufficiently large sample size and

conduct a thorough analysis using a variety of firm performance measures. Therefore, there is need of a comprehensive study which analyses the effect of working capital management on firms' financial and market performance in the Indian context.

1.2.4 Cash Holdings

Cash is one the most vital constituents of working capital. However, cash is not considered as invested or tied up capital and hence cash holding pattern is not taken into account while calculating the efficiency of working capital management. Nevertheless it has significant influence on the liquidity level of a firm and also has a bearing on other components of working capital. A number of studies have shown that firms hold a significant portion of their assets as cash and bank balance. For example Dittmar and Mahrt-Smith (2007) found that US firms kept 13% of their total assets as cash and marketable securities. Kalcheva and Lins (2007) found that internationally firms kept 16% of their assets in cash and Ferreira and Vilela (2004) calculated this ratio to be 15% for EMU countries. The question that arises here is that why do firms hold so much cash? Two major theories have been used by researchers to explain the cash holding by firms: trade-off theory and pecking order theory. The trade-off theory states that there are costs and benefits of holding cash. Firms adjust their cash holdings such that they are able to maximize the benefits and minimize the costs. The pecking order theory states that the cash holding level of a firm is just the result of investment and financing decisions. It states that it is expensive for firms to raise capital through the issue of new equity due to information asymmetry and therefore the firms follow the following order to raise funds: internal funds, debt and finally equity.

A number of studies have analysed the cash holding of firms in various countries. These studies mainly examine the determinants of cash holdings in firms and the effect of cash holding on the firms' market performance. A few studies have also found that cash holdings and their pattern differ from country to country. Ferreira and Vilela (2004) studied EMU firms and compared the cash holdings across a number of EMU countries. They found that capital market development and investor protection provisions do significantly affect the cash holding levels. However, almost all the authors have limited their study to developed economies like USA (Opler et al. 1999), Australia (Lee and Powell 2011), EMU countries (Ferreira and Vilela 2004) and France (Saddour 2006). Corporate finance studies on developing countries firms still lack depth (Sen and Pattanayak, 2005) and very few studies have been conducted to study the cash holding pattern and its implications for firms from growing economies. A small number of studies have

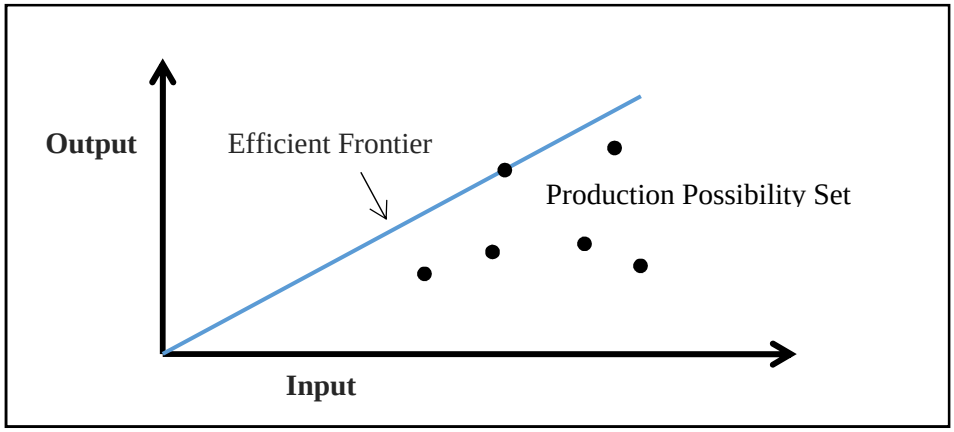
been conducted on Chinese firms but the results might have little applicability in other developing nations like India.

Kusnadi and Wei (2011) have found evidence that there is difference between cash holding of firms in countries where investor legal protection is weak and those where it is strong. These studies suggest that the cash holding model applicable to firms of one country may have little applicability in other countries since the market development and law enforcement scenarios differ. The results from these studies suggest that the cash holding pattern in firms of developing countries like India may differ from those of other countries and hence there is need to analyze the same. Since the developing economies are becoming targets for global investments, it therefore becomes important to examine and study the cash management in firms from such economies.

1.3 Data Envelopment Analysis as Efficiency Measure

Data envelopment analysis (DEA) is a non-parametric, linear programming based technique developed by Charnes et al. (1978) which evaluates the relative efficiency of a subject or decision making unit (DMU) in a group. The advantage of the non-parametric approach over parametric approach is that it does not require pre-specified functional form. DEA is useful in calculating efficiency especially in cases where there are multiple inputs and multiple outputs and where it is not possible to aggregate these multiple inputs (outputs) into one input (output). In DEA the ratio of total weighted outputs to total weighted inputs measures the relative efficiency. However the weights of individual inputs and outputs are not fixed and are allowed to vary such that each DMU is able to achieve the highest possible efficiency. The restriction is that no DMU can have ratio of weighted outputs to inputs more than unity. Linear programming is then used to solve and calculate the efficiencies. Efficiency scores range from 0 to 1 and a DMU is labelled as efficient if it has efficiency of 1.0.

The DEA measure is based on building an efficient frontier. This efficient frontier is a frontier that connects the most efficient DMUs and envelops all other DMUs.

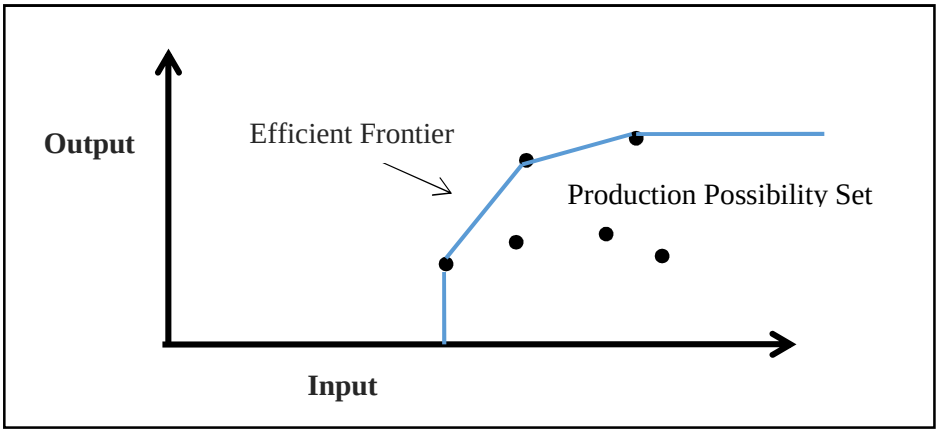


Source: Cooper, Seiford, & Tone (2006)

Figure 1.3: Efficient frontier in CCR DEA Model

The two most popular models are CCR (Charnes, Cooper and Rhodes) model and BCC (Banker, Charnes and Cooper) model. Charnes et al. (1978) developed the CCR model which assumes a constant return to scale. The efficient frontier in this case is a straight line. Figure 1.3 shows CCR efficient frontier in case of one output and one input.

The BCC model given by Banker et al. (1984) extends the CCR model for technologies that exhibit variable returns to scale. Here the efficient frontier is in the form of a convex hull. Figure 1.4 shows the BCC efficient frontier in case of one output and one input. In a practical scenario of varying economies of scale the BCC model is generally more suitable.



Source: Cooper, Seiford, & Tone (2006)

Figure 1.4: Efficient frontier in BCC DEA Model

The efficiency of any DMU is calculated by measuring the distance of the DMU from the frontier. This can be explained with the help of an example of two outputs and one input case. Figure 1.5 shows an efficient frontier BCEG connecting efficient DMUs. The DMU D is inefficient as it does not fall on efficient frontier. If we extend the line connecting O and D the

line touches efficient frontier on point X. This imaginary DMU represented by point X is an efficient DMU since it lies on efficient frontier. The efficiency of DMU D can be calculated by measuring the lengths of OD and OX and calculating the ratio OD/OX. If for example OD = 15 and OX = 20 then the OD/OX = 0.75 i.e. the efficiency of DMU D is 75%.

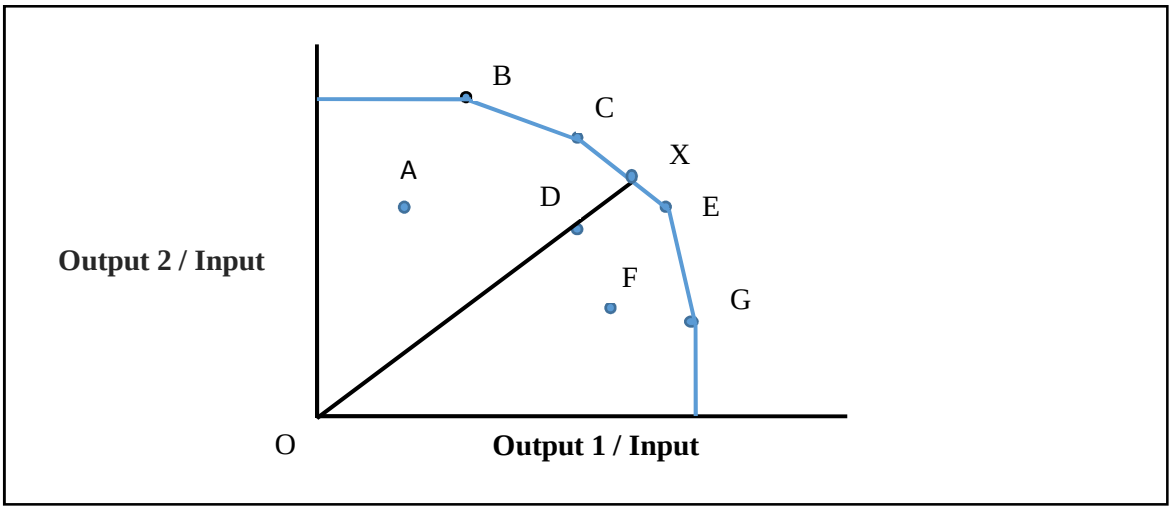


Figure 1.5: Efficiency Calculation in Two Outputs and One Input Case

The following expression gives basic DEA efficiency model:

$$\max h_o(u,v) = \frac{\sum_r u_r y_{ro}}{\sum_i v_i x_{io}}$$

$$subject\ to$$

$$\frac{\sum_r u_r y_{rj}}{\sum_i v_i x_{ij}} \leq 1\ for\ j = 1, \dots, n,$$

$$u_r, v_i \geq 0\ for\ all\ i\ and\ r.$$

Where x_{ij} is the ith input for DMU j and y_{rj} is the rth output for DMU j. x_{io} and y_{ro} are input and output values, respectively, of the DMU under evaluation. h represents the efficiency score.

Researchers have used DEA extensively for measuring different types of efficiencies because of its advantage of being a non-parametric technique and freedom to have different weights for different DMUs. For example Medin et al., (2011) use DEA to measure efficiency of hospitals, Sharma and Gupta (2010) and Chan et al. (2014) to measure efficiency of banks, Parameshwaran et al. (2010) for efficiency of automobile repair shops, Sharma and Raina (2013) for performance of automobile sector, etc. However, till date DEA has not been applied

to measure the efficiency of working capital management. Since working capital management too has inputs and outputs therefore DEA can be applied to measure WCM efficiency too.

1.4 Rationale of the Study

A large number of firms fail due to improper management of short term funds or due to liquidity problems. For a growing economy like India it becomes all the more important to have an effective and efficient working capital management. A firm with efficient working capital management can save a lot of cost and thus perform better and thereby create value for its shareholders. For this reason it is important to know how efficiently firms are managing liquidity in comparison to their peers in the industry. In order to gauge efficiency accurately, new tools for working capital efficiency measurement need to be studied and analysed.

In addition, all the factors that determine working capital level of a firm may not be within firm's control. Some factors may change with industry and some may be macroeconomic in nature. It is essential for firms to be aware of these factors and the extent of their influence so that they can fine tune their policy for maximisation of benefits. Hence it is important to study the factors other than the firm's policy decision that might affect its working capital levels. Consequently there is need of comprehensively studying the various determinants and analysing their effect on efficiency of working capital management in Indian firms.

The end goal of a firm's financial decision making is maximisation of shareholder's wealth (Ansari and Khan, 2012). A firm's working capital level and its efficiency will affect the firm's performance and therefore will influence its financial results and market performance. It is important to understand how and to what extent this phenomenon holds. This will aid the firms in understanding the consequences of change in internal and external factors on firm's working capital levels which in turn will affect its financial performance. Thus there is need to study the effect of working capital management efficiency on firm's financial performance.

In addition, corporate cash holding which form a crucial element of working capital need to be analysed separately. This is because the nature of cash holding as a liquid asset differs from other components of working capital and thus does not get covered in the analysis of WCM efficiency. Moreover studies have indicated that cash holdings have significant effect on other components of working capital and on firm's performance. Since the studies on cash holdings have been concentrated on developed economies, hence there is need for analysis of cash holding dynamics in Indian firms.

1.5 Scope of the Study

Overall scope of the study is to analyse the working capital management of public firms of Indian manufacturing sector in current scenario. Following are the broad areas of investigation that constitute the scope of the study:

1) The investigation in the present study is limited to the public ltd. companies operating in Indian manufacturing sector during analysis period.

2) The study period includes era of globalised Indian economy and therefore, includes evidence from the year 2004 to 2013. The duration includes pre financial crisis (2004-2007), financial crisis (2008-2010) and post financial crisis (2011-2013) period.

3) The study adopts a balanced panel data approach and therefore, includes an equal number of firms across the study period in every analysis.

4) The study analyses the efficiency of working capital management in Indian manufacturing firms using various measures including a new measure calculated using Data Envelopment Analysis.

5) The study explores WCM efficiency's trend, determinants (firm specific and macroeconomic) as well as its implications on firm performance. In addition the study examines the pattern and behaviour of corporate cash holdings.

1.6 Objectives of the Study

The overall objective of this study is to carry out a comprehensive analysis of working capital management efficiency in Indian manufacturing firms. Following are the broad objectives of the present study:

1. To analyse the working capital management efficiency measures and develop a better measure of WCM efficiency.

2. To evaluate and assess working capital management efficiency of firms operating in Indian manufacturing sector in current scenario.

3. To explore determinants of firms' WCM efficiency and to examine whether a significant statistical relationship exists between WCM efficiency and the determinants (firm specific and macroeconomic variables).

4. To examine the pattern of WCM efficiency change (productivity) using Malmquist Productivity Index and its constituents.

5. To examine whether a significant statistical relationship exists between firm's performance and its working capital management efficiency.

6. To examine the dynamics of corporate cash holdings and its effect on firm in the Indian manufacturing sector.

1.7 Methodology

This study follows a systematic approach to achieve its objectives and tries to link each step of analysis to the next one.

The first stage of the analysis aims to accomplish the objective 1 and 2. In this stage, this study adopts a non-parametric frontier technique called Data Envelopment Analysis (DEA) to estimate efficiency of working capital management in Indian manufacturing firms and examines the efficiency scores obtained using the new technique. It also compares the new DEA based WCM efficiency measure with the traditional measures and discusses the various advantages of the new measure over the traditional ones. This stage also analyses the trend in WCM efficiency over the ten year period (2004-2013) using both traditional and new measures. Graphical and statistical analysis are carried out to understand the pattern of WCM efficiency and to examine whether the efficiency has undergone any change over the study period. WCM efficiency is calculated and analysed separately for each of the 11 industries into which the whole sample of firms is divided.

The second stage of the study targets objective 3. In this stage of the analysis this study examines the influence of various firm-specific characteristics and macroeconomic variables on the WCM efficiency of firms. The traditional WCM efficiency measures viz. CCC and NTC along with DEA based efficiency measure are employed and both graphical and statistical analyses are carried out to analyse the effect of various determinants. This study adopts Panel data regression (determinants of efficiency) model for the purpose of empirical analysis in this phase. Separate regression models are employed for each of the efficiency measure and the analysis is carried out separately for each of the 11 industries. Results from all the measures and industries are combined to identify the variables with significant influence and to discover the direction of their influence on WCM efficiency.

In the next section of analysis the study targets the objective 4. Here Malmquist Productivity index and it components pure efficiency, scale efficiency and technology change (as given by Färe et al. (1994) are used to examine the change in WCM efficiency of Indian manufacturing firms over the study period. The trend in pure and scale efficiency along with technology change is analysed over the ten years to assess the change in WCM efficiency. Moreover the determinants of the MPI, pure efficiency and scale efficiency change are analysed using both graphical and statistical analysis. Panel data regression is used for carrying out empirical analysis using MPI, PE and SE (separately) as dependent variables and various firm-specific and macroeconomic variables as independent variables. This analysis is carried out to identify the influence of change in various variables on specific constituents of WCM efficiency change.

In the final stage of the WCM analysis the relationship/association between WCM efficiency and performance of firm is explored. Both traditional measures (CCC and NTC) and the new DEA based measure are used to examine the effect of WCM efficiency on firm performance. Firm performance is measured using accounting based, valuation based and wealth creation measures. Here again panel data regression model is employed for statistical analysis using performance measures as dependent variables and WCM efficiency measures as independent variables. Each performance measure was used in combination with each of the three WCM efficiency measure (CCC, NTC and DEA based measure) for robust analysis and separate analysis was carried for each of the 11 industries. The results of all the regression models were combined to infer the final outcome.

In the last section of this study, a different aspect of working capital management i.e. cash holding pattern of Indian manufacturing firms is analysed. The study analyses the movements in the cash holding of firms and examines its relationship with other firm characteristics. The study investigates that whether pecking order or trade-off theory is more applicable with respect to cash holdings in the Indian scenario. The mean reversal nature in cash holdings is analysed to examine the existence of a target/optimal level of cash. The optimal level of cash holdings is modelled and the impact of excess cash holding on the market performance of the firm’s stock is analysed. Graphical and statistical assessment is employed in the section for analysis.

1.8 Organisation of Thesis

Chapter 1 introduces the present study by providing a detailed background. It then discusses the scope, objectives and also briefly presents the methodology of the study.

A comprehensive review of literature and studies on working capital management and its efficiency evaluation is detailed in Chapter 2.

Chapter 3 describes the research design of study which includes methodology adopted, sample size, tools & techniques and models required for the study.

Chapter 4, 5 and Chapter 6 are empirical in nature and constitute major analysis portion of this study. Chapter 4 analyses WCM efficiency, its trends and determinants. Chapter 5 examines the change in WCM efficiency and analyses the impact of WCM efficiency on firm performance. Chapter 6 focuses on analysing the dynamics of corporate cash holdings.

Chapter 7 discusses the overall findings of the study with its policy and managerial implication. It also outlines the limitations, suggestions and future scope of research of the study. Bibliography and Appendix are incorporated at the end.

CHAPTER 2
REVIEW OF LITERATURE

Preview

This chapter presents a comprehensive review of studies on working capital management efficiency. The chapter discusses the studies pertaining to WCM efficiency, its importance and the measures used to gauge it. It also reviews empirical studies done on determinants and impact of working capital management efficiency. Moreover studies that have employed DEA as a tool for efficiency measurement in various fields have been reviewed and discussed. The chapter brings forth the gaps in the literature and lays the foundation for the theoretical and empirical background of subsequent analysis.

CHAPTER 2
REVIEW OF LITERATURE

2.1 Introduction

With the emergence of globalisation of economies, efficient intermediation of funds and productive allocation of scarce funds become an essential requisite for fostering growth of the economy. Each firm is now required to be more efficient in handling of resources in order to survive the competition. Working capital which is one of the critical components of firm's resources also needs to be handled and managed efficiently to ensure achievement of shareholders' wealth maximisation. Efficient working capital management requires accurate measurement of efficiency and understanding of its determinants and effects. Conventional ratio and cycle based techniques have been traditionally used to gauge the efficiency of WCM. The shortcomings of these techniques work as primer for development of new and improved techniques.

Several studies have examined the issue of working capital management efficiency; however a numbers of gaps still remain which require further exploration. This chapter aims to explore the major concerns of research in WCM and its efficiency which leads to emergence of gaps and lays the foundation of this study.

2.2 Importance of Efficient Working Capital Management

Strischek (2001) presents a banker's perspective on working capital and cash flow management. He suggests that working capital should remain proportional to sales and one should check incremental investment in working capital for 1 dollar increase in sales. Also he points out that banks measure appropriateness Strischek suggests that efficient working capital is essential to have more cash flow to repay bankers and will lead to more value for investors and therefore working capital management is the unsung hero of finance.

Payne (2002a) gives a list of 10 major mistakes that need to be avoided while managing working capital. He suggests that those firms that do not have effective working capital management achieve suboptimal results and are more likely to fail. He also points out that working capital management lies in the heart of a firm's business and its efficiency can bring

benefits in excess of a firm's expectation. Moreover Payne goes on to point out that working capital management is driver of balance sheet, profit and loss statement, cash flow and growth.

Payne (2002b) similar to previous paper here also it is pointed that efficient working capital management helps the firms to free up cash which can be put to more productive use Payne suggests that proper systems have to be in place to manage working capital otherwise firm will have to invest much more in working capital in comparison to its peers. He also states that the payoffs from working capital management initiatives give return in excess of 10 to 20 times of the investment.

Steyn et al. (2002) have analysed the working capital of high growth firms listed on Johannesburg Stock Exchange. They argue that firms which experience high sales growth also experience an increase in non-cash working capital base. Growth leads to increase in accrual of profit and decrease in availability of cash for financing growth and for financing increase current assets. This can lead to downfall of the firm. Thus it is essential for firms to not only concentrate on growth of sales but also on effectively and efficiently managing working capital so that there is no shortage of cash flow to finance day to day activities.

Harris (2005) suggests that working capital management is a difficult task but at the same time is very rewarding. The firms should not only concentrate on internal process improvement but also consider the internal and external constraints including human factor. The author further suggests that enabling entrepreneurial mind set through the organisation to empower and to make the employees understand true working capital needs will make the firm successful. The results of study imply that working capital management efficiency brings rewards but the task is difficult and would need support of everyone in the organisation.

Gundavelli (2006) suggests 7 ways for firms to improve the performance of working capital. He states that firms are looking forward to increase growth and for that working capital is seen as hidden reservoir which can be used to push expansion. He suggests that improved payable and receivable management can lead to freeing up of cash flows and this fund could provide upto additional 5 to 9 percent in net profits. The study again implies that adopting latest technology for improving business processes to improve receivables and payables can lead to substantial benefits to the firm.

Sagner (2007) analysed firms in US and points out that firms having unused and inefficient working capital are becoming target for mergers and Acquisition. This is because such firms have a lot of unused funds which can be utilised by the acquirer for productive use. Sagner

estimated that although the net working capital as percentage of sales has declined considerably but still about $600 billion is tied up in excess working capital. He further suggests that the firms follow just in time inventory, receivable collateralisation and standard centralised policy for payable management to make its working capital management efficient. Overall the study stresses the importance of efficient working capital for firm's sustainability.

Smid (2008) explores the industry best practices and trends on working capital management. The author finds that there is considerable benefit of having an efficient working capital which includes one-off release of funds into the business and also continued savings thereafter. He states "Ernst & Young find that the largest 1,000 European companies by sales have in total up to Euro 475 bn of cash surplus to WC requirements, equivalent to 20 per cent of their total WC scope". Smid states that overall there are many challenges in making working capital management efficient but the benefits are also huge. Thus working capital management should be a commitment and strategic objective of the firm in order for the firm to face global competition.

Bittner et al. (2011) have also stressed the importance of working capital management and state that it should be an essential focus area in today's business environment. The authors state that firms should try to cut down on inventory and other current assets in order to free up cash and to negotiate better payment terms with both customers and suppliers. The study stresses the need to have enterprise wide focus (right from the office of CEO) for effective management of liquidity. There needs to be a holistic approach by the firm to have better communications with both inside and outside stakeholders in order to have better relationship, reduced carrying cost, reduced obsolescence and therefore lower requirement of working capital. This according to the authorsmay also lead to new business opportunities which were previously absent.

Ek and Guerin (2011) have again stressed that working capital is the life blood of the firm and it is essential for it to manage the same effectively. Too much investment tied up in working capital can make a firm lose opportunity to invest the same more productively somewhere else. Right management of working capital is essential to combat underperformance but there is no fixed formula for calculating the right amount of working capital. The authors suggest that firms should focus on "order-to-cash impacting mainly receivables purchase-to-pay impacting mainly payables and forecast-to-fulfil impacting mainly inventory" in order to have efficient working capital. They further argue that right amount of working capital depends upon industry and individual firm and a firm should look at firms in upper quartile of firm's peers to fix its own target. They point out that improvement in working capital management can be done by

analysing the ‘current’ ‘could be’ and ‘should be’ levels of performance and that there is tremendous scope of improvement in most firms.

Lukkari (2011) in his thesis has carried out a bibliographic study of working capital management. He points out that the originality and novelty in research articles on working capital is low. Most of the studies have concentrated on relationship between working capital management and profitability using usual statistics. There has been shortage of studies on working capital practices. He points out that although studies in developed countries used data from firms of all sizes but the studies in developing countries have used mostly big size firms. He stresses that future research needs to be carried out in “tools for working capital management, inventing or improving alternative views to working capital management like process-oriented view and firm or industry specific studies”. Lukkari further finds that research in working capital has not been of very high quality and there is room for good research on mathematical models on WCM and alternative view on WCM.

Tăgăduan and Nicolaescu (2011) have analysed Romanian firms and found that proper working capital management by firms my reduce the negative effect of financial crisis and might improve the liquidity and cash flow levels of firms.

Etiennot et al. (2012) analyse the working capital management in 51 countries. They point out that working capital management has scarce finance research. They state that in less efficient financial markets which are common in emerging economies effective and efficient working capital management is critical for performance and survival of firms. They found that there is some suggestive difference between working capital ratios of firms from developed and developing economies. They suggest that working capital and financing needs of firms in emerging economies are affected by constraints and are generally more volatile. They further state that future research should analyse whether there exists an optimal working capital and whether this should change according to industry and country. Their study implies that there is still need to have further research in working capital management especially in emerging economies and using more intensive analysis to fulfil the scarcity of financial research in this area.

Bahhouth et al. (2012) have explored the role of technology on working capital requirements using 1474 firms in USA and state that since technology change in the last two decades have affected all aspects of life therefore its adoption is critical for survival of firms. They found that there has been significant reduction in the working capital due to technology upgradation. That is even though there has been an increase in sales, cost of sales and working capital; however

the increase in working capital is much smaller in comparison to sales and cost of sales. They also suggest that more research need to be carried out on working capital management controlling more on size and industry. They authors conclude that more efficiency will mean more efficient market as less finance is needed.

Banham (2013) argues that as soon as the financial crisis got finished the firms went back to the old ways of mismanaging working capital. The firms have now been trying to extend large credit in order to expand the customer base. The firms only pay attention to working capital when the market is volatile and they are facing hardships. He suggests that there needs to be balance between "diligent working capital management and giveaways for revenue opportunities". Banhan also suggests that as firms reward sales team for achieving sales target they should also reward should be there for achieving specific working capital metrics. The study implies that instead of too much squeezing during bad times and relaxing during good times, the firms should try to have an efficient and stable working capital management practice throughout as it is an essential indicator of a firm's well-being.

The reviewed literature has focussed and stressed on the importance of working capital management and its efficiency. The literature suggests that working capital management is essential for a firm's success and neglecting it may cause failure of firms. The studies further suggest that management of working capital varies with the country and it type of economy and that studies of one region may not be applicable to other regions. Specifically studies of developed countries like USA and Australia have little applicability in developing economies. Different authors have suggested different ways to improve the management of working capital. However almost all have stresses the need to increase efficiency. The studies state that although the working capital management is difficult task, however the rewards are also very high. The literature has also expressed the need to have more research on the working capital management. Since firms in growing economies like India need to improve their performance in order to compete at global stage therefore the efficiency of working capital management becomes in important area of study. There is thus need for a thorough research on working capital management efficiency in developing countries specially India which can throw light on its pattern and growth over the past decade in major industries.

2.3 Working Capital Management Efficiency Measure

Traditionally current ratio and quick ratio were used to measure the working capital position of firms. These measured current assets as percentage or ratio of current liabilities. The advantage

is that they are able to tell the financial strength of the firm, i.e. how easy or difficult will it be for the firm to meet its short term obligations in the current fiscal year. However few studies have questioned the adequacy of these ratios.

Gitman (1974) introduced the concept of cash cycle as measure of working capital management. The total cash cycle is defined as "as the number of days from the time the firm pays for its purchases of the most basic form of inventory to the time the firm collects for the sale of its finished product". The purpose of his research was to establish a simplified method of measuring working capital management which to provide reasonable estimate of peak corporate liquidity requirement and which can be directly calculated using readily available accounting data as against the then prevailing method of estimation using cash flows from cash budget.

Richards and Laughlin (1980) introduced the concept of cash conversion cycle by measuring the period between actual payment for expenditures and receiving of payment from customers. Also called net working capital cycle provided more explicit insights into management of working capital by firms.

Kamath (1989) has questioned the adequacy of current and quick ratio as measure of analysing working capital due to their static nature and advocate for cycle view of working capital. Both current and quick ratio measure the liquidity position as on date, i.e. there is no information about the liquidity maintained by the firm over the whole financial year.

Gentry et al. (1990) have introduced the concept of weighted cash conversion cycle. The authors criticise weighted cash conversion cycle for concentrating only on the duration for which the funds are tied and ignoring the amount of finds blocked in working capital. The weighted cash conversion cycle was according to authors improve the CCC by multiplying the each component of CCC (inventory, receivable and payable days) by the amount tied up in each component of working capital. The authors stress that using weighted cash conversion cycle provides deeper appreciation of the complexities of operating cash conversion cycle and may provide and improvement in the quality of short-term forecasts.

Shin and Soenen (1998) have introduced the concept of net trade cycle. They have criticized both cash conversion cycle and weighted CCC. They argue that CCC is calculated using addition of three different ratios having three different denominators and therefore it is mathematically incorrect/flawed. The also stress that WCCC requires data that can only be accessed by persons within the management of firm and therefore cannot be calculated by some

outside. This makes the measure WCCC useless. In comparison NTC is calculated using just one ratio and is similar to CCC without having mathematical flaw. The authors have used the NTC measure to analyse 58,985 firms for relationship between working capital and profitability. According to the authors the NTC measure provides an easy and useful way to check efficiency of working capital management and reducing the NTC to minimum value possible will create shareholders value.

Bhattacharya (2004) has written an exhaustive book on working capital management. The author has severely criticised the cash conversion cycle measure, calling it mathematically absurd. He argues that the adding of three ratios all having different denominators leads to this absurdness. He further states that the inventory, receivable and payable days are incomparable and adding them sometimes results in negative CCC which again has no meaning and interpretation. He also states that this measure fails the reversibility test and is therefore wrong. The author states that we need to abandon the 'days' and develop a dimension-free criterion. He argued that if the goods produced by each production cycle were to be sold immediately and in cash then the firm does not need any inventory of raw materials and finished goods. In this case the only fund that gets blocked is that which is in the conversion process. He explained that fund engaged in conversion process is same as the value of work-in-progress (WIP) inventory. This was called by the author as the "minimum amount of funds the firm requires under ideal condition" and was termed as core working capital (CWC).

Bhattacharya (2007) in his book on management by ratios has given another approach to measuring efficiency of working capital management. He states that in order to measure efficiency the firm needs to see whether the change in working capital investment is more than proportional to change in firm's sales. He proposed efficiency index of working capital management calculated using performance index (PI) and utilisation index (UI). The PI and UI are themselves calculated by comparing last year ratio of current assets to sales with that of this year ratio. The authors suggest that such a performance measures is essential since the modern day business tries to minimise the investment in current assets without consideration for stock outs etc. The measure is however only able to compare efficiency of one firm two different years and not two different firms. Bhattacharya suggests that the measure to estimate WCM efficiency should be such that it estimates efficiency by measuring working capital investment as percentage of scale of operations.

Valipour and Jamshidi (2012) have also used the WCM efficiency indexes suggested by Bhattacharya (2007) for analysing the relationship between WCM efficiency and efficiency of

overall assets for firms listed in Tehran stock exchange. They state that the efficiency indexes are chosen as the optimal measure as they have more determining power in comparison to CCC when estimating the efficiency of assets. Their results states that the relationship tested varies with industry, however overall there is a significant and positive relationship between WCM efficiency and efficiency of all assets.

Talonpoika et al. (2014) have suggested an improved version of cash conversion cycle called modified cash conversion cycle (mCCC) and test the same using data from firms in Helsinki Stock Exchange. Here the CCC was extended by subtracting days of advanced payments outstanding (DAO) from CCC to get mCCC. The authors suggest that mCCC has a remarkable effect on the CCC values and would in fact reflect "realistic picture of the efficiency of working capital management in all industries". Their study suggests that there is need for further research in the area of working capital management in order to improve the measures like CCC and bring out a truer picture of the efficiency of firms.

The literature shows that over the past years various measures for gauging working capital management efficiency have been suggested. The most popular measure is still cash conversion cycle although measures like net trade cycle etc. are now also gaining acceptance. We observe from the results of previous studies that although cash conversion cycle is an effective and popular measure for gauging WCM efficiency, it is not without its own flaws. A number of authors have questioned its mathematical correctness and other limitations. Even other measures suggested suffer from some or the other shortcomings. There is therefore a gap in literature and there is need for a better and more effective measure of WCM efficiency which can eliminate the shortcomings of previous measures.

2.4 DEA as Efficiency Measure

Charnes et al. (1978) have introduced the concept of data envelopment analysis. Their method was useful in calculating efficiency of a unit (DMU) relative to other units in case of multiple inputs and multiple outputs. The method was based on efficient frontier which was a straight line enveloping all efficient units. **Banker et al. (1984)** extended the method for variable returns to scale by making the frontier a convex hull making the DEA more useful in practical conditions. Since then DEA has been used in numerous areas for measuring efficiency of units.

Mukherjee et al. (2001) have used variable return to scale DEA to measure productivity of commercial bank in USA and have used two-stage DEA to further analyse the effect of other exogenous variables on efficiency.

Simar and Wilson (2007) have suggested the use of bootstrapping to improve the reliability of efficiency score obtained using DEA. They argue that since DEA measures efficiency relative to other DMUs, exclusion of some DMU may affect the results of others and therefore DEA results are sample sensitive. Therefore if bootstrapping with around 2000 iterations is carried out, the repeated resampling will make the result closer to result that would have been obtained in case all DMUs of the population were included in the sample.

Hoff (2007) has compared Tobit regression and OLS regression techniques in search of best method for use in the seconds stage DEA for analysing the effect of exogenous factors on efficiency scores. The author suggests "OLS may actually in many cases replace Tobit as a sufficient second stage DEA model". Thus both Tobit and OLS are useful but OLS is sufficient in giving results for second stage DEA.

Parameshwaran et al. (2010) have used DEA to measure performance of automobile repair shops. Using DEA the authors measured relative efficiency and efficient input/output targets for each repair shop.

Staub et al. (2010) have also used DEA to measure efficiency Brazilian banks and have compared it with their counterparts in US and Europe. They have further analysed the technical and allocative efficiency of the banks and the inefficiency in Brazilian banks was mainly due to technical inefficiency. They have also studied the effect of type of activity and size of bank on efficiency

Tsekeris (2011) has used both CRS and VRS DEA to analyse the efficiency of Greek airports and has employed bootstrapping to improve the accuracy of results. He further used regression in second stage of DEA to examine the influence of various factors on efficiency and found location and size to be an important factor.

Marschall and Flessa (2011) have used two-stage DEA to measure efficiency of efficiency of primary care in Africa and identify the reasons/factors that affect the efficiency. They have also applied the bootstrapped method given by Simar and Wilson (2007) to improve the accuracy of efficiency scores.

Medin et al. (2011) have used DEA to study cost efficiency of university hospitals in the Nordic countries. They have used both the CRS and VRS model for efficiency calculation and similar to other studied here too the authors have used bootstrapped two-stage DEA analysis for the analysis. They have used OLS regression in the second stage to analyse the effect of other factors on efficiency scores.

Noh (2011) has used CCR and BCC DEA model to measure efficiency of university libraries. The CCR model was used to measure technical efficiency and then using BCC model Noh calculated other types of efficiency scores including pure and scale efficiency.

Sharma and Raina (2013) have used DEA to analyse efficiency of Indian automobile industry. They also studied scale efficiencies and found that inefficient firms are either operating at a very high scale or a too low scale.

Agasisti et al. (2014) have recently used DEA to measure the efficiency of public schools in Italy. Here again the authors have employed two-stage DEA method They calculated the efficiency scores using bootstrapped BCC DEA model and then used Tobit regression to measure the effect of exogenous factors.

It is clear from the previous literature that Data Envelopment Analysis has been used in numerous areas to estimate efficiency of units/DMUs specially where there are multiple inputs and multiple outputs and where it is not possible to combine these multiple inputs and outputs. The advantages of DEA as pointed out by many authors make it a suitable candidate to measure efficiency of working capital management. Authors have suggested the use of two-stage DEA to analyse the factors that influence the efficiency of units. Moreover the use of bootstrapping has been suggested to reduce the sample bias problem of DEA.

2.5 Determinants of Working Capital Management

2.5.1 Determinants of Trade Credit

Nadiri (1969) was one of the first to study the determinants of trade credit and used data from US firms. He found that user cost like depreciation cost, carrying cost and credit standard of the borrower are important determinants of trade credit. Moreover even the monetary policy indicator like change in money supply has significant effect on trade credit. The study further found that the components of net trade credit i.e. receivables and payables are affected by different factors and therefore should be analysed separately.

Herbst (1974) also studied the determinants of trade credit in US firms however the study was restricted to lumber and wood products industry. He found that receivables are more determined by sales, linear trend etc. In contrast to the earlier study by Nadiri (1969), Herbst found that money supply and interest rates are not significant determinants. He also found that current obligation on long-term bank loan affects the level of payables and the level of purchases and capital requirements also have effect on payables.

Belt and Smith (1991) surveyed 144 Australian firms on the working capital management practices and found that the Australian firm practices were quite different in comparison to those of USA. They found that Australian firms lagged behind US firms in inventory management and credit and collection management; however the payment management system was much more efficient in Australian firms. They argue that though the management of working capital might differ but firms in both countries face similar liquidity management problems. They suggest that there is need to analyse the working capital management practices in other parts of the world to help understand global practices and develop better theories of working capital management.

Ricci and Di Vito (2000) too used survey method to also study working capital management in 200 UK firms and found that there is moderate level of sophistication in the cash and liquidity management of the firms. The study shows that modern and efficient ways of fund transfer leading to more efficiency working capital management was slowly gaining popularity back in 2000 suggesting that in developing countries these practices may take further time to catch up.

Filbeck and Krueger (2005) have used a survey in working capital management to analyse performance of working capital management and have discovered that working capital management differs significantly and the measures of WCM exhibit distinct levels across industries and also the measures vary significantly across time. The study implies that it is essential to analyse working capital management in each industry separately in order to avoid bias.

Delannay and Weill (2005) investigate the determining factors of trade credit in 9300 firms belonging to nine transition countries of central and Eastern Europe. Their results indicate that both financial and commercial motives have significant effect on the levels of credit taken and given by a firm. Their main conclusion was that the determinants vary from country to country depending upon their legal system, economic conditions and there is not generalised pattern. However overall they found that in general large and profitable firms provide larger credit to their customers. However the clients also tend to exploit the vulnerability of suppliers if it is suffering from decrease in sales. Moreover better access to back facilities also has effect on trade credit and thus there is substitution effect between the two.

Huyghebaert (2006) studied the dynamics and determinants of trade credit in firms but focussed specifically on start-up firms. He found that startup firms make use of trade credit more when they face financial constraints, i.e. when taking credit from suppliers has financial advantage over loans from banks and also when transaction costs are significant. He used

EBITDA/Assets and cost of bank debt as measure of internal and external financial constraints. The study found that high growth in the firm's industry also affects the use of trade credit by firms. Moreover firms that belong to industries having higher failure rates seem to borrow more from their supplier in comparison to other firms. Thus the study suggests that industry characteristics are important determinant of trade credit. Moreover the study found that firm's age and its transaction cost are significant determinants of trade credit. There were also evidences that inventory turnover effect the use of trade credit.

Paul and Wilson (2007) used survey method to study the determinants of trade credit 355 firms in UK. The paper analyses many reasons for the demand of trade credit including financing cost, transaction cost, financial benefit, operational considerations, asymmetric information, marketing conditions etc. They found that trade credit is affected by the level of inventory kept by firms. It was also found that firms with lower credit scores and therefore facing higher financial risk tend to increase the usage of receivables. They suggest that trade credit is used for both supplementary and complimentary purposes. It is thus affected by short and medium term loans held by firms, factoring services used and preferential credit terms provided by the suppliers of the firm. They also state that there is strong influence of suppliers' relationship with the firm and suppliers tend to invest in firms by allowing them longer credit than the agreed terms and conditions.

Dorsman and Gounopoulos (2008) have studied working capital management of multinational firms in major European countries. They analysed the working capital components receivables, payables and inventory using metrics like ratio of inventory to total assets, inventory turnover, receivable turnover, ratio of receivables to total assets and ratio of payables to total assets. The study stresses the need to have an effective inventory control so that raw material and work in progress are quickly converted to finished good, proper monitoring of receivables and payables and cash control using cash pooling in order to have an efficient working capital. They found that national-level differences do matter when the firms are managing working capital. Moreover, local modification and adjustments are needed to made by the firms

García-Teruel and Martínez-Solano (2010) studied a large number of SMEs (47,197) in Europe and their results seemed to support the price discrimination theory since firms with higher margins were found to grant more credit to their customers. They found that the firms increased granting of credit in order to arrest falling sales. They also found that firms which are larger in size, having greater growth opportunities and larger investments in short term assets

are likely to receive more and better credit facilities from suppliers. They also found some evidence of substitution effect i.e. when the firms have the option to receive finance from alternative sources they are less likely to use vendor financing. The study also found evidence of variation in trade credit across European countries which can be explained due to difference in financial market structure across countries. However they found that across all countries firms which have better access to external financing, grant more credit to their customers.

Vaidya (2011) is one of the very few studies that have explored the determinants of trade credit in Indian context. The study found that firms that have higher profitability tend to receive and grant less trade credit. It was also found that firms that have more bank loans tend to take more trade credit from others. Vaidya also finds evidence that holding more liquid assets has positive effect on both receivables and payables. Overall the study found evidences of inventory management motive for offering trade credit i.e. the firms try to reduce their finished goods inventory by offer more lenient credit terms. Moreover when the inventory levels of raw materials and finished goods increases, the firms tend to postpone payments to suppliers. Unlike earlier studies, this study found that firms with more access to bank credit do not pass on the benefit by grant more credit to buyers. Overall the results show that the relationship of determining factors of trade credit in India is very different in comparison to other countries.

Guy and Mazra (2012) analysed a small sample of 65 Cameroonian firms in the year 2006. The authors have used financial, transactional and socio cultural variables to measure the joint effect of all types of explanatory variables. The results showed positive significant relationship between rationing and trade credit. Company, size, age of firm, rationing, leader ethnicity, number of suppliers, turnover, debt, cash discount, short-term bank were important variables that were tested. They found evidence that firms with better reputations with banks tend to get more credit from the suppliers and the payment period is influenced by the amount and frequency of transactions. Cost of bank debt and the amount of short term loans have significant effect on the level of trade credit. Their results were in agreement with the results of compromise financing but were contrary to the principles of pecking order theory.

Overall the literature on determinants of trade credit shows that there is a variety of factors that influence the receivables and payables and there is considerable variation in their relationships across the countries. There have been very limited study in this area in Indian context and more research is needed to get a better understanding.

2.5.2 Determinants of Overall Working Capital Management

Kim et al. (1998) were one of the first to analyse the determinants of overall corporate liquidity in a large panel of US firms between 1975 and 1994. Their results supported the trade-off theory as the authors state "The optimal amount of liquidity is determined by a trade-off between the low return earned on liquid assets and the benefit of minimizing the need for costly external financing". They found that investment in current assets increases with increase in cost of outside financing, increase in volatility of cash flows and expected return on future investment opportunities. They also found evidence that firm's size, market to book value and return on investments of physical assets tend to have significant influence on a firm's liquidity. Moreover they found evidence of significant influence of expected future economic conditions on a firm's liquidity.

Chiou et al. (2006) studied the determinants of working capital using measures net liquid balance and working capital requirements using 19180 firm quarter data of Taiwanese firms during 1996 to 2004 and applied regression analysis. They predicted that working capital management is not only affected by firm-specific factors but also by a number of outside factors. They study found that debt ratio and operating cash flows do effect the working capital management. However the study failed to find any effect of industry and business cycle on working capital management. Moreover the study did not find any consistent evidence on effect of firm specific factors like growth rate, size and financial performance of firm on the working capital of firm.

Moussawi et al. (2006) studied working capital management in US firms during 1990-2004 and found that firms tend to over invest in working capital which in turn reduced the firm's market value as the market recognises the over-investment and discounts for it. On further investigation they found that firm's size, expected future sales growth, CEO compensation and corporate governance practices have significant effect on the management of working capital. The found that there is an important role of board monitoring in controlling working capital management of the firm. Moreover they stress that industry norms are critical in determining the level of working capital and efficiency of it management.

Nazir and Afza (2009) analysed 132 manufacturing firms in 14 industries of Pakistan listed on Karachi Stock Exchange during 2004-2007. Using working capital requirement as dependent variable the authors analysed the affect of level of economic activity, debt, firm's growth, size, return on assets, cash flows, industry and Tobin's Q the working capital management of firm. They found that a Tobin's Q, leverage and profitability (ROA) were significantly influencing

the working capital requirement of firms. Another important finding was that the management practices of working capital are influenced by the industry norms. Nazir and Afza found no significant effect of economic conditions on the working capital requirements. The results of the study are mostly in agreement with the results of Chiou et al. (2006). They observed that although working capital management is an important for higher shareholder returns but it has not gained much attention of the researchers.

Smith and Fletcher (2009) investigated working capital management practices in industrial firms of South Africa and utilised data of 103 firms during the years 1998-2007. The firms were further divided into 12 industries for analysis. In this study also working capital requirements and net liquid balance were used as proxies for working capital management. The authors tested these proxies for possible influence of industry, leverage, cash flows, return on assets and turnover and found that out of all the variables tested turnover had the most significant influence on working capital management. The study found that no other variable tested was found to be a significant determinant of working capital management. They also suggested that subgroups within variables should also be tested to give more meaningful and correct results and may be ignoring underlying relationships between variables.

Taleb et al. (2010) analysed 82 firms listed at Amman Stock Exchange of Jordon during a short period of 2005-2007. A number of factors including both financial and economic were used in study to explore the determinants of working capital management. The study used factors like economic activity level, debt ratio, firm's growth rate, cash flows, size, ROA and Tobin's Q. Their results indicate that cash flows, sales growth, Tobin's Q, return on assets and size of firm had significant effect on working capital management. They stress the importance of proper corporate governance by stating "The evidence appears to emphasize the role of board monitoring of management and management's compensation in its control of the firm's working capital". The study also stresses the importance of industry practices as determinant of working capital management.

García-Teruel and Martínez-Solano (2010) used a large sample of 3589 small and medium sized firms in UK during 1997-2001 to analyse the determinants of accounts receivables. They used panel data model and GMM estimate for the analysis. The results of the study indicate that firms have a target level of payables and thus follow partial adjustment model. Moreover it was found that firms which are larger in size and have better access to financing facilities (internal of external) use less credit from suppliers and thus have lower level of payables. This suggests that firms follow principles of pecking order theory. It was also found that firms having higher

growth opportunities tend to use more credit from suppliers in order finance their sales growth. The authors also stress that the level of economic activity indicated by GDP growth has positive effect on accounts payables

Gill and Mathur (2011) studied the factors affecting corporate liquidity management in Canada firms using a sample of 164 firms during the years 2008-2010. Their results showed that the liquidity holdings are affected by the firm's size, short term debt, internationalisation of firm, investment and the industry. While the size, internationalisation, and industry was found to be positively related, short term debt was found to be negatively related to liquidity holdings. However they also found evidence that the factors and their relationship with liquidity holdings differed in manufacturing and service industry and the authors suggest that liquidity holdings and their determinants vary from country to country. The study also found that the liquidity levels are adjusted by the management as the management feels the need to have more liquidity. A small sample size and consideration of data for only 3 years are major limitations of the study.

Gill (2011) is another study by Gill where in he has analysed 166 Canadian firms listed on Toronto stock exchange during the period 2008-2010. The study explored the factors that influence the working capital requirements and found that return on assets, growth rate of firm, firm's size and internationalisation of firm affects the working capital. The authors also found evidence that the factors differed in service and manufacturing industry and also differed from country to country. The results were somewhat in contradiction to results of previous studies. While factors like debt ratio, internationalization and Tobin's Q affected only manufacturing industry on the other hand factor like sales growth affected only the service industry.

Palombini and Nakamura (2012) have analysed the key factors affecting working capital management in Brazilian firms using a large sample of 2976 companies during 2001-2008. They use cash conversion cycle as the dependent variable and have applied fixed effect paned data model for the analysis. They found evidence that firms with higher level of debt generally have lower levels of working capital. The results also showed that ownership concentration and compensation structure has significant influence on working capital. Further free cash flows and growth rate were found to negatively affect the working capital levels. They found no evidence of the effect of past behaviour of working capital management on current levels of cash conversion cycle. They suggested that future studies should try to look for alternate measures of working capital and should try to examine the impact of external factors.

Saarani and Shahadan (2012a) have examined the determining factors of working capital in Malaysian firms using sample of 285 Enterprise 50 (E50) firms during 2006 to 2008. They have applied to structural equation modelling (SEM) technique for the analysis and have used net liquid balances and cash conversion cycle as prosier for working capital management. Their results indicated that tangibility of assets, leverage, profitability and non-debt tax shield were the main factors that affected the working capital management of firms in Malaysia. They failed to find any relationship of firm's growth, size and age with the working capital management of the firm and unlike previous studies no impact of industry was found. The study was constrained with small sample and short time frame.

Abbadi and Abbadi (2013) analysed the determinants of working capital in Palestinian firms using an extremely small sample of 11 firms listed on Palestinian stock exchange. They used data during 2004-2011 and tested for variables like return on assets, cash flow, leverage and size. The results indicated that ROA and operating cash flows have significant positive relationship with working capital requirements. On the other hand leverage and size of firm have a significantly negative affect. Moreover the economic variables GDP growth rate and prevailing interest rates did not have any significant effect. They stated that the results were consistent with results from studies from other developing countries. They also estimate that the long cash conversion cycle in Palestinian firms may due to conservatism and unstable political and economic environment. They concluded that since most factors that influence working capital are within firm's control, it can manage them more effectively for efficient management of working capital.

Ali (2013) examined both firm-level and environmental factors that might influence the working capital management efficiency using non-financial Pakistani firms. He analysed a small sample of 32 firms using data during 2000-2008. Using panel regression the author found that cash flows, debt ratio, growth of firm and size are significant in paper industry, whereas size and profitability had significance in cement industry. Leverage, growth and performance were important in tobacco industry while in jute industry growth, financial performance and size were found to be significant. The study also found some influence of macroeconomic factors like unemployment, economic production level on working capital efficiency of firm. An important outcome of the study was significance of sectorial differences in influencing working capital of a firm.

Mathuva (2013) studied the determining variables of inventory holding in Kenyan firms using a small sample of 28 firms during 1996-2008. The results indicated that size of firm had some

influence on the levels of inventory holdings. He found evidence that the firms maintained a target (optimal) level of inventory but the adjustment towards the target is not quick. This according to Mathuva can be explained by the stochastic nature of inventory management. The study further found that the firms which had higher capacity to invest in capital expenditures, had more internal resources, higher growth opportunities and large size tend to invest more in inventory. Moreover firms which had less volatility in sales and higher net profit margin hold lower levels of inventory. Debt, age and macroeconomic factors were found to have limited effect on working capital. Mathuva suggests need of more research in the area to investigate more determinants of inventory.

Naser et al. (2013) studied non-financial firms listed on Abu Dhabi securities exchange to explore the factors that affect the working capital management of firms. They used data from the year 2011and all firms excluding firms providing financial services were included in the sample. They used cash conversion cycles as proxy for working capital management and analysed six factors for their influence. The determinant factors analysed were industry, operating cash flows, debt, size, sales growth and return on equity. The results showed that the efficiency of working capital was influence by a firm's size, sales growth and leverage. While sales growth and size of firm had negative relationship with cash conversion cycle, leverage had positive influence. According to them "Large companies have better negotiation power over their customers as well as their suppliers." and they therefore have lower cash conversion cycle.

Mongrut et al. (2014) used an unbalanced panel data analysis to analyse the factor that determine working capital management of Latin American firms. They have used data from Argentina, Brazil, Chile, Mexico and Peru for the period 1996-2008. Cash conversion cycle was used as the dependent variable and size of firm, proportion of tangible assets, expected sales, country risk and market power firms were used as independent variables. The results from the study indicate that size of the firm has a negative relationship with the CCC and expected sales growth has positive relation with CCC. It was also found that the industry practices and country risk too significantly affect the cash conversion cycle. The study suggests need of more exhaustive study to have better understanding of the determinants of working capital management efficiency in Latin America and other countries.

Overall a number of studies have tried to analyse the effect of different types of factors on the working capital management of firms. The results from most studies indicate that the determining factors differ from country to country and from industry to industry. The proxy

variables used to measure working capital management also differ across the studies. Most of the studies also suffer from problems of small sample size and short period of study. There are number of shortcomings/gaps in these studies which include: not considering macroeconomic factors as determinants of working capital, using a small sample size, not controlling for industry effect, using only one of the components of working capital and using only cash conversion cycle or its constituents as efficiency measure which may give suboptimal results. Moreover there has been very limited study on determinants of working capital management efficiency in Indian firms. There is therefore need of study to fill the gap in literature which thoroughly analyses the internal and external determinants working capital management efficiency of Indian firms across industries and uses recent data from a sufficiently large sample.

2.6 Impact of Change in WCM Practices

Smith (1980) was one of the first researchers to highlight the trade-off between liquidity and profitability acting as two goals of working capital management i.e. maximising liquidity reduced profitability and vice-versa. He states that working capital management is important because it has effect on profitability, risk and therefore on its value.

Shin and Soenen (1998) used as large sample of 58,985 US firms during a long period of 20 years (1975-1994) to analyse the relationship between net trade cycle and profitability. They found a strong negative relationship between net trade cycle and profitability. They also found that shorter net trade cycle is related to higher stock returns (risk-adjusted). They found that in addition to net trade cycle other measures like current ratio were too negatively related to the firm's profitability, however the stock returns (measured using Jensen's Alpha) depend upon the industry of the firm. The study also found that the real benefit from reducing the NTC would come on decreasing the current assets and not by increasing the current liabilities. The study suggests that the focus of financial managers should be shorten net trade cycle in order to create shareholder's value.

Deloof (2003) explored the relationship between working capital management and corporate profitability using a sample of 1009 Belgian firms during a short period 1992-1996. He used various types of working capital days and cash conversion cycle as measure for working capital management. Similar to previous study by Shin and Soenen (1998) this study finds that reducing the receivables and inventory can increase the profitability of firms. Moreover it was also found that less profitable firms take longer to repay payables and thus have higher payable

days. Overall the study stresses the importance of reducing investment in current assets in order to improve shareholders' wealth.

Eljelly (2004) used current ratio and cash conversion cycle to explore the relationship between working capital management and profitability in emerging economy. He uses a tiny sample of 29 firms from Saudi Arabia over 1996-2000. Eljelly found significant negative relationship between the measures of working capital management and profitability and the relationship becomes more evident in case of long cash conversion cycle or higher current ratios. The study stresses that between the two measures, CCC is a better measure to check the effect on profitability, however CCC loses its importance in case of service industry. The study highlights that techniques like JIT system, factoring and credit insurance can improve the management of working capital and therefore profitability.

Lazaridis and Tryfonidis (2006) used a sample of 131 firms listed on Athens stock exchange and analysed them for relationship between working capital management and profitability during a short period of 2001-2004. They show that there is a significant relationship between gross operating profit and cash conversion cycle. They suggest that by optimising the cash conversion cycle the mangers can improve the profitability of the firm. They also found that less profitable firms wait longer to pay their suppliers and there is negative relationship of inventory and receivable with profitability. The results of the study were in agreement with the earlier studies by Shin and Soenen (1998) and Deloof (2003).

Padachi (2006) analysed the trends in working capital management and its relationship with the firm's performance using a small sample of 58 small manufacturing firms in Mauritius for the period 1998-2003. The study found that higher investment in inventory and receivables may result in lower levels of profitability. In the study the authors have used receivable, payable and inventory days along with the cash conversion cycle as measures of working capital management and return on assets as measures of firm's performance. Panel data fixed effect model was applied for the analysis. The results also indicate that buyer-seller relationship is important. Padachi stresses the need to undertake further research in working capital management of small firms and use of large sample size.

Vishnani and Shah (2007) was one of the first studies to analyse the impact of working capital management on the corporate performance in India. The authors have used data from a very small sample of 23 firms of consumer electronics industry during the period 1995-2005. The results of the analysis were mixed, however the authors state that in majority of the firms the relationship between liquidity and profitability was positive. From the correlation analysis the

authors concluded that there is no uniform correlation between the profitability and liquidity. Overall the authors conclude that there is no fixed relationship between liquidity and profitability of firm and different firms within same industry show different relationship. However the study confirms that there is significant effect of working capital management on the performance of a firm and the managers should focus more on liquidity management in order to improve firm's performance.

Mathuva (2009) examined the influence of working capital management on profitability of firms. He used a small sample of 30 firms listed on Nairobi stock exchange (Kenya) during the period 1993-2008. The results indicate that there was negative relationship between receivable collection period and profitability and a positive relationship between payable period and profitability. Both of these results are in agreement with results of previous studies. However the study also found there was a positive relation between inventory holding period and profitability which was in contrast with previous results. Overall the results established that there was significant influence of the components of working capital on performance of firm.

Nazir and Afza (2009) analysed the impact of aggressive working capital management on a firm's profitability. The authors used data from a sample of 204 non-financial firms across 17 industries listed on Karachi stock exchange for the period 1998-2005 and applied panel data analysis. The authors used return on assets and Tobin's Q as measures of performance and found that there is a positive relationship between the amount of current assets and profitability. The study also found evidence of a negative relationship between total current liabilities and profitability. Both the results indicated that less aggressive working capital management leads to higher financial performance. However it was also found in the study that investors give higher preference to those forms which have higher levels of current liabilities. Over the results were mixed as one hand the study stresses need of less aggressive WCM for better profitability and on the other it suggest that firms the higher levels of current liabilities are assigned higher values by investors.

Zariyawati et al. (2009) used panel data of 1628 firm years from firms listed on Bursa Malaysia for the period 1996-2006. They used data across six sectors and used cash conversion cycle as measure of working capital management. They found evidence of a negative relationship between cash conversion cycle and profitability. The results of the study were consistent with previous research (Shin and Soenen (1998) and Deloof (2003)) and stress towards reduction of cash conversion cycle in order to improve the profitability and performance of firm. Zariyawati et al. state "in purpose to create shareholder value, firm

manager should concern on shorten of cash conversion cycle till optimal level is achieved". They further stress that working capital management is a crucial component of financial management and should be focussed more to create firms value.

Charitou et al. (2010) analysed a sample of 43 firms listed on Cyprus stock exchange to examine the effect of working capital management policies on financial performance of firm. The period of the study is 1998-2007 and multivariate regression analysis was applied for the analysis. The results indicate that cash conversion cycle and all its components (inventory, receivable and payable days) significantly influence the performance of firm measured using the variable return on assets. It was found that the financial health of a firm has negative relations with cash conversion cycle and its components. Charitou et al. state that efficient utilisation of a firm's short term resources would lead to increased profitability and lower volatility which in turn may reduce the risk.

Danuletiu (2010) has analysed the relationship between the efficiency of working capital management and profitability of firm using a very small sample of 20 firms of Alba Country. The time period of the study was 2004-2008. Her found that although weak there is a negative relationship between the efficiency of working capital management and profitability. The study also found that around half of the firms analysed followed aggressive working capital management and half followed conservative so there were equal mix of both types of firms. The study had limitation of a small sample size of 20 firms scattered across different industries which might have resulted in weak relationships.

Erasmus (2010) made use of the measures net trade cycle and return on assets to examine the relationship between working capital management and profitability of a firm. He used a large sample of South African firms listed on Johannesburg Securities Exchange for the period 1989 to 2007. The results of the study indicate that there is a significant negative relationship between the working capital management and profitability. Both the measures NTC and current ratio confirmed this relationship however it was also found that if those firms that got delisted from exchange during the period were considered then there was no evidence of a significant relationship between working capital management and profitability. Overall Erasmus states that the managers need to focus more on working capital management to ensure that there is no overinvestment in working capital and should work towards reducing the investment in order to increase the shareholders wealth.

Gill et al. (2010) used a sample of 88 US firms listed on New York stock exchange during a relatively short period of 3 years (2005-2007) to analyse the relationship between a firm's

working capital management and profitability. Using cash conversion cycle and gross profit margin the study found that by optimising cash conversion cycle and accounts receivable a firm can earn more profits. The study found a negative relationship between receivables and profitability but found no significant relation of profitability with inventory levels. The payable levels were found to be positively related to profitability, but overall there was evidence of a positive relationship between cash conversion cycle and financial performance. The study had limitation of limited sample size and duration and the authors stress for need to extend the study by using a larger sample and more variables.

(2010) analysed working capital management's impact on the performance of firms listed in Malaysia. They studied firm's performance from the perspective of profitability and market value using data of 172 firms for the period 2003-2007. They used cash conversion cycle, current ratio and current to total asset ratio for WCM and Tobin's Q, return on assets and return on invested capital as measures of firm's performance. They found that there is significant negative relationship between working capital management measures and measures of firm's performance. Mohamad and Saad thus stress the importance of working capital management and suggest that firms should improve its efficiency of WCM to improve market value and profitability. They suggest the use of a larger sample size and more measures of WCM and performance to further analyse the relationship between the two.

Enqvist et al. (2011) examined the impact of working capital management on profitability of firms during the different business cycles. The authors used data from a sample of Finland firms over 18 year period 1990-2008. They found that during downturns the impact of WCM on profitability is more prominent in comparison to the impact during economic upturn. The results show that during economic crisis period the significance of efficient inventory and receivable management increases. Overall the results are consistent with the results of previous studies and indicate existence of a negative relationship between CCC and firm performance. The authors further suggest that "investing in working capital processes and incorporating working capital efficiency into everyday routines is essential for corporate profitability" and therefore financial planning of firms should also include working capital management as an essential component.

Lingesiya and Nalini (2011) analysed the relationship between working capital management and firm's performance in small sample of 30 Sri Lankan firms for the period 2006-2010. The authors used a variety of measures like cash conversion cycle, current ratio, quick ratio etc. to measure working capital management and used return on assets to measure performance of

firm. The results from panel data analysis confirmed results from earlier studies that higher investment current assets lead to lower levels of profitability and that the relationship is significant. Lingesiya and Nalini state that financial results of a firm can significantly improve if the firm is able to manage it working capital more efficiently. The study has limitation of using a very small sample and short duration and also using only return on assets as performance measure.

Pimplapure and Kulkarni (2011) have used just one Indian firm's five year data (2006-2010) to analyse the impact of working capital management on firm's profitability. A number of variables including quick and current ratio, current assets to sales, current asset to total assets, inventory, receivable and payable turnovers etc. were used as measures of working capital management. In addition Pimplapure and Kulkarni used return on investment as measure of profitability. They concluded that "increase in the profitability of the company is less than the proportion to decrease in working capital throughout the study period." The study is however severely constrained due to sample size of just one firm and therefore its results cannot be generalised for other firms in India.

Raheman et al. (2011) studied a number of sectors for performance of working capital management and profitability. They found that those sectors which had performed well in working capital management also had higher financial performance. The sectors which as whole were laggards in working capital management measures had low levels of operating profitability. They further state that in manufacturing sector as a whole working capital management should an important concern as proper management of receivables and inventory can convert a laggard industry into a performing one. Overall the study stressed that managers can create value for shareholders by reducing the cash conversion cycle and net trade cycle its components but each component of CCC and NTC (inventory, receivables and payables) must be dealt individually with separate policy.

Sharma and Kumar (2011) was one of the first comrehensive studies to assess the impact of working capital management on profitability. The study uses a sample of 263 firms from BSE 500 index and data for the period 2000-2008. The results were somewhat contradictory to results of previous studies and to the theoretical foundation. Sharma and Kumar found that cash conversion cycle had positive relationship with the profitability of firm. In other words, as the cash conversion cycle reduces profitability also goes down. The study found a positive relationship between payables and profitability and also between inventory and profitability. It also found a negative relation between receivables and performance. The study suggests that

due the unusual and strange results obtained from the analysis there is feed to do further research by taking a larger and broader sample.

Akinlo (2012) uses a small sample of 66 Nigerian firms for the period 1997-2007 to explore the relationship between working capital management and profitability. The author used cash conversion cycle and its components (inventory, receivable and payable days). The study found that as the lengthening any of the three days i.e. inventory, receivable and payable days reduce the profitability of the firm and shortening the length of cash conversion cycle as a whole improves the profitability of firm. Akinlo stresses that the results are able clearly underline the importance of working capital management in a firm. Overall the results of the study are in agreement with the previous literature and establish that efficiency of working capital management has a direct association with the financial performance of a firm.

Ashraf (2012) also studied Indian firms for effect of working capital management on profitability of firms using a very small sample of 16 firms listed on Bombay stock exchange for the period 2006-2011. The study used a variety of measures including cash conversion cycle, components of CCC, current ratio etc. as proxy of working capital management and used net operating profitability for firm's performance. The results were in concurrence with the earlier literature (Shin and Soenen (1998) and Deloof (2003)) but in contrast to the results of Sharma and Kumar (2011) and indicated that there is a negative relationship between working capital management and profitability of the firm. Ashraf concludes that "managers can create value for their shareholders by reducing the number of days, accounts receivable and inventories to a reasonable minimum."

Baños-caballero et al. (2012) focussed on small and medium scale enterprises for exploring the relationship between working capital management and profitability. The authors used an unbalanced sample of 1008Spaning SME firms for the period 2002-2007. The results of the study were different from the results of previous studies and showed that instead of linear negative relationship between working capital management and profitability, there is a concave relationship between the two. This indicates that there is an optimal level of working capital which balances the benefits and cost of the investment and thus maximises the profitability of the firm. Overall the study stresses the importance of effective management of working capital management in improve the performance of firm. Baños-caballero et al. advise that close watch should be kept on working capital cycle to keep it at an optimal level and thereby maximise firm's profitability.

Barine (2012) also conducted a study on Nigerian firms to study the relationship between cost and benefit of working capital investments. Using a small sample of 22 firms from different industries and using data only for the year 2010 the author found that the cost of investment in working capital is much more than the returns from the investment and this affects the profitability of the firm. Barine suggests that firms should optimise investment in working capital in order to avoid over investment in the same. However the he also point out "proper management requires trade-off of risks of and returns for financial efficiency of firm's operations which is not evidenced from results on quoted Nigerian firms". Overall the results though reiterate the results from previous literature, however such a small sample and duration cannot be generalised.

Baveld (2012) studied a sample of 37 public listed firms from Netherland and used two sets of periods from 2004 to 2006 which was non-crisis period and 2008 to 2009 which was financial crisis period. He found that there exist negative relations of account receivable, inventory and account payables with the profitability of the firm. It was also found that these relationships somewhat change during the crisis period. e.g. during crisis there was no significant relationship between receivables and profitability and there was a stronger negative relationship between inventory and profitability. In case of cash conversion cycle Baveld found that though its relationship with profitability is negative, however during crisis there is no significant relationship between the two. He suggests that future research should expand the study for data from other developing countries of the world.

Bhunia and Das (2012) explored the Indian steel firms during the year 2003-2010 using a sample of 100 small to medium sized firms. They found that there is week relationship between working capital management and profitability but there was no evidence of an impact of working capital management cycle on profitability of firm. They stress inspite of the results working capital management is a crucial component of financial management. However the study is limited to only steel industry and takes into consideration only small and medium sized firms and thus the results cannot be generalised for all industries.

Garcia et al. (2012) have conducted a comprehensive study of European firms on the impact of working capital management on the firm's profitability. They used large sample of 2974 firms across 11 European stock exchanges during the period 1998 to 2009. The study was able to confirm the results of previous literature and found a significant negative relationship between receivable, payable and inventory days and also the cash conversion cycle with profitability of the firm. Similarly a negative relation was found between the current ratio and profitability. As

the study is comprehensive in nature, its result that "companies can improve their profitability by reducing their cash conversion cycle." can be generalised for at least European countries. However, Garcia et al. suggest that sector wise analysis should be carried in future to have a more robust result.

Kaddumi and Ramadan (2012) have used a small sample of 49 Jordanian firms listed on Amman stock exchange for the year 2005-2009 to study the relationship between working capital management and profitability. They have used a variety of variables as proxy for working capital management and performance and have applied fixed effect and OLS model for the analysis. They found negative relation of collection period and inventory with firm's profitability and positive relationship between payable period and profitability. The results show that there is a significant effect of working capital management on the profitability of firms and shareholders' wealth can be increased by shortening the cash conversion cycle and net trade cycle. However the results also show that there was a positive relation between ratio of current assets to total assets and profitability. This according to them can be attributed to "conservative investment policy in working capital" by Jordanian firms.

Owolabi and Obida (2012) is another study on Nigerian firms which analysed the relationship between a firm's liquidity management and profitability. The authors used a tiny sample of 12 firms for the period 2005-2009. It was found that liquidity management has significant impact on corporate profitability and a firm can increase its profits by improving credit policy and shortening the cash conversion cycle. The study concludes that if the managers focus and handle cash conversion cycle carefully they can create good profits for the firm. According to the authors "Managers can create value for their shareholders by reducing the number of days of accounts receivable and inventories to a reasonable minimum". The results of the study are agreement with earlier studies on Nigerian firms.

Sabri (2012) studied a sample of 45 Jordanian firms listed on Amman Stock Exchange for the period 2000 to 2007. He examined whether there was any difference in profitability between firms that had long cash conversion cycle and those which had short cycle. It was found that there was significant difference in profitability of firms depending upon the length of their cash conversion cycle. The results show that the relationship is inverse i.e. firms with shorter cash conversion cycle have higher profitability and vice-versa. The results also indicated that there was negative relationship between accounts receivable and profitability and also between account receivable and profitability. The second relationship is counter intuitive, however Sabri explains that "when a company delays the payment of accounts payable, this may expose them

to a fine of delay and harm their reputation and may lead to loss of cash discount and then reduce their profitability".

Vural et al. (2012) analysed the importance of working capital management and its performance of firms in Turkish firms. They used sample of 75 manufacturing firms listed on Istanbul Stock Exchange for the period 2002-2009 and applied dynamic panel data analysis technique. They used Tobin's Q and gross operating profit as measures of firm's performance. The results of the study show that by shortening the collection period and thus the overall cash conversion cycle, a firm can improve its performance. Vural et al. also found that relationship of other components of cash conversion cycle (payables and inventory) with the performance of firm is statistically insignificant. In addition it was also found that leverage too had important influence on profitability of the firm.

Baños-Caballero et al. (2013) examined as sample of UK firms for association between working capital management and firm's performance. The results of the study were slightly in contrast to those of previous literature as the authors found evidence of an inverted U shaped relationship between working capital management and performance. It suggests that here exists an optimal level of working capital which maximised the benefits and minuses costs and thus maximises firm's value. Any investment in working capital below or beyond this level leads to reduction in value of firm. The results also show that this optimal level is lower for firms that are financially constrained. The study suggests "that managers should be concerned about working capital, because of the costs of moving away from the optimal working capital level."

Bolek (2013) studied a sample of Polish firms listed on Warsaw stock exchange for the period 1997-2007 to test the theory that higher liquidity leads to lower levels of profitability. He did not find any significant relationship between the liquidity measures and profitability measures measured using return on assets and return on equity. Bolek explains this as following "The lack of relationship between working capital indicators (measured using ratio of current assets and current liabilities to total assets) and profitability ratios may indicate weak and not integrated management in the field of liquidity, risk and profitability in companies listed on the Warsaw Stock Exchange". Bolek further concludes that more market and knowledge development in Poland may change this relationship in future as the Polis economy is still developing and there is shortage of managerial expertise.

Goel (2013) analysed the Indian retail industry using a tiny sample of five firms for the year 2009 to 2011. The explored for relationship between working capital management (and its components) with the profitability of the firm. The results of the study are not clear; however

the Goel states “proper working capital management helps in efficient utilization of resources”. His results also indicate that firms which have efficient working capital management are able to capture large market and grow fast due to their efficiency. Also it was found that firms which have less than proportional growth in assets as compared to growth in sales tend to manage working capital more efficiently and are more successful.

Kaur and Singh (2013a and 2013b) is another exhaustive study of Indian firms which examines the relationship between working capital management and profitability. They used a sample of 164 firms of BSE 200 index for the year 2000 to 2009 and used measures like cash conversion cycle and operation cycle days for the analysis. The results of the study were in agreement with earlier studies that efficient management of working capital leads to higher profitability. The results suggest that firms should focus on reduction in investment in current assets which would reduce the cost of financing current assets and thereby improve profitability. Kaur and Singh suggest that planning working capital in advance and proper controlling it will help in creating shareholders’ wealth. The results were however in contrast to another Indian study Sharma and Kumar (2011) which found opposite relationship. The study concludes that “Working capital management is, therefore, one of the important facets of a firm’s financial management effecting both its profitability and efficiency.”

It can be observed there are a large number of studies which have analysed the relationship between working capital management and firm performance. The results of these studies are however not consistent. While many found that reducing the liquidity leads to higher performance, on the other hand some studies found a reverse relationship and still some others found no association between the two. Most of these studies have used profitability as main indicator of performance, however since a firm’s aim is to maximise shareholder’s wealth therefore market performance too should be included as one of the performance indicators. Overall the shortcoming in the studies include small sample size, using cash conversion cycle or other possibly suboptimal measures of working capital, not controlling for industry effect and not analysing effect on market performance. Moreover, there are very few studies on Indian firms and the few which are present have given contradictory results. There is lack of comprehensive study which analyses the effect of working capital management efficiency on firms’ financial and market performance in the Indian context using large sample and recent data.

2.7 Corporate Cash Holding Pattern

Opler et al. (1999) was one of the first studies to examine the cash holdings of firms and analysed both determinants and implications of corporate cash holdings of US firms for the period 1971 to 1994. Their results supported the trade-off model and indicated that firms that have high growth opportunities and volatile cash glows tend to hold more cash. On the other hand it was also found that firms which are large and have high credit ratings hold less cash. The results also show that firms that perform well have tendency to hoard more cash. Opler et al. did not find significant effect of excess cash holdings on dividend payouts, spending on acquisitions and capital expenditures. They conclude that "management accumulates excess cash if it has the opportunity to do so".

Faulkender (2002) analysed small firms in USA using a sample of 4637 firms for cash holding patterns. Using data from a survey in 1993 the author found that firms with high cost of financial distress and having higher debt hold more cash. Firms that perceive higher information asymmetries hold more cash in comparison to other firms. Moreover firms that have had difficulty in raising capital in the past tend to keep lower cash but older firms, even though they have better access to capital tend to hold more cash. It was also found that the cash holding tend to decrease with increase in size of firm but managerial ownership effect on cash holding was not significant. Faulkender suggests that these findings "confirm the presence and impacts of financial frictions on the cash holdings of small firms".

Dittmar et al. (2003) conducted a cross country analysis of cash holdings using sample of more than 11,000 firms across 45 countries. Their results suggest that firms in countries where there is little shareholder protection tend to hold almost double the cash held by firms in countries where the rights are protected. They found that other factors of cash holdings like investment opportunities and asymmetric information become less important if there is poor shareholder protection in the country. They also found that because of agency costs, firms hold more cash if it is easier to access funds. They suggest that there is need of more research in implications of excess cash. The study overall suggests that cash holding pattern varies with country due to the changes in laws, economy and other conditions.

Ferreira and Vilela (2004) studied firms in EMU (Economic and Monetary Union) countries and reaffirmed the results of Dittmar et al. (2003) that firms in countries where there are superior investor protection laws hold less cash as compared to firms in other countries. This according to author supports the principle of managerial discretion agency cost. However they suggest that development of capital markets in the country have negative affect on cash

holdings of firms. Their results also suggest that cash holdings of firms are positively affected by cash flows and investment opportunity set but leverage and size tend to negatively affect the cash holdings. They suggest that their finds are consistent with the trade-off theory and also somewhat support he principle of pecking order theory but are in contrast to principles of free cash flow theory.

Ozkan and Ozkan (2004) used a sample of 1029 UK firms to investigate the determinants of cash holdings in firms. The study found that cash flows, growth opportunities, liquidity and debt significantly affect the cash holdings of firms. There were also evidences that firms follow a target level of cash holdings. It was also found that ownership structure too has an important role to play in determining the cash holdings. They found that as managerial ownership increase the cash holdings decrease but beyond a point, any further increase in managerial ownership increases the level of cash holdings. In addition it was also found that firms owned by families hold more cash. Overall the findings suggest "unobserved firm heterogeneity, as reflected in the time-constant fixed effects, is significant in affecting cash-holding decisions".

Faulkender and Wang (2006) examined the marginal value of cash holdings by firms in US. They found that marginal value of cash decreases with increase in cash holdings and higher debt. They also decrease with better access to capital market but increases if the firm choses to distribute cash through dividends instead of share repurchase. They stress that market values liquidity and rewards firms with higher valuation if they hold more cash. The market perceives the friction that makes raising capital from outside costly. According to the study "for the mean firm-year in the sample, the marginal value of cash is $0.94." However with increase in cash this value goes down and it suggests that there is an optimal level of cash which is the upper bound.

Nguyen (2006) analysed the cash holdings of firms in Japan to examine whether firms hold cash due to precautionary motive and to reduce the volatility of operating earnings. Their findings suggest that cash holdings increase with increase in firm risk but decrease with increase in industry risk. Increase in firms size and debt tend to decrease the level of cash holdings and but increase in profitability, growth prospects and dividend payout ratio tend to increase the cash holdings. The increase in investment opportunity and earnings volatility tend to increase the level of cash holdings. Overall the results of the study support the principles of precautionary motive of holding cash and the importance of firm level risk mitigation. The results of the study are partially consistent with principles of trade-off theory and pecking order theory.

Saddour (2006) investigated the determinants of cash holding using a sample of French firms for the year 1998 to 2002. Their results show that firms tend to increase their cash holdings when their business is risky and when they have high cash flows. It was also found that larger level of debt decreases the amount of cash holdings and that growing firms hold more cash than others. It was found that the relationship of cash holdings with firm characteristics is different for growth and mature firms. For growing firms size, liquidity and short term debts have negative relationship with cash holdings. On the other hand for mature firms increase in size, payout to shareholders and investment level increases the cash holdings and amount of trade credit and R&D expenses decrease the cash holdings. Saddour also found evidence that Tobin's Q of firm increases with the cash levels of firms.

Drobetz and Grüninger (2007) examined the cash holdings in Swiss firms during the period 1995 to 2004. The results showed that Swiss firms hold almost twice the level cash held by firms in US and UK. They found that size of firm and it tangibility has negative effect on cash holdings and leverage has a somewhat non-linear effect. They also found that there is positive effect of dividend payments and level of operating cash flows on corporate cash holdings. Their results also showed that there was some effect of corporate governance practices on cash holdings of the firm. They conclude that most of their findings can be explained using transaction and precautionary motive of holding cash.

Han and Qiu (2007) examined a sample of publicly traded firms from U.S. for the period 1997 to 2002 to test for precautionary motive firm's cash holdings. They found that cash flow volatility affects the cash holdings but the impact depends upon financial constraints. If a firm is financially constrained it increases its cash holdings when there is increase in cash flow volatility. For firms that are not financially constrained there was no evidence of significant relationship between cash flow volatility and cash holdings. Han and Qiu further stress "decrease in future cash flow uncertainty by hedging will reduce the incentive for the precautionary cash holdings".

García-Teruel and Martínez-Solano (2008) investigated a large ample of 860 Spanish small and medium sized firms for the period 1996 to 2001. The results showed that firms follow a target optimal level of cash and try to converge to this level. The speed of convergence was found to be higher than the speed found in previous studies. This target level was found to be higher for firms with higher growth opportunities and larger cash flows. On the other hand the target cash holdings is lower for firms which have higher leverage and have higher level of

cash substitutes. In cash of macroeconomic variables interest rate was found to effect cash holdings wherein an increase in interest rates decreased the level of cash held by firms.

Bates et al. (2009) studied US firms during the period 1980 to 2006 to investigate the reason of cash holdings by firms. The authors found that the cash to total assets ratio had increase during the period of the study and it has reached to level where a firm can pay off all of its debt by using its cash holdings. The authors suggest that increase in cash holdings may be the result of increased volatility and riskiness of cash flows. They also suggest that this might be because now firms hold less inventory and receivables and have increased R&D expenses. The study concludes that precautionary motive plays a significant role in explaining increase in cash holdings and there was little evidence to suggest the role of agency conflicts.

Denis and Sibilkov (2010) examined the relationship between financial constraint, cash holdings and its value. Using a sample of 74,347 firm-year observations during the period 1985–2006 the authors found that "greater cash holdings are associated with higher levels of investment for constrained firms with high hedging needs and that the association between investment and value is stronger for constrained firms than for unconstrained firms". Their results suggest that large cash holdings make financial constrained firms to undertake profitable projects that might otherwise not have been undertaken. They also found that a few financially constrained firms keep a low level of cash holdings because of persistently low cash flows. Overall they suggested that greater cash holdings are good for financially constrained firms as it increases their value.

Dittmar (2010) used a huge sample of 4,285 US firms for the period 1965 to 2006 to analyse the dynamics of cash holdings in firms. He found that firms have target cash ratio and they actively adjust towards this target. Dittmar however also found that the speed of adjustment is varies across firms and there is large dispersion in adjustment speed. He suggests that the cause of this variation is the cost of adjustment. He concludes that "firms do manage their cash ratios but do so imperfectly in the presence of adjustment costs". Dittmar also found that firms that experience high volatility in cash flows do keep more cash if adjustment costs are high and there is no relation between cash flow volatility and cash holdings if the adjustment cost is low.

Ferreira and Leal (2010) compared cash holdings in Brazilian and US firms. For US firms the authors found that firms with low ROA have high cash and as ROA increases the levels of cash decreases but for firms with highest ROA the cash holdings are again high. They further found that Brazilian firms keep a lower level of cash in comparison to US firms and as the ROA of firm decreases the level of cash holdings come down. They attribute this difference to high

interest rates in Brazil. The analysis of market value indicated that higher cash holdings are associated with higher market to book value in both the markets.

Fresard (2010) analysed the cash holdings in US firms during the period 1973–2006 and found that keeping larger cash in comparison to peers leads to gain in market share. This effect was found to be more pronounced when the competitors face financial constraints and when there are higher strategic interactions among the competitors. He stresses that "results suggest that cash policy comprises a pre-emptive dimension that impacts rivals' actions."

Simutin (2010) examined a sample of US firms between 1960-2006 for relation between excess cash holdings and stock returns. Overall the study found that there is positive relationship between corporate cash holdings and future stock returns. However Simutin also found that during economic downturns firms with excess cash performs worse than other firms and thus it can be said that such firms have higher betas. He suggests that firms keep cash in anticipation of future investment needs. During expansion firms with more cash have readily available funds and thus are able to expand faster. He also found that "find that future investment activity is strongly and positively related to excess cash" but found no relation between excess cash and future profitability.

Kim et al. (2011) examined the cash holding levels of 125 US restaurant firms between the period 1997 and 2008. The study found that firms with more investment opportunities keep more cash. Moreover firms that are large in size, which have high levels of other liquid assets, firms that make higher capital expenditures and those which pay dividends hold less cash. Kim et al. suggest that both precautionary and transaction motive help in explaining the determinants of cash holdings and more or less the finding support the trade-off theory. They further suggest that future studies should study the relationship between cash holdings and firm value.

Kusnadi and Wei (2011) examined a large sample of firms across the globe and found that firms from those countries where legal protection is strong tend to decrease their cash holdings with increase in cash flows and this relationship is more evident in financially constrained firms. The authors however did not find any relationship of cash holdings with financial development of the market. The authors suggest that managers of international firms should take into consideration the level of legal protection in the country of operation before deciding on the cash holding policy and optimal cash management of the firm. The results show that country level effect is important determinant of cash holding dynamics.

Lee and Powell (2011) examined 1817 Australian firms representing 13,783 firm-years to study the determinants of cash holdings. Their findings indicate that the trade-off model best explains the pattern of cash holding in firms. The authors also found that firms with transitory excess cash earn significantly excess returns but if the excess cash is persistent then it is penalised by the market. Thus the marginal value of cash declines with increase in cash holdings and longer holdings of excess cash. Lee and Powell stress that "The results are consistent with agency costs associated with the holding of excess cash for extended periods."

Lian et al. (2011) analysed Chinese firms for effect of financial crisis on corporate cash holdings using data 1999 to 2009. They found that the firms tend to increase their cash holdings during the time of financial crisis in comparison to normal times. When firms face financial constraints and when they have more investment opportunities they hold more cash. Moreover it was found that firms that have lower levels of debt, lower level of net current assets and lower capital expenditures tend to increase their level of cash holdings. The study suggests that Chinese firms are cautious with respect to cash and exhibit properties similar to the firms in US.

Martínez-Sola et al. (2011) studied the relationship between corporate cash holdings and firm value using sample of 472 US industrial firms for the period 2001- 2007. They tested for existence of optimal cash holdings that may maximise the value of firm and whether any deviation from this level has negative impact on firm's value. The results indicated that there is a concave relationship between cash holdings and firm value. This indicated that there exists an optimal level of cash where the firm value gets maximised and any deviations from this level reduces the value. The study suggests that the findings of the study support the trade-off theory.

Venkiteshwaran (2011) analysed US firms to examine process of adjustment towards the optimal level of cash holdings. The author found that typical firms follow a trade-off model and thus have a target optimal cash level. Such firms constantly try to converge towards this optimal level and in general take two years to close the gap. It was also found that excess cash takes longer to converge to optimal level in comparison to firms with deficit cash. The study further indicated that small firms generally hold excess cash but are quicker in correcting the deviations from the optimal level than large firms. This according to Venkiteshwaran suggests that it is more expensive for financially constrained firms to operate at a suboptimal level of cash in comparison to other firms.

Gill and Shah (2012) have investigated the determinants of corporate cash holdings in Canadian firms taking a sample of 166 firms listed on Toronto stock exchange for the period

2008 to 2010. Their results showed that variable like cash flows, leverage, size of firm, board size, net working capital and market value to book value do significantly affect the cash holdings of firms. They also found that corporate governance indicators like board size and CEO duality increase the cash holdings in Canadian firms. According to Gill and Shah, their findings support the trade-off theory and also support the precautionary and transaction motive of holding cash. The study is limited to Canadian firms with a relatively small sample size and thus it findings cannot be generalised for firms from other countries.

Iskandar-Datta and Jia (2012) studied the trends in cash holdings across seven countries for the period 1991 to 2008. The results in indicated that there has been rise in cash holdings across all countries except Japan where there decline was observed. It was also found that determinants of cash holdings varied from country to country and firm-specific variables were able to explain changes in cash holdings only for some countries. The results point to individuality in cash holding decisions in each country." Iskandar-Datta and Jia also found that firm level attributed that effect cash holdings have changed over the years. According to authors "corporations in these industrialized countries have undergone major changes, which have driven firms to elevate their cash balances for precautionary purposes."

Islam (2012) is one of the few studied that have analysed the cash holding of firms in developing economies. He examined the determinants of cash holdings in Bangladeshi firms for the period 2006-2010. Islam found that operating income, leverage, size, cash flow and tangibility have significant effect on cash holdings whereas Tobin's Q, working capital and cash flow volatility did not have significant effect on cash holdings. He also found that firms keep a high ratio of cash to total assets (approx. 11%). He concludes that the results are more or less similar to result from developed and other countries and support he principle of trade-off theory.

Lau and Block (2012) investigated the effect of presence of controlling founders and families on the level of cash holdings. The authors found that founder firms held higher level of cash in comparison to family held firms. The authors suggest that in the presence of strong shareholder protection, it is difficult for controlling shareholders to hoard cash at the expense of minority shareholders. Moreover it was also found that presence of controlling family as owners and managers do not change the relationship between cash holdings and firm value suggesting that this does not increase the agency costs. The authors conclude that "economic incentives, psychological commitment and firm specific knowledge of founders help to mitigate the agency cost of cash holdings".

Noguera and Trejo-Pech (2012) examined the cash holdings in firms from Latin American countries during the period 1995 to 2007. The result indicate that Latin American firms did no increase their holdings during the period of study as opposed to US firms which hoarded more cash during the same period. However, the determinants of cash holdings were same as in US firms since increase in capital expenditure, working capital and debt decreased the level of cash holdings in firms while increase in growth opportunities increased the cash holdings. However, it was also found that firm size and dividend payments increased the level of cash and cash flow volatility was not found to have any effect on cash holdings. These according to them were contradicting to the theoretical expectations.

Song and Lee (2012) examined the effect of Asian financial crisis on the cash holdings of firms in Asian countries. The results indicate that after crisis firms try to increase cash holdings by decreasing the investments. The authors found that due to crisis the sensitivity to cash flow risk increased and that explained the increase in cash holdings. Thus the study suggests that the crisis completely changed the cash holding policies. The results further suggest that precautionary motive is dominant in explaining the cash holding pattern and the firms become more conservative after experiencing financial shock. This according to Song and Lee suggests that financially constraint firms should hold more cash.

Sodjahin (2013) examined the relationship between cash holdings and stock returns using data from US firms for the period 1965 to 2010 and found that "a change in a company's cash-holding policy predicts subsequent stock returns". The results also showed that firms which exhibit positive change in cash holdings earn higher stock returns in comparison to firms which have negative change in cash holdings. He found that the relationship between change in cash holdings and stock returns is significant and unconditional whereas relationship between cash holdings and stock returns is conditional on size and ratio of book value to market value. The effect or the relationships are stronger in small cap firms and cash constrained firms.

Tong (2014) recently conducted an exhaustive study using a large sample of 10,264 firms for the period 1985 to 2005 to examine the trade-off theory of cash holdings. He divided the cash holdings into optimal and deviation from the optimal level. The results of the study indicated that deviations from the optimal levels of cash leads to lower marginal value of cash, which is at its highest at optimal level of cash. Tong suggests that value of cash to the shareholders is higher when the change reduces the deviations from the optimal level of cash. He concludes that results clearly suggest that there is an optimal level of corporate cash holdings and there is support for the trade-off theory of cash holdings.

It is essential that while analysing the working capital management of Indian firms, focus should also be given on the dynamics of cash holding as cash forms an integral part of working capital. It is observed that very recently in the last 4-5 years corporate cash holdings has caught the attention of researchers. A number of studies have been recently conducted on the pattern of cash holdings by firms, their determinants and implications. However most of these studies have used sample from firms in developed countries and research in the area on firms from developing economies is still scant. There has been almost no study that has analysed the cash holdings in Indian firms.

Results from earlier studies suggest that the cash holding pattern and its effect on market performance of firm varies from country to country and from period to period. Moreover there are contradictions on the applicability of theories that can explain the cash holding and its change and different authors have suggested different motives of holding cash. There is thus need of a study which can analyse the dynamics of cash holdings in Indian firms and examine its effect on performance.

2.8 Research Gap and Conclusion

Analysis of available literature shows that there have been a large number of studies conducted on working capital management, its efficiency, determinants and impact on performance. However, still a number of research gaps remain demanding need of further research the area.

The traditional measures of WCM efficiency have been criticised and thus there is need of new measure which can overcome the existing problems and provide effective measurement of WCM efficiency. The trend and determinants of WCM efficiency need to be analysed in the Indian context since there is lack of robust research in the area. Most of the existing research either suffer from some shortcomings or are not applicable to developing economies like India. The impact of changes in WCM efficiency on performance also demands further examination since existing studies have ignored many aspects of firm performance. Moreover most of these studies suffer from problems like small sample size, small time period, insufficient factors, suboptimal measures, etc. which makes the results less applicable universally. The cash holdings pattern which forms a critical element of working capital has not been analysed for Indian firms and thus there is strong requirement of research in the area.

The literature also suggests that frontier analysis techniques are recognized as an effective way for efficiency measurement. The non-parametric Data Envelopment Analysis has been proven to be easy, simple and has been widely applied to measure the overall technical efficiency in

numerous areas. Moreover, regression has been suggested as a suitable technique for second stage analysis of determinants of efficiency change. This approach though successful in other area has so far not been applied for working capital management efficiency.

The discussion on reviewed literature brings forth the gaps in the literature and discusses the various research issues. This chapter lays the foundation for the theoretical and empirical background of subsequent chapters. It will serve as a guideline for theoretical and literature support to develop an analytical framework of methodology and techniques to address the research questions and objectives of this study.

CHAPTER 3
RESEARCH DESIGN

Preview

This chapter discusses the overall research design of this study based on the research questions that will be empirically studied. This chapter discusses systematic description of the research methodology and link its with the research objectives. Stage wise description of research methodology adopted in this study along with the size and composition of the sample and data sources are presented in the chapter. A detailed description of variables used and statistical models & tools applied have been discussed in this chapter.

CHAPTER 3
RESEARCH DESIGN

3.1 Introduction

The objective of this study is to perform a comprehensive evaluation of working capital management efficiency in the Indian manufacturing sector. Using both traditional and new measures of WCM efficiency, the study aims to analyse the efficiency and its changes in Indian firms. The study further aims to explore the factors that influence the efficiency and also examine the linkage between WCM efficiency and financial performance. The study is carried in systematic stage wise manner. In the first stage, the study evaluates the efficiency and efficiency changes using both traditional and new measures. In the second stage the study explores the factors (both firm-specific and macroeconomic) that influence or affect the WCM efficiency of firms. In the third stage, the study explores the empirical association between efficiency (and productivity measures) and performance measures. In addition this study examines the pattern of cash holdings in Indian manufacturing firms. Since each stage requires different samples, variables, models and techniques, therefore the research design has been discussed in separate subsections according to stage of analysis.

3.2 Stage 1 – Measurement and Analysis of Working Capital Management Efficiency

3.2.1 Introduction

This study has adopted a combination of traditional measures and new measure for calculating and analysing the efficiency of working capital management in firms. A new measure based non-parametric DEA technique has been adopted to estimate efficiency in working capital management in Indian manufacturing sector The traditional measures that have been widely used and suggested in literature (as discussed in chapter 2) are cash conversion cycle (CCC) and net trade cycle (NTC). This study has therefore also used CCC and NTC to gauge the working capital management efficiency. Further DEA based MPI has been used to analyse efficiency gains/ losses during the time period of the study. Using these measures both graphical and statistical analyses have been carried out to examine the trend/pattern in the WCM efficiency.

3.2.2 Variable Specification

The traditional measures CCC and NTC require almost similar variables to estimate the efficiency. In case of CCC, three types of days namely inventory days, receivable days and payable days are required to be calculated. Inventory days is calculated using variables cost of goods sold and average inventory, receivable days is calculated using the variables net credit sales and average receivables and lastly payable days is calculated using net purchases and average payables. For calculating NTC inventory, receivable and payables figures along with net sales are required. In case of the new measure based on DEA the efficiency is calculated using a set of inputs and outputs. Following NTC the proposed DEA based measure uses inventory, receivables and payables as inputs and requires sales and cash flow from operations as outputs (discussed in the latter sections). The details of all the variables used in various measures of WCM efficiency are given below.

Inventory: Inventory is one of the most important constituent of working capital and includes business assets invested in raw materials, work in progress and finished goods. Since this study measures the efficiency of working capital management therefore inventory held by firms in each year is a critical variable. This study calculated inventory value by summing all raw materials, work in progress, spares and finished goods.

Receivables: Receivables also referred as debtors are another important constituent of working capital and includes the money owed to the firm by customers. These mainly constitute the payments yet to be received for goods sold on credit and are generally short term in nature. Selling on credit has become almost essential to boost sales and therefore the money blocked to debtors is considered as part of investment in working capital (Singh et al., 2013).

Payables: Payables are also referred as creditors and unlike inventory and receivables they are part of current liabilities. Payable refers to the money owed by the firm to others (generally suppliers). These mainly constitute the payments yet to be made by the firm for the goods it has purchased on credit. Payables have been used in calculation of WCM efficiency since it is an extremely important part of working capital. Payables allow a firm to delay payments to supplier and therefore help the firm in reducing the required investment in working capital.

Net Sales: Net Sales are the total amount of sales generated or operating revenues earned by a firm through its primary business after accounting for returns, discounts, damaged products etc. Net sales represent the total scale of operations of a firm and thus can be used as output of investments made in working capital. NTC measure directly uses net sales as output where as

CCC measure utilises it indirectly. The proposed DEA based measure too directly uses net sales as one of the outputs. The study directly uses the net sales figure given in the profit and loss statement of firms.

Cash Flow from Operations: It has been suggested by many researchers that a firm's operating efficiency is not dependent on liquidation value of its assets but rather on cash flow generated by those assets (Shin & Soenen, 1998). Thus one of the important aims of working capital investment is to generate cash from operating activities. A firm generating higher cash flow from operations with same level of working capital investment can be considered more efficient. This study therefore selected cash flow from operations (CFO) as an output variable in the new DEA based efficiency measure. CFO is calculated by adjusting net income for depreciation and other non-cash charges. CFO figure was directly available from the database (CMIE Prowess).

Cost of goods sold (COGS): COGS is the cost that is incurred in manufacturing the product and includes direct labour and material costs. COGS along with inventory value are used to calculate inventory days. COGS figure was also available from the database.

Net credit sales and net purchases: Net credit sales value is required for calculating the receivable days (used in calculating CCC). The data for credit sales is not available publically and most researchers have used net sales as its proxy. This study too uses the value of net sales as proxy for net credit sales. Net purchases value is required for calculating payable days.

3.2.3 Data and Sample

Sample

Firms can be broadly divided into manufacturing sector and non-manufacturing sector (which includes service and financial firms). Because of the nature of product and business it is the manufacturing sector firms which are required to keep inventory of raw material, work in progress and finished goods. Since the aim of the study is to study the working capital management efficiency of firms, therefore it is essential that the sample of firms considered should be such that their balance sheet has all constituents of working capital. Moreover, working capital is more critical for manufacturing firms in comparison to service firms. This study therefore selected only the manufacturing sector firms in the sample of study.

Since the private limited companies are not required to publish their results publicly therefore there is unavailability of data for most private ltd firms. Therefore only the public ltd firms are

selected for analysis. Moreover, since most of these firms are listed on stock exchanges it would enable further analysis of market performance.

The study is restricted to 10 years (2004- 2013) as it was found that the period is sufficiently long to cover the different market/economic conditions. The period 2004-2007 covers the pre-crisis period when the economy was rising and was at its full boom till end of 2007. From 2008 to 2010 there was global financial crisis and latter during 2011-2013 there was recovery and growth of economy.

In the study each year of the analysis includes same number of firms as this would be more meaningful while assessing the growth or decline in the performance of the Indian manufacturing sector over the study period. Therefore the sample consisted of only those firms for which the required data was available for all the years under consideration. A total of 1244 manufacturing firms were found which had data available for all variables. The firms were further divided into 11 industries to make the comparison only among peers. The sampling is classified as restrictive population sampling as the study covered the entire population with the required restriction of balanced panel and availability of data for all variables. Table 3.1 shows the list of 11 industries and the number of firms in each of them. The complete list of firms is given in Appendix I.

In case of DEA the sample size is an important concern since DEA is sensitive to sample size and to the number of inputs and outputs adopted for the study. This is because DEA measures efficiency relative to the peers in the sample. Cooper et al. (2007) provides two rules of thumb to assess the adequacy of sample size and can be expressed as follows

$$N \geq \max\{x \times y\,, 3(x+y)\}$$

Where N = number of DMUs; x = number of input variables and y = number of output variables.

In our case (as discussed later) $x = 3$ and $y = 2$ (max), therefore $x \times y = 6$ and $3(x+y) = 15$. Thus each industry should have a sample of more than 15 firms for DEA to give correct results. As it can be observed from Table 3.1 all the 11 industries have a sample size much greater than 15.

Data Collection

The required data was collected from the annual financial statements of listed companies in the Indian manufacturing sector using Centre for Monitoring Indian Economy (CMIE) Prowess database. There was no need for further data editing because published report data is expected

to be free from measurement errors or noise and exhibit adequate reliability. Time period of the study is 2004 to 2013 (10 years) and all the firms for which data were available for all the ten years were considered in the sample. As stated before the balanced panel data set includes equal number of cross-sectional units across the 10-year period of study.

Table 3.1: Industry wise number of firms in sample

Industry	Number of firms
Food and Agro Products (Food)	139
Textiles (Text)	163
Drugs and Pharma (Drug)	104
Plastics and Polymers (Plas)	90
Other Chemicals (Chem)	130
Consumer Goods and Electronics (Cons)	87
Construction and Infrastructure (Infr)	84
Metals (Meta)	142
Machinery (Mach)	109
Transport Equipment (Tran)	107
Miscellaneous Manufacturing (Misc)	89
Total	**1244**

3.2.4 Tools and Techniques

The traditional measures and the new proposed DEA based measure is used for measurement of WCM efficiency.

3.2.4.1 Traditional Measures

Cash Conversion Cycle

The cash cycle concept was introduced by Gitman (1974) who proposed to measure the time period from the time payment is made for raw materials to the time goods are sold. Later this measure was extended by Richards & Laughlin (1980) who incorporated account payables and gave the concept of Cash conversion cycle (CCC) sometimes also called Net working capital cycle (NWC). CCC/NWC is a WCM efficiency measure which measures the efficiency in terms of days.

$$Cash\ Conversion\ Cycle = Inventory\ Days + Receivable\ Days - Payable\ Days$$

where

$$Inventory\ Days = \left(\frac{Inventory}{Annual\ Cost\ of\ Sales}\right) \times 365$$

$$Receivable\ Days = \left(\frac{Accounts\ Receivable}{Annual\ Sales}\right) \times 365$$

$$Payable\ Days = \left(\frac{Accounts\ Payable}{Annual\ Purchases}\right) \times 365$$

CCC is an efficiency measure that measures the working capital management efficiency of a firm. CCC measures the duration from the point investment is made for purchasing inventory to the time it is converted back to cash. In other words, it measures the time for which the cash of the firm is tied up in short term assets. The advantage of CCC is that it is easy to calculate and gives an intuitive view of the liquidity position of firm. CCC serves as a good measure for comparing a firm to its peers and for comparing the firm's liquidity position over time. A shorter CCC is desirable as it indicates that a firm is managing its working capital effectively and means that firm's funds are tied up in current assets for shorter duration. Most of the studies related to working capital have used CCC as the main measure to gauge the efficiency of WCM.

There are however few shortcomings of the CCC measure pointed out by researchers. Hrishikesh Bhattacharya (2004) and Shin & Soenen (1998) point out that CCC calculation is mathematically incorrect. They argue that as all three components of CCC (inventory days, receivable days and payable days) have different denominators thus they cannot be added in a straight forward manner. The measure assumes that inventory days in all three components are universal and comparable which is mathematically incorrect.

Bhattacharya (2004) also argues that the concept of negative working capital cycle is absurd as there is not a logical interpretation of this result. A negative CCC can indicate that there is high WCM efficiency, but cannot explain its meaning. Another shortcoming of the net working capital cycle concept is that it only focusses on the length of time that funds are tied and ignores the amount of funds tied up (Gentry et al., 1990). Another problem with the measure is that equal weights are assigned to each component of working capital. Since the level of liquidity attached with each components of working capital may not be the same therefore assigning equal weights to them may result in biased or suboptimal results.

Despite the criticism, cash conversion cycle remains by far the most popular measure for assessing working capital management efficiency. As many authors have pointed out, this is because the CCC measure, to a large extend does the job of estimating the efficiency of WCM. This study therefore has also used CCC along with other measures for assessing working capital efficiency of Indian manufacturing firms.

Net Trade Cycle

Researchers like Shin and Soenen (1998) and Erasmus (2010) proposed an alternative measure Net Trade Cycle.

$$Net\ Trade\ Cycle = (Inventory + Receivables - Payables) \times \frac{365}{Net\ Sales}$$

NTC measures WCM efficiency by calculating net working capital per unit of sales. It measures the number of "days sales" the firm has invested in working capital and how much more funds will be required in case of change in sales. e.g. if NTC of a firm say ABC is 40 and the sales of the firm increases from 10 billion to 15 billion then ABC requires additional (40/360)*(15-10) = 0.55 billion just for working capital requirements. Similar to CCC, smaller the value of NTC higher is working capital management efficiency of the firm.

NTC improves on CCC by measuring all three components as percentage of sales. CCC's shortcoming of adding three different ratios with three different denominators is therefore solved in NTC and the calculation is no longer mathematically flawed. The results of NTC are very similar to that of CCC i.e. if the firms are ranked according to CCC and NTC the ranks will be similar (Goel and Sharma, 2014). Another advantage of NTC is that it is straight forward and easy to calculate.

However, there are some shortcomings in the NTC measure too. Here again like CCC equal weights are assigned to each component of working capital e.g. it is assumed that Rs. 10 million worth of inventories is having same liquidity as Rs. 10 million worth of payables and thus can cancel each other. Each firm has different level of liquidity attached with each component of working capital and thus the components cannot be simply added without assigning some weights. Moreover, it may be easy for some firms to liquidate inventory while for others it may easier to recover receivables and thus assigning same weights is not appropriate. Another shortcoming of NTC is that like CCC it may also give negative values. The negative results indicate that the efficiency is very high but do not give any logical

interpretation. However, after CCC, NTC is now becoming a popular measure for measuring WCM efficiency as it is easier to calculate and as per researchers gives comparable results.

3.2.4.2 New DEA based Measure

Data envelopment analysis (DEA) is a linear programming technique developed by Charnes et al. (1978) which evaluates the relative efficiency of a subject or decision making unit (DMU) in a group. DEA is used to calculate efficiency of subjects also called decision making units (DMUs) especially in cases where there are several inputs and outputs and where it is not possible to aggregate these multiple inputs (outputs) into one input (output). In DEA relative efficiency is measured using the ratio of aggregate weighted outputs to aggregate weighted inputs; however the weights are not allocated in advance. Here the weights of individual inputs and outputs are not fixed and are allowed to vary. Through linear programming the weights are assigned to the outputs and inputs such that each DMU is able to get the highest possible efficiency score. The restriction is that no DMU can have ratio of weighted outputs to inputs more than unity. The DEA score ranges between zero & one and determine the benchmarks with the best practicing units in a peer group. A DMU is labelled efficient if it has efficiency of 1.0. The DEA measure is based on building an efficient frontier. This efficient frontier works as a frontier that connects the most efficient DMUs and envelops all other DMUs.

Charnes et al. (1978) developed the initial CCR model which assumes a constant return to scale. The BCC model given by Banker et al. (1984) extends the CCR model for technologies that exhibit variable returns to scale (VRS). This was done by making the efficient frontier a convex hull instead of a straight line. The VRS model is widely applied in the literature as it is based on a more practical aspect of market conditions.

These two models can further be divided into two types namely input oriented model and output oriented model depending upon whether we are trying to minimise inputs or maximise outputs. There is no consensus on the choice of inputs and output in the literature.

As stated in chapter one, the basic DEA efficiency model is given by the following expression

$$\max \theta\,(u,v) = \frac{\sum_r u_1 y_{1o} + u_2 y_{2o} + \cdots + u_s y_{so}}{\sum_i v_1 x_{1o} + v_2 x_{2o} + \cdots + v_m x_{mo}}$$

$$subject\ to$$

$$\frac{u_1 y_{1j} + \cdots + u_s y_{sj}}{v_1 x_{1j} + \cdots + v_m x_{mj}} \leq 1\ for\ j = 1, \ldots, n,$$

$$u_r, v_i \geq 0 \; for \; all \; i \; and \; r.$$

This form is also called the primal form. Here *y and x r*epresent outputs and inputs respectively. u and v are weights assigned to outputs and inputs. There are *s* outputs and *m* inputs. The same linear programming model can also be represented in its dual form (Cooper et al., 2007). The following expressions give the dual form of basic DEA CCR models (Cooper et al., 2011):

Input Oriented Model

$\min \theta$

$$s.t. \sum_{j=1}^{N} x_{ij}\lambda_j \leq \theta x_{io} \qquad i = 1,2,\dots,m; \qquad (1)$$

$$\sum_{j=1}^{N} y_{rj}\lambda_j \geq y_{ro} \qquad r = 1,2,\dots,s; \qquad (2)$$

$$\lambda_j \geq 0 \qquad j \neq o \qquad (3)$$

Output Oriented Model

$\max \varphi$

$$s.t. \sum_{j=1}^{N} x_{ij}\lambda_j \leq x_{io} \qquad i = 1,2,\dots,m;$$

$$\sum_{j=1}^{N} y_{rj}\lambda_j \geq \varphi y_{ro} \qquad r = 1,2,\dots,s;$$

$$\lambda_j \geq 0 \qquad j \neq o$$

Where x_{ij} is the ith input for DMU *j* and y_{rj} is the rth output for DMU *j*

x_{io} and y_{ro} are input and output values, respectively, of the DMU under evaluation.

θ represents inverse of efficiency score

φ represents the efficiency score.

λ represents the weights attached to different DMUs.

There are s outputs and m inputs for all N DMUs

By adding the condition

$$\sum_{j=1}^{n} \lambda_j = 1$$

Both input oriented and output oriented CCR models can be converted into the BCC model.

The number of constraints of the primal depends upon the number of DMUs, while the number of constraints of the dual depends upon the number of inputs and outputs. The computational efficiency of linear programming codes depends to a greater extent upon the number of constraints rather than on the number of variables. In a typical DEA exercise, about 5 inputs and 5 outputs are considered, while the number of units being compared is much larger (of the order of hundreds or even thousands). Hence, the dual formulation is computationally more efficient than the primal. The dual form is thus used by most software for calculating the DEA based efficiency.

The computations in DEA are unit free and do not require price information of inputs and outputs or weights (Charnes et al., 1984). The focus is on the operational efficacy of DMUs and hence DEA is appropriate to measure the WCM efficiency estimates of Indian manufacturing sector. The deterministic nature of DEA ignores the size disparity of DMUs and this one is the notable advantage of this study as Indian manufacturing sector comprises of a large variety of firms each having different size and other characteristics.

Data Envelopment Analysis (DEA) because of its many advantages like non-parametric approach, relative measurement and flexibility to choose different weights of inputs and outputs make it particularly suitable for measuring efficiency (Marschall and Flessa, 2011). It has been used in numerous studies to examine various types of efficiencies, e.g. efficiency of banks (Staub et al., 2010), university libraries (Noh, 2011), airports (Tsekeris, 2011), hospitals (Medin et al., 2011), etc. However in case of working capital management DEA has not been applied and its efficiency is still measured using the traditional measures.

Present study uses the two-stage DEA model to analyse the WCM efficiency of Indian manufacturing sector firms. Here in the first stage WCM efficiency is calculated and in the second stage the effect of various exogenous variables on the calculated efficiency scores are determined. By measuring WCM efficiency using DEA the study intends to overcome the problems of traditional measures like mathematically incorrect calculation, assignment of fixed weights to constituents and ordinal scale of measurement etc and hence aims to measure WCM efficiency more effectively.

Similar to NTC measure inventory, receivables and payables are used as inputs and net sales value is used as output variable in the DEA model. In addition, since a firm's operating efficiency is not dependent on liquidation value of its assets but rather on cash flow generated by those assets (Shin & Soenen, 1998) therefore cash flow from operations was also selected as an output variable.

Since, payables reduce the amount of firm's own funds required to be tied up in working capital, therefore higher level of sundry creditors is preferable and thus payables are not normal inputs. They are reverse inputs and thus linear transformation given by Seiford and Zhu (2002) is used to transform reverse inputs into normal inputs.

Knox Lovell and Pastor (1995) state that an output oriented BCC DEA model is translation invariant with respect to inputs and vice versa. Since in our case one of the inputs (sundry creditors) has been translated (modified) therefore output oriented BCC DEA model is used to preserve the invariance property.

Bootstrapping

Since DEA measures the relative efficiency where the sample size is generally small, it is argued that firms that are not considered/omitted in the sample may lead to biased results (Hawdon, 2003). Since the comparison is among firms in the sample, a number of authors have argued that DEA efficiency scores will change from sample to sample and thus cannot be trusted. To overcome this problem Simar and Wilson (1999) propose a bootstrap method and this has also been advocated by researchers like Lothgren (1998) and Hawdon (2003). The bootstrap method "draws a random sample with replacement from the observed values in the original sample, (and) it can be treated like a sample drawn from the underlying population itself" (Ray, 2004). It then carries smoothening to achieve final bias corrected efficiency scores. The bootstrapping thus removes the bias by resampling large number of times from the given sample to create the effect of entire population. If resampling and smoothening are carried out quite a large number of times, the DEA efficiency scores of DMUs are found to be closer to the values that would have been assigned to them if the sample contained all firms in the population. A number of researchers including Cummins et al. (2003), Hawdon (2003) and Staat (2006) have advocated and used bootstrapping to calculate bias free efficiency scores. This study thus also used bootstrapping to achieve optimal and correct efficiency measure.

3.3 Stage 2A – Determinants of WCM Efficiency

3.3.1 Introduction

This stage of study analyses the proposition that the working capital management efficiency of Indian manufacturing firms are significantly affected by firm-specific variables and macro-economic variables.

Firms operate in global competitive environment and face various threats and opportunities. They try to minimise their weaknesses and utilise their strengths to compete and thrive in the market. Therefore, both internal and external factors effect a firm's operations and change the way a firm performs and the extent to which it is able to achieve its objectives. In other words, both firm-specific, micro-economic variables and macro-economic conditions influence the efficiency and productivity of an organisation. Efficiency of working capital management too may get influenced by the dynamic forces of firm-specific and macro-economic conditions. Thus, the efficiency of a firm's WCM cannot be solely determined by the set of inputs-output only and there might be significant influence of various other factors. There can be mainly two categories of these influencing factors namely firm-specific and macroeconomic. The investigation of these influencing variables plays an important role in assessment of efficiency and investigating its change. Figure 3.1 shows the relationship between WCM efficiency and determining variables.

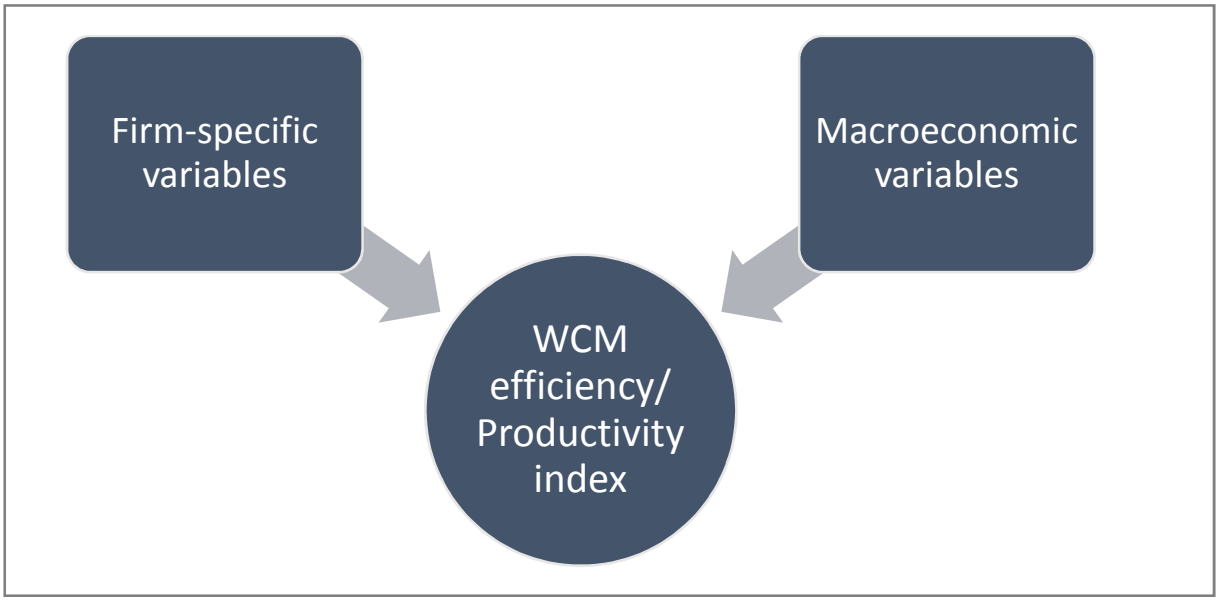


Figure: 3.1: Relationship model between WCM efficiency and explanatory variables

A number of studies including Mukherjee et al. (2001) and Simar and Wilson (2007) suggest the use of a two stage DEA process where the efficiencies obtained from first stage of DEA

model are regressed on exogenous variables to determine the impact of these variables on the efficiency scores. Therefore this two-stage DEA can also be used to measure WCM efficiency of Indian manufacturing firms and analyse its exogenous determinants. However for higher robustness of the results this study not only used the efficiency scores obtained through the new DEA based measure but has also employed the traditional WCM efficiency measures CCC and NTC for analysis.

The literature has used a number of variables to examine their influence on working capital. A number of previous studies on determinants of working capital were examined and the key variables used in these studies were analysed. The studies considered included Delannay and Weill (2005), Chiou et al. (2006), Moussawi et al. (2006), Smith and Fletcher (2009), García-teruel and Martínez-solano (2010), Taleb et al. (2010), Palombini and Nakamura (2012), Saarani and Shahadan (2012), Abbadi and Abbadi (2013) and Naser et al. (2013). Based on the importance given in literature some variables were shortlisted for examination of their influence on WCM efficiency. Most common firm-specific factors discussed in literature were age, size, ratio of fixed to total assets, debt ratio, sales growth, return on assets and ratio of cash to total assets. The macroeconomic factors that were found to be important were Gross Domestic Product (GDP) growth rate, interest rates and inflation rate.

The efficiency scores obtained in the first stage were used in the second stage to analyse the exogenous factors affecting efficiency. For the second stage of the two-stage DEA, some of the studies have used ordinary least square regression (OLS) and others use Tobit regression but there is still no settlement on which method is better. However, Hoff (2007) states "OLS may actually in many cases replace Tobit as a sufficient second stage DEA model" and thus this study used OLS in analysis.

3.3.2 Variable Specification

The first step was to identify the factors that might influence working capital level of firms. Following the previous literature the following variables were shortlisted for investigation of their influence on working capital management efficiency.

Firm-Specific Variables

(i) Age:

Age of firm is measured as:

$$\text{Age of firm} = \text{Year under study} - \text{Year of incorporation}$$

Age can be one of the important influencing factors on WCM efficiency. Many authors including García-teruel and Martínez-solano (2010) and Guy and Mazra (2012) have found significant relationship between age of firm and the efficiency of working capital management. On the other hand other like Chiou, et al. (2006) and Saarani and Shahadan (2012) have not found any significant relationship between the two. Age may have two opposite effects on efficiency of working capital management. First, younger firms maybe more aggressive in managing short term assets in comparison to old firms since they generally have shortage of funds and may thus try to a) minimise their investment in working capital and b) increase the current liabilities. Therefore young firms may manage working capital more efficiently leading to inverse relationship between WCM efficiency and age. On the other hand, age may provide experience to old firms enabling them to handle the working capital more effectively and efficiently which may be not be there in young firms. Hence it's also possible that age may have a positive relationship with the WCM efficiency.

(ii) Size*:*

Size of firm is measured as:

$$\text{Size} = ln(\text{Total assets})$$

Size of firm is one the most examined determinant of working capital management efficiency in literature. A large number of authors have analysed the impact of firm's size on WCM. While many studies including Delannay & Weill (2005), Zariyawati et al. (2009) and Palombini & Nakamura (2012) found a significant effect of size, on the other hand authors like Chiou et. al. (2006) and Nazir & Afza (2009) did not find any association of size with WCM efficiency. A well-established firm generally has a large size. Such a firm may use its size to influence it's a) suppliers to give large and long credit and b) buyers to pay up quickly and reduce the receivables. Both of these would lead to increased WCM efficiency. There is however a possibility of opposite effect too. A large firm may have sufficient financial stability and thus may like to keep large inventory at hand to keep up with the future demands and may also not mind extending large credit to customers to maintain its market leadership. Thus it's also possible that WCM efficiency of firm may decrease with increase in size of firm.

(iii) Fixed assets ratio:

Fixed assets ratio is measured as:

$$\text{Fixed assets to total assets ratio} = \text{Net fixed assets} / \text{Total assets}$$

Fixed asset ratio represents the amount of investment made by firm in plant, machinery and equipment. A number of authors have shown that there is some effect of this investment on the management style of working capital and on the liquidity level maintained by the firm. Authors like Moussawi et al., (2006), Uesugi & Yamashiro (2008), Vaidya (2011), Gill & Mathur (2011), Mongrut et al. (2014) found effect of fixed asset ratio on management of working capital. Higher proportion of fixed assets in total assets implies that the firm's product portfolio requires large investments. It is expected that as a firm makes more investments in fixed assets, it may experience shortage of funds available for investment in working capital. Such firms may thus try to manage their working capital more efficiently (by reducing current assets and increasing current liabilities) to reduce the required investment. Thus ratio fixed asset to total asset may have positive effect on WCM efficiency.

(iv) Debt ratio:

Debt ratio is measured as:

$$\text{Debt ratio} = \text{Total Borrowings} / \text{Total Assets}$$

The amount of debt held by a firm affects its risk profile and thus might affect its decisions on liquidity levels to be maintained. A large number of previous studies including Chiou, Cheng, & Wu (2006), Appuhami (2008), Nazir & Afza (2009), Zariyawati, et al. (2009), Gill (2011) and Valipour, et al. (2012) have found significant relationship between debt levels and working capital management. With the increase in the level of debt, a firm faces increased risk of bankruptcy (Adams et al., 2003). Such firms may try to avoid any further financial risk and may thus become more risk averse to avoid financial distress. It is expected that such firms may keep large amount of current assets to increase the liquidity and may keep small amount of current liabilities to reduce the possibility of default. It is therefore expected that debt ratio may have negative relationship with WCM efficiency.

(v) Sales Growth:

Sales growth is measured as:

$$\text{Sales growth} = (\text{Sales in current year} - \text{Sales in past year}) / \text{Sales in past year}$$

Firms with high sales growth tend to be more aggressive in managing working capital which may have significant effect on WCM efficiency. Numerous previous studies like Kim, Mauer, & Sherman (1998), et al. (2006), Zariyawati, et al.(2009), Gill (2011) and Valipour et al. (2012) have found that there is effect of sales growth on the working capital management efficiency. However, while some of these studies found a positive relation others found the relationship to

be negative; on the other hand others like Appuhami (2008) and Nazir & Afza (2009) have not found any evidence of sales growth influencing WCM. High sales growth may make a firm anticipate higher sales in future. This may push the firms to make maximum use of their available resources to scale up the operations. Such firms may increase the level of payables by pushing the suppliers to give more credit. Moreover suppliers too feel more confident in lending to firms with higher sales growth. However this may also lead to increase in inventory due to higher purchase of raw materials in anticipation of higher future sales. In addition higher sales growth leads to decrease in levels of finished goods inventory due to higher sales. It is therefore expected that sales growth may have significant impact on WCM efficiency.

(vi) Return on Assets (ROA):

Return on assets is measured as:

$$\text{Return on Assets} = \text{Profit after tax} / \text{Total assets}$$

Return on assets is an efficiency measure which measures the firms' efficiency in generating returns from its assets. It is therefore possible that this efficiency measure may have significant effect on the efficiency of working capital management. Authors like Chiou, et al. (2006), Nazir & Afza (2009), Mohamad and Saad (2010) and Valipour et al. (2012) have found significant relationship between ROA and WCM measures. However Appuhami (2008) found that there is no significant relationship between the two. Higher return on assets indicates higher efficiency in overall assets utilisation and hence may also indicate higher efficiency in utilisation of short term assets (when the comparison is among firms belonging to same industry). Moreover higher ROA in a firm builds up confidence of its suppliers and they may agree to give higher and linger credit to firms. It is therefore expected that a positive relationship may exist between ROA and WCM efficiency.

(vii) Cash and Bank Balance to Total Assets:

Cash holding is measured as:

$$\text{Cash holding} = \text{Cash and marketable securities} / \text{Total Assets}$$

Cash holding of a firm indicates its liquidity preference. The liquidity preference in turn affects the working capital level maintained and may affect the efficiency of working capital management. Authors like Love et al. (2007), Uesugi and Yamashiro (2008) and Gill and Mathur (2011) have significant relationship between the cash holdings level and working capital management. On the other hand García-teruel and Martínez-solano (2010) state that there is no relationship between the efficiency of working capital and cash holdings. Cash and

banks balances are the most liquid assets and are alternatives to other current assets (inventory, receivables etc.). Firms which keep large amounts of cash may have to reduce the investment in other current assets like inventory and receivables. It is thus expected that proportion of cash and bank balance may have a positive effect on the efficiency of working capital management.

Macroeconomic Variables

(i) Gross Domestic Product (GDP) growth:

GDP growth rate measures the change in level of economic activity and serves as a proxy for economic conditions. High GDP growth rate indicates increase in economic growth (Bartleet and Gounder, 2010) which may lead to increased capacity to produce goods. Since improvement or deterioration of economy can effect liquidity and it management therefore, higher GDP growth may have significant effect on the working capital management and its efficiency.

(ii) Interest Rate:

Interest rates are indicators of the borrowing rates prevalent in the market. Higher interest rates in the market may force the firms to switch from bank finance to other sources of finance like sundry creditors for short term credit. An increase in level of sundry creditors will improve WCM efficiency; therefore higher interest rates may lead to increase in efficiency of WCM. The interest rates may thus have a significant relationship with the efficiency of working capital. This study uses average interest rates of central government (Indian) securities as indicators of prevailing interest rates.

(iii) Inflation Rate:

Inflation rate reflect the rate of increase in price levels of goods and services. An increase or decrease in inflation might change the amount of funds available to a firm for investing in working capital which may in turn change the balance of current assets vs. current liabilities. It is therefore expected that inflation may have significant effect on the efficiency of working capital.

(iv) Financial Crisis:

The financial crisis of 2009-10 broke many firms and most others suffered financial crunch and slowdown in demand. It is expected that such drastic change in economic conditions would have affected the management style and efficiency of firms. Since working capital management

efficiency depends upon the liquidity management approach of the firm, it is expected that the WCM efficiency would have been significantly affected in the period of financial crisis.

Table 3.2 shows the list of variables selected for analysis of their influence on WCM efficiency along with their brief description.

Table 3.2 Variables examined for influence on WCM efficiency

	Variables	**Description**
Firm-Specific Variables	Age	Age of firm from the date of incorporation
	Size	Size of firm in term of natural log of total assets
	Fixed asset ratio	Ratio of net fixed assets to total assets
	Debt Ratio	Ratio of total debt to total assets
	Sales Growth	Growth in sales
	ROA	Ratio of net profit to total assets
	Cash holding	Ratio of cash holding to total assets
Macroeconomic Variables	GDP	Yearly GDP growth rate of India
	Interest Rate	Interest rates of government securities
	Inflation	Whole sale price index
	Financial Crisis	Dummy equals 1 for all observations during 2007-08, 2008-09 and 2009-10.

3.3.3 Tools and Techniques

To analyse the determinants of WCM efficiency, this study adopts graphical analysis and panel data regression model.

Panel data is pooling of observations on a cross-section of individuals, countries, firms, household over several periods (Baltagi, 2008). Panel data in general is termed as longitudinal data which illustrate the observations of a number of cross-sections such as individuals and respondents in time-series. Therefore, panel data includes set of data on several units at two or more points in time. Panel data set incorporates two dimensions of data set i.e. cross-sectional and time-series and hence enhances the deterministic power of sample as it receives multiple observations on each unit in the sample. It depicts a hierarchical structure or more complex clusters of multilevel data (Hsiao, 2006; Luke, 2004).

Panel data accounts for random error and unobserved heterogeneity of observations which is difficult to measure precisely. Socio-economic factors, cultural factors and other dimensions which vary over time but not across the cross-sections (GDP, inflation and qualitative

regulatory practices) are difficult to measure precisely. Panel data provides multi-level structures suitable for hierarchical modelling and therefore has several advantages over the single cross-sectional or time-series data (Hsiao, 2003). Considering its multiple advantages, panel data analysis is widely being used in the social and economic studies.

If all the cross section units have same number of time-series observations then such a panel is called a balanced panel. On the other hand if there are unequal numbers of time-series observations then such panel is termed as unbalanced panel. This study collected data such that all firms have same number of years of observations and thus adopts balanced panel data analysis. Using panel data regression allows us to control for unobserved variables which vary with time but may not vary across entities.

Regression model establishes relationship between dependent and independent variables. A simple Panel regression model can be expressed as follows:

$$Y_{it} = \alpha + \beta X_{it} + u_{it},$$

$$i = 1,2, \dots, N$$

$$t = 1,2, \dots, T$$

Here *i* represents individual entity and *t* represents time period. Therefore Y_{it} represents the dependent variable of i^{th} entity at t^{th} time. $X_{it}$is the independent observation on i^{th} cross-section in t^{th} time period. *N* is the total number of entities and *T* is the number of time periods under consideration. β is a vector of coefficient which is to be estimated. u_{it} denotes an error component of the model. It can be expressed as one-way or two-way form depending on whether or not it considers time specific individual invariant component in addition to unobservable cross-sectional specific time invariant effect. $u_{it} = \mu_i + v_{it}$ is a one-way form of the disturbances, $\mu_i$refers to the unobservable cross-sectional specific time invariant effect and v_{it} refers to the remainder disturbances (Baltagi, 2005). The two-way form of error component is considered an additional time specific individual invariant component and can be expressed as $u_{it} = \mu_i + \gamma_t + v_{it}$ where $\gamma_t$refers to individual invariant component.

Based on the role of error term in the model, panel data regression model can be classified into two types namely fixed effect model and random effect model. Fixed effect model is used when we are only interested in examining the impact of factors that vary with time and may be invariant across cross section. “The fixed effect model assumes that the slope coefficients of the regressor do not vary across cross-sections” (Gujarati, 1982). On the other hand random

effect model is used when we have some indication that the difference in entities across cross section has some effect on the dependent variable. Here unlike fixed effect, the model also takes into consideration time invariant variables.

It is difficult to make a choice between both of these panel regression models. Results from both of the models significantly differ in case of few observations (Hsiao, 2003). The choice between these two is based upon the assumption one makes about the likely correlation between the cross-section specific error component e_i and the X‘s regressors. If it is assumed that the e_i and the X‘s are uncorrelated then random effect is a suitable model however in case of an assumption that the e_i and the X‘s are correlated then fixed effect may provide better estimations.

$$H_0: E(u_{it}|X_{it}) = 0$$

This study is mainly interested in measuring the effect of variables which vary with time, i.e. there is little interest in time invariant factors. Moreover, a test was developed by Hausman (1978) to test whether fixed effect model is better suited or not. The underlying null hypothesis is that the fixed effects and random effects estimates do not differ significantly. If null hypothesis gets rejected, it suggests that the random effect model is not suitable and fixed effect model should be applied.

Considering its above mentioned benefits this study has applied panel data regression model to examine the influence of various firm-specific and macroeconomic variables on the WCM efficiency and MPI. The study also applied Hausman test to choose between fixed effect and random effect model.

In order to make sure that the data is suitable for carrying out panel data regression model, there is need to test for stationarity, since it is a requirement for regression analysis. A stationary series has the property that its mean, variance and autocorrelation are all constant over time. If the series is not stationary then it has to be transformed by suitable technique to make it stationary. Existence of unit root in a data set leads to non-stationarity series. As a general rule non-stationary data cannot be predicted, modelled or forecasted accurately. If such data is used in the model, the results obtained might be spurious.

Since the data set in this study is panel in nature therefore there is need to conduct panel unit root tests to check for stationarity in the data set. This study therefore adopts the unit root tests advocated by Levin, Lin and Chu (LLC) (2002). The LLC test may be interpreted as pooled

Augmented Dickey- Fuller (ADF), with differing lag lengths across the units of the panel and applicable to both small and large panels.

This stage uses E-views statistical tool to apply Panel data regression model and requisite tests. The specifications of Panel data regression models have been detailed in chapter 4 of this study along with the empirical results.

3.4 Stage 2B: Measuring WCM Efficiency Change using Malmquist Productivity Index (MPI)

3.4.1 Introduction

In this stage Malmquist Productivity index and it components pure efficiency, scale efficiency and technology change (as given by Färe et al. (1994) are used to examine the change in WCM efficiency of Indian manufacturing firms over the study period. In addition, change in a number of firm specific and macroeconomic determinants are examined for their influence on WCM efficiency change.

Malmquist (1953) initially conceptualised the Malmquist productivity index and the idea was later further developed by Caves et al. (1982), Färe and Grosskopf (1992) and Färe et al. (1994). Productivity is defined as the ratio between two efficiencies, as calculated by the DEA, for the same production unit in two different time periods (Odeck, 2000). MPI makes use of the efficiency scores calculated using DEA to analyse the change in efficiency. It is used to measure the change (progress or regress) in efficiency of DMUs along with change in technology over time.

3.4.2 Variable Specification

Productivity index can be decomposed into its two main components, technical efficiency change which reveals the convergence or divergence of DMUs from the best practicing frontier; and the technological change which depicts improvement or deterioration in all DMUs. Fare et al. (1994) (FGNZ) decomposed the Malmquist productivity index into three parts, representing (i) change in pure efficiency (PE) (ii) change in scale efficiency (SE) and (iii) change in technology (TC). PE and SE together measure change in the technical efficiency of firm. TC is the change in efficiency due to change or improvement in technology due to which there may be change in efficiency of all firms.

PE measures the change in technical efficiency of DMU i.e. improvement in efficiency due to improvement in the process. On the other hand SE measures change in efficiency due to

improvement in scale of operations. The dependent variables were MPI, PE and SE of the current year (as detailed in section 3.4.3). The variables (inputs and outputs) used to calculate MPI and its components were same as that used in calculating DEA based WCM efficiency.

The variables that have been used to examine the influence on WCM efficiency are almost same as those used in stage 2A. However since this stage examines the influence of various variables on 'efficiency change' instead of efficiency therefore change in values of the determining variables are used as independent variables. That is, the difference between value of variables in previous year and this year are used as independent variables. The independent variables were age change (AGEC), size change (SIZC), change in fixed assets to total assets ratio (NFAC), debt change (DEBC), change in sales growth (SLGC), change in cash and bank balance to total assets (CASC) and change in return on assets (ROAC). Since change in age of firm will always be one year therefore this variable (AGEC) was eliminated from the analysis. In addition, macro-economic factors change in GDP growth rate (GDPC), change in interest rate (INTC) and change in inflation rate (INFC) were also tested for possible influence on MPI and its components pure efficiency (PE) and scale efficiency (SE).

3.4.3 Tools & Techniques

Here MPI and its components pure efficiency, scale efficiency and technology change are used to analyse the WCM efficiency change over time. The mathematical representation of MPI is as follows.

We define:

C_{ij} = Efficiency at time i relative to technology at time j assuming CRS

V_{ij} = Efficiency at time i relative to technology at time j assuming VRS;

The Malmquist productivity index (MPI) is defined by

$$MPI = \left(\frac{C_{21}}{C_{11}} \times \frac{C_{22}}{C_{12}}\right)^{1/2}$$

Here 1 and 2 are first and second period of study respectively.

If the MPI value is greater than 1 then it implies that the efficiency has improved with time, if it is less than 1 it means deterioration in the efficiency of firms and a value of 1 implies no change in efficiency. If technical efficiency changes are greater than the technological change,

it implies that the productivity progress is due to increase in efficiency of firms known as "catching–up" effect. On the other hand higher technological change "innovation" is due to the technological innovation in the firms (Cummins et al., 1999).

The efficiency change or productivity can be decomposed as follows:

MPI = (Technical Efficiency Change) x (Technological Change).

Here technical efficiency change is further decomposed into pure efficiency change and scale efficiency change.

Technical Efficiency Change = (Pure Technical Efficiency Change) x (Scale Efficiency Change)

Malmquist productivity index can be broken into three parts, representing (i) change in pure efficiency (PE) (ii) change in scale efficiency (SE) and (iii) change in technology (TC) and each part can be calculated as follows:

$$PE = \frac{V_{22}}{V_{11}}$$

$$SE = \frac{C_{22}/V_{22}}{C_{11}/V_{11}}$$

$$TC = \left(\frac{C_{21}}{C_{22}} \times \frac{C_{11}}{C_{12}}\right)^{1/2}$$

MPI along with its components PE, SE and TC have been used by many researchers to study the change in efficiency in various areas. However, in spite of its effectiveness in analysing the efficiency change none of the studies have employed MPI to examine WCM efficiency change.

This study used Efficiency Measurement Software (EMS) (by Holger Scheel) to calculate efficiency without bootstrapping as it also provides a list of benchmark DMUs (discussed later) an output. However, since EMS software does not have the facility for bootstrapping therefore the study used the FEAR package by Paul W. Wilson (Wilson, 2008) to calculate bootstrapped DEA efficiency. FEAR is also used to calculate Malmquist productivity index and its components pure efficiency change, scale efficiency change and technology change. The software is able to directly calculate MPI and thus one doesn't have to first calculate DEA based efficiency and then go on to calculate MPI.

This stage uses MPI along with its components PE, SE and TC to analyse the change in WCM efficiency. Initially MPI, PE, SE and TC values are calculated for all firms and for all years.

Subsequently average industry wise values are calculated and analysed. The cumulative WCM efficiency change is also examined to check the nature of change in WCM efficiency over the years.

Thereafter various firm specific and macroeconomic variables were tested for their influence of WCM efficiency change. Graphical examination along with panel data regression model as detailed in Stage 2A is again used for this analysis. However, unlike in stage 2A, pooled data from all industries is used for the study.

Hence in this stage WCM efficiency change or WCM productivity is analysed using MPI and its components and then the influence of change in various firm-specific and macroeconomic variables on this efficiency change is examined using graphical and statistical analysis.

3.5 Stage 3: Impact of WCM Efficiency on Firm Performance

3.5.1 Introduction

This stage investigates the empirical association between WCM efficiency and performance indicators of Indian manufacturing firms. In this stage the study examines whether the efficiency of working capital management impacts the overall performance of the firm. As a firm improves its efficiency in managing liquid assets, it is expected that this improvement in working capital management performance would get translated into improved financial performance. Few authors like Mathuva (2009) state that decisions which focus on maximising profitability reduce the chance of appropriate liquidity and decisions that focus too much on liquidity tend to reduce a firm's profitability. Authors like Zariyawati et al. (2009) state that it is not easy for firms to efficiently manage their day to day liquidity and at the same time run business operations smoothly and profitably. Thus the way working capital is managed can have a significant impact upon both the liquidity and profitability of the company (Shin and Soenen, 1998).

Some of the researches like Padachi (2006), Gill et al. (2010) and Sharma and Kumar (2011) have found that there exists a positive relationship between cash conversion cycle and firms' profitability. That is as firms improve their working capital efficiency their profitability tends to go down. On the other hand studies like Charitou et al. (2010), Lazaridis and Tryfonidis (2006), Vural et al. (2012), Mohamad and Saad (2010) and Mansoori and Muhammad (2012) have found that there is significant negative relationship between cash conversion cycle and firm's performance. That is as the efficiency of working capital in firm improves the financial

performance of firm also improves. However, still other studies like Danuletiu (2010) and Chandrabai and Rao (2011) have found non-significant relationship between WCM efficiency and performance of firm. Thus there is no agreement on the relationship between the two.

In almost all of the previous studies, cash conversion cycle has been used as the main measure for estimating working capital management efficiency. Given the limitations of CCC, using it as the only measure for WCM efficiency may not give results that are reliable. This study thus adopts three measures of working capital management efficiency: traditional measures cash conversion cycle and net trade cycle and the new DEA based WCM efficiency calculated in the previous section. The WCM efficiency calculated and used in previous sections were used for further analysis in this section. The results obtained are thus expected to be more reliable and applicable to manufacturing sector in general.

Moreover, almost all the previous studies have used profitability or return on assets as the main measure of firm's performance. A firm's performance should not only consider accounting performance that is evident from its annual report but should also consider the market performance of the firm's stock (Soana, 2011). This study thus also employs a number of performance measures which includes both accounting and market performance ratios. Firm's performance is estimated and the study develops and tests statistical models for linkages between firm's performance and WCM efficiency.

3.5.2 Variable Specification

The following measures are utilised to gauge firms' performance:

Return on Equity (ROE):

ROE is measured as:

$$ROE = \frac{Net\ Profit}{Book\ Value\ of\ Equity}$$

ROE measures the performance by measuring the returns generated from investments made by equity investors. ROE was used as performance indicator by Danuletiu (2010) for assessing impact of WCM efficiency on performance. ROE is also an efficiency measure which measures the efficiency of firm in earning profits from each unit of investment made by shareholders in the form of equity. It is expected that increase in efficiency of working capital management may lead to higher efficiency in utilisation of shareholders fund and therefore there may be some relationship between the two.

Return on Sales (ROS):

ROS is measured as:

$$ROS = \frac{Net\ Profit}{Net\ Sales}$$

Also referred as profit margin, ROS is one of the most commonly used measure to measure performance of firm. It is an accounting based performance measure and is one of the profitability measures. A few authors like Kaur and Singh (2013) have used ROS for assessing impact of WCM. ROS gives an indication of how well the firm is able to control its cost and earn higher profit on each unit of sales. Thus the ratio gives information about the performance and management quality of a firm. It is expected that a firm which has higher control over its costs will manage it working capital much differently in comparison to its competition.

Tobin's Q (TQ)

Tobin's Q is measured as (Chung and Pruitt, 1994):

$$TQ = \frac{(Market\ value\ of\ (Equity + Preferred\ Stock + Debt))}{Total\ Assets}$$

Tobin's Q has been used by many studies including Mohamad and Saad (2010) and Vural et al. (2012) for measuring firm's performance while examining impact of WCM. Tobin's Q is a measure of the market performance and long term performance (Srivastava and Laplume, 2014) of firm. If the ratio's value is less than 1, it suggests that market is undervaluing the firm and this may be due to bad perception about the firm. On the other hand, a value greater than 1 suggests that the firm is overvalued. Thus overall the ratio is an indication of the valuation of firm. It is expected that change in WCM efficiency may change the investors' perception towards growth aspects and future performance of firm and may thus impact its Tobin's Q.

Price to Earnings Ratio (PE)

PE is measured as:

$$PE = \frac{Price\ per\ share}{Earnings\ per\ share}$$

PE gives an indication of the amount that the investors are willing to pay per dollar of firm's earnings. PE is also considered an indicator of firm's market performance as firms which are expected to perform well in future are valued higher by investors and thus enjoy higher PEs. If

the PE of a firm goes up it may indicate improved market performance and market perception. It is expected that change in liquidity management and WCM efficiency may affect the investor's perception and thus have effect on PE ratio.

Market Value Added (MVA)

MVA is measured as:

$$MVA = (Market\ value\ of\ equity + debt) - (Book\ value\ of\ equity + debt)$$

MVA is widely used as a proxy variable for stock return and wealth creation. MVA is closely related to economic profit and defined as the difference between a firm's market value and capital invested. A positive value of MVA indicates that firm has created market value whereas a negative value denotes destruction in the market value of the firm. MVA is widely used as a proxy variable for stock return and wealth creation in studies like Finegan, (1989), Kramer and Pushner (1997), Elali, (2006) and Cheng et al. (2007) and can be a good measure to test for association with new DEA based WCM efficiency measure. It is expected that an improvement or deterioration in the WCM efficiency would have some impact on the market performance of firm. An improvement in WCM efficiency may be seen as a positive sign by the investors and therefore the market value may improve. However some authors like Baños-Caballero et al. (2013) have also suggested that there exists an optimal level of working capital investment at which the performance of firm is at its highest. Therefore it is hypothesized that there would be a significant relationship between WCM efficiency and firm' performance.

CCC, NTC and the new DEA based measure are used as measures of WCM efficiency. Table 3.3 lists the firm performance measures used in the study.

Table 3.3 Description of measures of firm's performance

Variables	**Description**
ROE	Measures returns with respect to equity investment
ROS	Measures accounting profit with respect to sales
TQ	Measures market value of firm
PE	Measures market value with respect to earnings
MVA	Measures creation/destruction of value

3.5.3 Tools and Techniques

The objective of this stage was to investigate whether there is significant influence of change in efficiency on the performance of the firm i.e. whether there is any link between working capital management efficiency and financial performance of firm.

Here the data for WCM efficiency was available in the form of values of CCC, NTC and DEA based measure. This data was available from the previous stage for all firms and for all years.

Similar to stage 2, panel data having both cross sectional and time series data is available here. As stated in the previous section that this study was interested in analysing the effect of time varying factors and want to control for time invariant factors, panel data regression is the most suitable. Thus this study applies panel data regression model using the working capital management efficiency measures as independent variables and the firm's performance measures as dependent variables. Each model had one measures of firm's performance as dependent variable and one of the WCM efficiency measures. A set of firm specific variables were also used in the model as control variables. Hausman test was applied to check the suitability of fixed effect model over random effect. Moreover, as in stage two, tests for stationarity (Levin, Lin and Chu, 2002) was also carried out to check whether or not the data is suitable for applying panel data regression model.

Here also the data was collected from the annual financial statement of firms using CMIE Prowess database for the duration 2004-2013 and the firms were divided into 11 industries.

This section also uses E-views statistical tool to apply Panel data regression model and necessary tests. The specifications of Panel data regression models have been detailed in chapter 5 of this study along with the empirical results.

3.6 Dynamics of Corporate Cash Management

3.6.1 Introduction

Two major theories have been used by researchers to explain the cash holding by firms: trade-off theory and pecking order theory.

The trade-off theory states that there are costs and benefits of holding cash. Firms adjust their cash holdings such that they are able to maximize the benefits and minimize the costs. According to Levasseur (1979) the main benefits associated with holding cash is the safety as the firms are not forced to raise external funds whenever there is a need to finance the growth

opportunities. This was termed by Keynes as transaction cost motive. Moreover, if liquid funds are available then the firm does not have to liquidate its assets to finance its operations and investment activities. This is termed as the precautionary motive. On the other hand, the major cost associated with holding cash is lower returns from the fund that could have been invested more profitably elsewhere. Another cost is that of agency cost which arises if the managers are not maximizing shareholders wealth and are just increasing the assets under their control.

The pecking order theory states that the cash holding level is just the result of investment and financing decisions. It states that it is expensive for firms to raise capital through the issue of new equity due to information asymmetry and therefore the firms follow the following order to raise funds: internal funds, debt and finally equity (Saddour, 2006). When there are surplus funds, the firm may accumulate cash and pay back their debt when due. In conditions of crisis, it first decreases cash and then if needed raises debt (Opler et al., 1999). Thus internal resources cause change in cash holdings and it is indifferent whether these internal funds are used to accumulate cash or to repay debt.

The Cash holding pattern has recently caught the interest of researchers and lately many authors have investigated the behaviour of firms' cash holdings. Studies conducted in various countries have come up with a number of determinants of cash accruals and have found evidence in support of both trade-off and pecking order theories. Almost all the past studies have concentrated on firms in developed economies. Even though results from some studies suggest that the cash holding pattern and its effect on market performance varies from country to country, but still very few studies has been conducted to analyse the cash accruals in a developing economy like India. To fill this gap in the literature this study analysed the cash holdings and its dynamics in the context of Indian manufacturing sector firms.

3.6.2 Methodological Framework

This study analyses the cash holding levels of Indian firms and then investigated for evidences of mean reversal in cash accruals i.e. examines for existence of a target/optimal of cash. It then models and calculates the optimal level of cash holdings and studies the pattern of deviances from this level. Lastly, it analyses the impact of holding excess cash on the market performance of the firm's stock. The data was again collected using CMIE Prowess database and the duration of the study was 2004-2013. Due to unavailability of data of some variable the sample size was reduced to 924 firms.

A number of studies have shown that firms hold a significant portion of their assets as cash and bank balance. For example Dittmar and Mahrt-Smith (2007) found that US firms kept 13% of their total assets as cash and marketable securities. Kalcheva and Lins (2007) found that internationally firms kept 16% of their assets in cash and Ferreira and Vilela (2004) calculated this ratio to be 15% for EMU countries. This study analysed the cash holdings level in Indian firms and how these differed from firms of developed countries.

One of the major objectives of the study was to check whether the cash holdings of firms follow trade-off theory. A number of authors have also found evidences that firms follow a target level for cash accruals and continuously try to adjust their accruals towards this level. It has been found that firms' responses to changes in cash holdings are dynamic in nature and they try to readjust their cash accruals towards a target level. This was an important outcome as it proved that there is a target optimal level of cash accruals which the firms try to achieve by adjusting their holdings. There is however no such study in Indian context and hence there is need to investigate whether such behaviour of targeted cash holding is exhibited by Indian firms.

This study investigates this problem by first analysing the tendency of accruals to return to any target level, i.e. whether there is any proof of mean reversion. Any evidence of mean reversion would suggest that firms do follow a target optimal level of cash holding. Using both graphical analysis and regression analysis the study investigated the existence of any relation of current cash holdings levels with previous cash holdings levels.

After it was established that firms are following a targeted level of cash holdings the study then used previous studies' variables to estimate a model for optimal level of cash holdings. Taking clues from past studies like Opler et al. (1999), Saddour (2006), Venkiteshwaran (2011) and others, the study employed the following variables to determine the optimal cash holding levels: cash flow, borrowings, net working capital, receivables, demand shock measured by the proxy variable 'lagged median change in sales', size measured by the natural log of total assets and growth opportunities measured using price to earnings ratio (PE). Both pooled data model and panel fixed effect panel data regression model were employed. Cash deflated by total assets was used as dependent variable, while the above mentioned variables were used as independent variables. The results not only would provide with a model for estimating optimal level of cash holdings, but would also help in confirming the relationship of various firm specific characteristics on the cash holdings of firm, It would also help in analysing which of the two theories (pecking order or trade-off) better explains the cash holdings in Indian manufacturing

sector. This study goes on to further analyse, how the firms move towards the optimal cash level and how much time was required by a firm in general to eliminate the gap between actual and optimal cash holding.

Some of the past studies have also concentrated on the implications of cash holdings by firms and found that there is a significant relationship between change in cash holdings and change in performance. It is clear from the previous studies that there is an association between a firm's cash holdings and its performance. This study therefore explores the relationship between the cash levels and the market performance of the firm. Panel data regression model was employed to estimate the association. For this analysis, the study employed market to book value (MVtoBV) as dependent variable and used cash holding (Cash/Assets) and square of cash holdings $(Cash/Assets)^2$ as independent variables. In addition, a few control variables were employed for controlling the effect of other firm specific characteristics.

After estimating effect of cash holding on market value of firm, the study investigates the perception of market/investor towards excess cash holdings (cash in excess of optimal cash level) i.e. whether there is any proof of excess market return on firm's stock due to excess cash held. To analyse this, the study employs panel data regression model. It uses excess return measured as the difference between return from stock of firm and return from benchmark market index as dependent variable. The independent variables used were change in excess cash (in comparison to last year) and change in actual cash. In addition, yearly change in assets (size), change in cash flow, change in sales and change in debt (borrowings) were employed as control variables.

This section analyses the dynamics and pattern of corporate cash holdings and examines various aspects of firm's cash holdings ranging from determinants to implications. It uses E-views statistical tool to apply Panel data regression model and necessary tests. The specifications of Panel data regression models have been detailed in chapter 6 of this study along with the empirical results.

CHAPTER 4

ANALYSIS OF WCM EFFICIENCY AND ITS DETERMINANTS

Preview

This chapter analyses the WCM efficiency of Indian manufacturing firms, its trend and its determinants. The chapter is divided into three sections. Section A introduces the proposed new DEA based measure for assessing WCM efficiency and discusses its advantages over the traditional measures. This section also calculates and analyses the efficiency scores calculated using the new technique. Section B examines the trend in WCM efficiency with the help of traditional and the DEA based measure. Finally Section C investigates the influence of various firm-specific and macroeconomic factors on WCM efficiency with the aid of graphical and statistical analysis. Here again both traditional and the DEA based efficiency measures are used for the analysis.

CHAPTER 4
ANALYSIS OF WCM EFFICIENCY AND ITS DETERMINANTS

4.1 Introduction

The objective of this chapter is to effectively measure and analyse the efficiency of working capital management in Indian manufacturing firms. This study consideres both traditional and new DEA based measures for measuring the efficiency of working capital management. The new methodology for calculating the new DEA based WCM efficiency measure is first explained along with its benefits over traditional measures. Thereafter the study analysed the efficiency scores obtained using the new measure. Trend analysis of WCM efficiency over the past ten years is carried out with the help of both traditional and new measure using graphical and statistical analysis. In order to examine the cause of changes in the WCM levels across years the study examined the influence of various firm-specific and macroeconomic factors on WCM efficiency using both graphical and statistical analysis.

The Chapter is divided into three sections. Section A deals with measures of WCM efficiency and explains in detail the proposed DEA based measure, its benefits and analyses the efficiency scores obtained using the new measure. Section B deals with trend analysis of WCM efficiency and examines its variation over the years. Section C examines the firm specific and macroeconomic factors that influence WCM efficiency of firms.

4.2 Section A- WCM Efficiency Measurement and Analysis

This study uses both traditional WCM measures (CCC and NTC) and the new proposed DEA based WCM efficiency measure to analyse the working capital management in Indian manufacturing sector.

4.2.1 Traditional Measures of WCM Efficiency:

Cash Conversion Cycle:

CCC is the most popular measure among researchers and industry for assessing the efficiency of working capital management. CCC measures the duration between the time investment is made in purchasing inventory and the time when it is converted back to cash. In other words, it

measures the time for which the cash of the firm is tied up in short term assets.

$$\text{Cash Conversion Cycle} = \text{Inventory Days} + \text{Receivable Days} - \text{Payable Days}$$

where

$$\text{Inventory Days} = (\text{Inventory}/(\text{Annual Cost of Sales})) \times 365$$

$$\text{Receivable Days} = ((\text{Accounts Receivable})/(\text{Annual Sales})) \times 365$$

$$\text{Payable Days} = ((\text{Accounts Payable})/(\text{Annual Purchases})) \times 365$$

Net Trade Cycle:

NTC is another measure which has gained importance and popularity in the recent research. NTC measures WCM efficiency by calculating net working capital per unit of sales. It measures the number of "days sales" the firm has invested in working capital.

$$\text{Net Trade Cycle} = (\text{Inventory} + \text{Receivables} - \text{Payables}) \times 365/(\text{Net Sales})$$

4.2.2 New DEA Based WCM Efficiency Measure:

In DEA relative efficiency is measured using the ratio of aggregate weighted outputs to aggregate weighted inputs. The weights are not decided in advance but are calculated dynamically with the help of linear programming such that each DMU is able to get the highest possible efficiency score.

Similar to any efficiency measure DEA too requires a set of inputs and outputs. In case of WCM, a firm which requires lesser funds to be tied up in net current assets to achieve the same level of operations/sales, or, which achieves higher sales with the same amount of funds blocked in working capital, can be termed as more efficient. Thus for WCM efficiency, components of net current assets may act as inputs and scale of operations may act as output. This is similar to the NTC measure where value of net current assets is used as percentage of sales to measure WCM efficiency. Thus in a way, the proposed DEA based WCM efficiency measure extends the NTC measure, but unlike NTC, it allows input and output variables of each firm to have different weights.

Inputs: Inventory (raw materials, work in progress and finished goods) and receivables constitute major portion of the investment in working capital and are the most important components of current assets. This study therefore selected both inventory value and receivables as inputs.

Sundry creditors are sources of short term finance and this financing reduces the amount of firm's own funds that are required to be tied up in working capital. That is, presence of sundry creditors significantly reduces the value of net current assets. Hence sundry creditors value is used as the third input variable. However, there is a modification required before sundry creditor can be used as an input. Since, sundry creditors reduce the amount of firm's own funds required to be tied up in working capital, therefore higher level of sundry creditors is preferable. Thus, sundry creditor is different from other inputs and is a reverse input (Lewis and Sexton, 2004) or an undesirable input (Zhu & Cook, 2007). In case of such inputs a higher value is desirable and leads to higher efficiency. This is opposite to normal inputs where higher levels lead to lower efficiency.

Most DEA software accept only normal inputs and therefore there is need to modify/transform sundry creditor values before it can be used. Seiford and Zhu (2002) have given a linear transformation approach for DEA models to transform reverse inputs. Here reverse input x_j are transformed to normal input $\bar{x_j}$using $\bar{x_j} = -x_j + v \geq 0$, where v is a translation vector that makes $\bar{x_j} > 0$. This study implemented this transformation by first finding the largest value among sundry creditor in a particular industry (say v), then multiplying sundry creditor values of all firms by -1 and then adding $v + 1$ to the resultant value. In this way the modified sundry creditor will now be higher for less efficient firm and vice versa.

Table 4.1 shows partial data from Plastic and Polymer industry for the year 2004-05 to demonstrate the above described method. It can be seen that the maximum value of sundry creditor among the sample is 571.9. 1 is added to this value to make it 572.9 and all sundry creditor values are subtracted from this number to get the modified sundry creditor value.

Table 4.1: Input and outputs of Plastic and Polymer industry 2004-05 (partial data) [1]

DMU	Inventory	Receivables	Sundry	Modified	CFO	Sales
1	20	40.3	31.4	541.5	26.9	150.2
2	32.2	69.4	20.3	552.6	2.5	125.9
3	95.5	247.2	45.2	527.7	-42.5	943.3
4	6.5	22.6	5.7	567.2	3.6	91.2
5	27.3	86.4	16.5	556.4	-26	184.3
6	489.9	560.2	571.9	1	39.6	2340.2
7	625.6	222.1	478.5	94.4	67.7	6385.1
8	74.8	60.3	132.6	440.3	178.4	731.6
9	48.5	72.3	22.6	550.3	13.8	406.5
10	56.7	63.9	30.5	542.4	16.1	225.5

Output: It is known that investment in working capital is made essentially to have uninterrupted operations/sales. A higher level of sales for same level of working capital investment means higher WCM efficiency. Thus, like NTC, net sales value is selected as an output variable.

In addition, literature suggests that a firm's operating efficiency is not dependent on liquidation value of its assets but rather on cash flow generated by those assets (Shin and Soenen, 1998). One of the important aims of working capital investment is to generate cash flow. A firm having higher cash flow from operations for same level of investment in working capital is more efficient. This study therefore selected cash flow from operations (CFO) as second output variable.

NTC on which the DEA based measure is based, uses only sales as output. The addition of the variable 'cash flow from operating activities' as an output in the proposed measure is based on judgement (and not on results from previous studies), therefore for ensuring robustness, this study calculates two different DEA based WCM efficiency scores. The first efficiency score uses only net sales as output variable and the second uses both net sales and cash flow from operating activities as output variables.

Lovell and Pastor (1995) state that an output oriented BCC DEA model is translation invariant with respect to inputs and vice versa. Since in our case one of the inputs (sundry creditors) has been translated (into modified sundry creditors) therefore it is essential to use output oriented BCC DEA model to preserve the invariance property.

Since DEA measures relative efficiency and the sample size is generally small, it is argued that firms that are omitted from the sample may lead to biased results (Hawdon, 2003). To overcome this problem Simar and Wilson (1998) propose a bootstrap method and this has also been advocated by researchers like Lothgren (1998) and Hawdon (2003). The bootstrap method "draws a random sample with replacement from the observed values in the original sample, (and) it can be treated like a sample drawn from the underlying population itself" (Ray, 2004). It then carries smoothening to achieve final bias corrected efficiency scores. The bootstrapping thus removes the bias by resampling large number of times from the given sample to create the effect of entire population. This study uses bootstrapping with 2000 iterations as suggested by Simar and Wilson (2007) to achieve a bias free efficiency measure.

It is important to mention that working capital levels vary with industry. Each industry has different requirement and different established norms for working capital investment. Since

DEA is a measure which measures a firm's efficiency relative to other firms in the group therefore it becomes essential that we calculate WCM efficiency separately for each industry in order to avoid any industry bias. It is also essential to calculate efficiency for each year separately to neutralise the effect of exogenous factors.

To summarise, for a particular year WCM efficiency of any firm relative to a sample of firms belonging to the same industry is calculated by applying bootstrapped output oriented BCC DEA model using inventory, receivables, modified sundry creditors as inputs and net sales as output. *Thus two DEA based WCM efficiency were calculated DEA Efficiency 1 (DEA Eff 1) (output variable: net sales) and DEA Efficiency 2 (DEA Eff 2) (output variable: net sales and cash flow from operations).*

Efficiency Measurement Software (EMS) (by Holger Scheel) is used to calculate efficiency without bootstrapping as it is also able to provide a list of benchmark DMUs (discussed later) in output. However, since EMS software does not have the facility for bootstrapping therefore FEAR package by Paul W. Wilson (Wilson, 2008) is used to calculate bootstrapped DEA efficiency.

4.2.3 Benefits of the New DEA based WCM efficiency Measure

Measuring WCM efficiency using DEA provides a number of benefits. These advantages and how they help in making DEA based WCM efficiency a better measure over traditional measures are explained below.

a) No mathematical fallacy

As mentioned before, there is a mathematical flaw in the concept of CCC measure (Bhattacharya, 2004). The concept assumes that inventory days, payable days and receivable days can be added, i.e. days in all three are universal and comparable. This assumption is incorrect, all the three have different denominators and simple addition may not give correct results. Moreover, CCC can sometimes take negative values, i.e. negative working capital days, which is an absurd result and has no real interpretation (Bhattacharya, 2004).

The new DEA based measure solves these issues since the efficiency is calculated using ratio of weighted outputs to weighted inputs through linear programming and thus ensures mathematical correctness (Ramanathan, 2003). The method is not dependent on units of inputs/outputs. Cooper el al. (2006) proved that whatever be the units of measurement of inputs and outputs the efficiency measure will remain same (provided these units are same for all firms).

b) Higher measurement scale of efficiency measure

There are mainly four types of measurement scales namely nominal, ordinal, interval and ratio. Since CCC is calculated by adding three ratios with different denominators therefore the measure is not a ratio scale and at best is an interval scale measure. This makes the measure unsuitable for division and multiplication operations. For example a CCC value 10 is better than CCC value 20, but it cannot be quantified that how much better. It cannot be said that 10 days of CCC makes the firm twice as efficient as a firm with 20 days CCC. The DEA based measure removes this problem as it directly calculates WCM efficiency of the firm using ratio of weighted outputs and inputs. The measure is thus a ratio scale and hence suitable for performing all major mathematical operations. Here it can be directly inferred that a firm with efficiency measure 0.62 is twice as efficient as a firm with measure 0.31. This property may be extremely useful to managers for benchmarking analysis.

c) Variable Weights

Another problem with earlier measures like CCC and NTC is that they give fixed and equal weights to each input and output. This implies that 'y' inventory days are as liquid as 'y' receivable days. This is not true as for different firms different level of liquidity is associated with each component of working capital. For some firms it may be easier to liquidate inventory while for others it's may be easier to recover receivables and thus assigning equal weightage to all components is a restricting condition.

The DEA based measure is flexible as it allows each firm to have different weights for each of its inputs and outputs (such that it maximises the firm's efficiency score) making the measure more realistic. For example, if the firm is efficient in receivable management it will assign higher weight to receivables in order to maximise overall efficiency. Table 4.2 presents an example of the result from DEA WCM efficiency output for a DMU (CPCL). It shows different weights assigned to different inputs. These weights also enable a firm to know that which of the inputs is being managed more/less efficiently. Since DEA tries to maximise weighted output to weighted inputs, therefore the input which is assigned higher weight is the one being managed more efficiently. For example in the case of CPCL receivable management is most efficient and creditor management is least.

Table 4.2: DEA output showing weights assigned to inputs (DMU from Plastic and Polymer Industry 2004-05)

DMU	Efficiency	Inventory	Receivabl	Modified Sundry Creditor
CPCL	0.6409	0.4205	0.4554	0.1241

d) Benchmarking Analysis

Unlike traditional measures benchmarking analysis is possible with the help of DEA based WCM efficiency measure. Two types of benchmarking information are obtained from the output of DEA based efficiency (using EMS software).

(i) For a DMU say X with efficiency less than 1, a list of benchmark DMUs along with the weights is obtained as output. These benchmark DMUs are efficient firms (efficiency score of 1) and the DMU X can become efficient if it reduces its inputs to a value given by multiplication of weights of benchmark firms and X's original input. Table 4.3 shows part output (from EMS software) and shows efficiency and benchmark of two firms. Here DPL is an inefficient firm and has DMU number 50 and 61 as benchmarks. If DPL reduces it's input to 0.67 times of its original input then this firm will become efficient and will lie on the efficient frontier determined by DMUs 50 and 61.

(ii) For a DMU say Y with efficiency equal to 1 (efficient DMU), the output shows the number of DMUs for which DMU Y acts as benchmark. In Table 4.3, FIL is an efficient firm and has 4 firms in the sample for which this firm acts as benchmark.

Therefore in addition to providing efficiency, the DEA measure also provides the information about how much to improve to reach benchmark which is not available in measures like CCC and NTC.

Table 4.3: DEA output showing benchmarking information (DMUs from Plastic and Polymer industry 2004-05)

DMU	**Efficiency**	**Benchmarks**
DPL	0.3157	50 (0.67) 61 (0.33)
FIL	1	4

e) Flexibility and modifiability

The DEA based WCM efficiency measure is flexible and can be modified according to the requirements.

(i) Restrictions on weights: This study used unrestricted weights in the measurement of WCM efficiency where the weights of inputs and outputs can take all values between 0 and 1. However, DEA allows us to put restrictions on weights of inputs and outputs to restrict the weights to a minimum or maximum value. Conditions can be put on weights of inputs and outputs like e.g. Weights of receivables $\geq$ 2.5 x Weights of sundry creditors etc. This flexibility permits measurement of efficiency in all types of conditions especially when it is desirable to give more weight to one input/output in comparison to other input/output.

(ii) Change in return to scale: This study used variable return to scale model for measurement, but other models like constant, non-decreasing and non-increasing return to scale can also be used according to the requirement.

4.2.4 Analysis of WCM Efficiency Scores

In the next part of analysis, DEA based WCM efficiency scores were analysed to examine their pattern. For each firm and for each year WCM efficiency was calculated relative to other firms in the same industry. Due to huge space requirement, this study does not present here WCM efficiency of each firm. However, for all industries and for each year from 2004 to 2013 max and min efficiencies are presented in Table 4.4 and mean and median efficiencies are shown in Table 4.5. In each table part (a) gives result for DEA EFF 1 and part (b) gives results for DEA Eff 2.

Table 4.4: Minimum and maximum values of DEA WCM efficiency

(a) DEA Efficiency 1

Industry	Efficiency	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Food and Agro Products	Min	0.025	0.025	0.048	0.018	0.022	0.026	0.025	0.025	0.030	0.024
	Max	0.737	0.684	0.859	0.662	0.708	0.707	0.713	0.707	0.703	0.943
Textiles	Min	0.036	0.040	0.043	0.052	0.042	0.025	0.025	0.039	0.013	0.039
	Max	0.788	0.860	0.845	0.815	0.851	0.733	0.740	0.812	0.807	0.807
Drugs and Pharma	Min	0.022	0.059	0.058	0.138	0.091	0.154	0.088	0.167	0.094	0.015
	Max	0.823	0.754	0.917	0.866	0.788	0.825	0.857	0.908	0.860	0.887
Plastics and Polymers	Min	0.055	0.054	0.125	0.062	0.072	0.043	0.010	0.037	0.051	0.127
	Max	0.773	0.767	0.845	0.733	0.752	0.867	0.707	0.823	0.834	0.868
Other Chemicals	Min	0.100	0.075	0.077	0.067	0.038	0.055	0.080	0.082	0.114	0.140
	Max	0.795	0.842	0.798	0.899	0.900	0.887	0.892	0.795	0.827	0.848
Consumer Goods	Min	0.055	0.070	0.018	0.061	0.046	0.062	0.048	0.058	0.007	0.013
	Max	0.816	0.787	0.675	0.768	0.786	0.711	0.750	0.869	0.771	0.786
Construction and Infra	Min	0.050	0.080	0.065	0.073	0.055	0.045	0.061	0.077	0.048	0.024
	Max	0.719	0.800	0.730	0.785	0.721	0.705	0.773	0.827	0.790	0.731
Metal products	Min	0.060	0.093	0.123	0.127	0.105	0.061	0.064	0.100	0.109	0.089
	Max	0.786	0.779	0.860	0.833	0.899	0.804	0.739	0.794	0.884	0.757
Machinery	Min	0.037	0.068	0.099	0.078	0.092	0.101	0.072	0.096	0.056	0.042
	Max	0.874	0.828	0.887	0.903	0.872	0.787	0.856	0.870	0.852	0.920
Transport Equipment	Min	0.013	0.011	0.023	0.035	0.039	0.014	0.007	0.013	0.008	0.033
	Max	0.673	0.702	0.736	0.718	0.766	0.686	0.819	0.789	0.823	0.797
Misc Manufacturing	Min	0.071	0.039	0.140	0.054	0.135	0.125	0.053	0.024	0.004	0.000
	Max	0.781	0.751	0.831	0.769	0.853	0.821	0.788	0.831	0.749	0.697
Average Min		0.048	0.056	0.074	0.070	0.067	0.065	0.048	0.065	0.049	0.050
Average Max		0.779	0.778	0.817	0.795	0.809	0.776	0.785	0.820	0.809	0.822

(b) DEA Efficiency 2

Industry	Efficiency	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Food and Agro Products	Min	0.024	0.032	0.056	0.019	0.025	0.032	0.025	0.033	0.029	0.034
	Max	0.827	0.795	0.844	0.768	1.000	0.835	0.868	0.811	0.822	0.756
Textiles	Min	0.037	0.044	0.049	0.063	0.042	0.025	0.023	0.048	0.015	0.060
	Max	0.745	0.794	0.859	0.837	0.843	0.809	0.733	0.896	0.846	0.859
Drugs and Pharma	Min	0.022	0.061	0.076	0.137	0.108	0.153	0.153	0.181	0.095	0.042
	Max	0.823	0.811	0.814	0.843	0.827	0.876	0.810	0.885	0.851	0.839
Plastics and Polymers	Min	0.071	0.054	0.121	0.063	0.073	0.040	0.009	0.038	0.055	0.126
	Max	0.793	0.731	0.841	0.772	0.748	0.815	0.720	0.794	0.844	0.845
Other Chemicals	Min	0.099	0.076	0.077	0.065	0.037	0.053	0.098	0.126	0.149	0.139
	Max	0.873	0.810	0.821	0.893	0.863	0.869	0.900	0.857	0.889	0.883
Consumer Goods	Min	0.108	0.071	0.071	0.104	0.084	0.064	0.054	0.059	0.053	0.012
	Max	0.889	0.839	0.785	0.793	0.761	0.719	0.745	0.752	0.759	0.742
Construction and Infra	Min	0.052	0.106	0.066	0.072	0.057	0.047	0.062	0.110	0.054	0.058
	Max	0.779	0.816	0.818	0.798	0.798	0.698	0.825	0.781	0.758	0.743
Metal products	Min	0.060	0.093	0.122	0.128	0.105	0.061	0.066	0.097	0.107	0.086
	Max	0.840	0.818	0.859	0.780	0.868	0.835	0.751	0.809	0.839	0.810
Machinery	Min	0.048	0.069	0.106	0.079	0.096	0.101	0.074	0.094	0.058	0.046
	Max	0.844	0.826	0.855	0.815	0.825	0.737	0.749	0.833	0.854	0.837
Transport Equipment	Min	0.021	0.052	0.045	0.038	0.057	0.016	0.009	0.018	0.013	0.036
	Max	0.710	0.642	0.711	0.723	0.780	0.609	0.707	0.697	0.743	0.816
Misc Manufacturing	Min	0.139	0.084	0.136	0.058	0.157	0.141	0.054	0.024	0.021	0.011
	Max	0.868	0.827	0.827	0.793	0.844	0.822	0.773	0.823	0.801	0.792
Average Min		0.062	0.067	0.084	0.075	0.076	0.067	0.057	0.075	0.059	0.059
Average Max		0.817	0.792	0.821	0.801	0.832	0.784	0.780	0.813	0.819	0.811

From Table 4.4 its can be seen that in all industries, there is a vast difference between maximum and minimum efficiencies. The maximum values are in the range of 0.70 – 0.80 and indicates that in all industries some firms do operate at higher level of efficiency. The minimum values are in the range of 0.05-0.06 and in some industries it is as low as 0.02. This indicates that in all industries, there are firms which are extremely inefficient in managing working capital. The minimum values of WCM efficiency in all industries are approximately 7-8% of the maximum values which clearly indicates that the most inefficient firms are not even in competition in comparison to efficient ones. The overall average min and max values have

shown slight changes over the years, which indicate that the range of WCM efficiency of industries has not undergone any prominent change.

Table 4.5: Mean and median values of DEA WCM efficiency

(a) DEA Efficiency 1

Industry	Efficiency	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Food and Agro Products	Mean	0.281	0.270	0.296	0.265	0.258	0.249	0.258	0.259	0.251	0.239
	Median	0.234	0.210	0.228	0.224	0.208	0.190	0.203	0.197	0.189	0.159
Textiles	Mean	0.340	0.355	0.356	0.320	0.329	0.285	0.293	0.405	0.367	0.393
	Median	0.308	0.324	0.310	0.272	0.287	0.262	0.260	0.387	0.352	0.377
Drugs and Pharma	Mean	0.429	0.386	0.463	0.450	0.430	0.480	0.460	0.513	0.483	0.438
	Median	0.405	0.353	0.441	0.423	0.413	0.470	0.429	0.494	0.461	0.411
Plastics and Polymers	Mean	0.356	0.343	0.467	0.321	0.313	0.401	0.299	0.441	0.436	0.405
	Median	0.323	0.314	0.459	0.300	0.267	0.382	0.244	0.406	0.413	0.368
Other Chemicals	Mean	0.470	0.429	0.423	0.524	0.473	0.483	0.484	0.417	0.450	0.473
	Median	0.457	0.415	0.392	0.510	0.440	0.464	0.461	0.389	0.412	0.472
Consumer Goods	Mean	0.341	0.346	0.282	0.316	0.300	0.284	0.305	0.396	0.365	0.333
	Median	0.304	0.317	0.260	0.286	0.263	0.244	0.283	0.367	0.306	0.275
Construction and Infra	Mean	0.328	0.379	0.325	0.345	0.309	0.323	0.338	0.394	0.378	0.327
	Median	0.305	0.330	0.274	0.268	0.252	0.253	0.282	0.383	0.360	0.292
Metal products	Mean	0.420	0.397	0.474	0.371	0.376	0.384	0.272	0.338	0.412	0.337
	Median	0.392	0.364	0.463	0.331	0.350	0.373	0.250	0.304	0.391	0.303
Machinery	Mean	0.460	0.380	0.468	0.433	0.439	0.348	0.377	0.421	0.388	0.386
	Median	0.425	0.337	0.447	0.409	0.397	0.307	0.355	0.400	0.354	0.354
Transport Equipment	Mean	0.191	0.185	0.195	0.243	0.250	0.198	0.217	0.202	0.247	0.239
	Median	0.148	0.137	0.151	0.200	0.194	0.154	0.170	0.154	0.180	0.191
Misc Manufacturing	Mean	0.399	0.299	0.500	0.372	0.459	0.387	0.378	0.425	0.314	0.223
	Median	0.387	0.291	0.492	0.354	0.428	0.342	0.327	0.389	0.282	0.188
Mean of Means		0.365	0.343	0.386	0.360	0.358	0.347	0.335	0.383	0.372	0.345
Median of Medians		0.323	0.324	0.392	0.300	0.287	0.307	0.282	0.387	0.354	0.303

(b) DEA Efficiency 2

Industry	Efficiency	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Food and Agro Products	Mean	0.330	0.331	0.339	0.340	0.326	0.316	0.329	0.302	0.278	0.271
	Median	0.279	0.273	0.262	0.296	0.265	0.247	0.263	0.232	0.199	0.175
Textiles	Mean	0.375	0.420	0.408	0.357	0.344	0.339	0.315	0.421	0.395	0.433
	Median	0.344	0.389	0.361	0.304	0.296	0.308	0.270	0.399	0.371	0.403
Drugs and Pharma	Mean	0.455	0.420	0.474	0.470	0.478	0.529	0.498	0.535	0.525	0.484
	Median	0.444	0.378	0.446	0.439	0.475	0.518	0.476	0.517	0.500	0.439
Plastics and Polymers	Mean	0.439	0.384	0.484	0.357	0.346	0.445	0.393	0.452	0.460	0.427
	Median	0.401	0.349	0.478	0.313	0.299	0.414	0.337	0.415	0.420	0.389
Other Chemicals	Mean	0.496	0.457	0.456	0.536	0.495	0.538	0.509	0.460	0.505	0.517
	Median	0.485	0.448	0.438	0.531	0.456	0.544	0.493	0.421	0.467	0.498
Consumer Goods and Elect.	Mean	0.410	0.406	0.316	0.370	0.326	0.318	0.332	0.419	0.394	0.340
	Median	0.379	0.359	0.281	0.340	0.280	0.272	0.302	0.396	0.374	0.287
Construction and Infra	Mean	0.390	0.424	0.394	0.376	0.359	0.344	0.371	0.445	0.414	0.395
	Median	0.342	0.397	0.362	0.332	0.291	0.275	0.301	0.443	0.407	0.349
Metal products	Mean	0.452	0.430	0.513	0.388	0.387	0.414	0.293	0.350	0.425	0.379
	Median	0.441	0.423	0.495	0.346	0.362	0.390	0.254	0.303	0.415	0.340
Machinery	Mean	0.472	0.445	0.485	0.470	0.448	0.373	0.398	0.450	0.429	0.421
	Median	0.453	0.441	0.486	0.450	0.420	0.331	0.381	0.412	0.408	0.395
Transport Equipment	Mean	0.222	0.220	0.223	0.302	0.291	0.241	0.236	0.231	0.258	0.284
	Median	0.177	0.155	0.160	0.254	0.216	0.180	0.175	0.173	0.198	0.217
Misc Manufacturing	Mean	0.519	0.408	0.533	0.429	0.506	0.476	0.440	0.457	0.437	0.342
	Median	0.506	0.383	0.527	0.397	0.499	0.454	0.378	0.452	0.408	0.286
Mean of Means		0.415	0.395	0.420	0.400	0.391	0.394	0.374	0.411	0.411	0.390
Median of Medians		0.401	0.383	0.418	0.340	0.299	0.331	0.302	0.410	0.408	0.349

From Table 4.5 it can be seen that the mean and median values of WCM efficiencies are around 0.40 and indicate that the average WCM efficiency is around 40%, which is somewhat on the lower side. Since use of bootstrapping creates effect of entire population, therefore the results suggest that Indian manufacturing firms are only 40% percent efficient. The table also shows that in almost all industries individually and also overall, the mean values are greater than the median values. This indicates that the efficiency scores are somewhat skewed to the right which in turn means that there are more firms which are having WCM efficiency on the lower side and the majority of the firms have WCM efficiency less than 0.40 (approx.). This also

points out that a large number of firms are managing their working capital inefficiently. The mean and median values of overall sector and individual industries show some variations over the years, indicating that there have been few changes in the WCM efficiency of firms during the last decade.

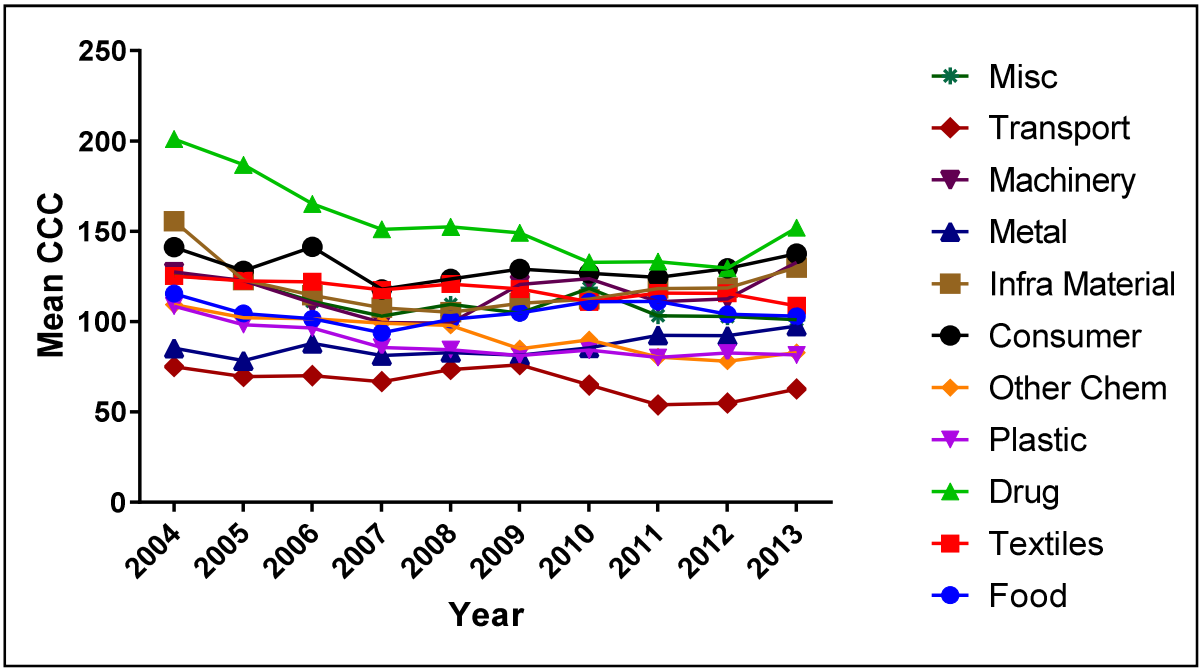
In addition, it is observed from mean and median efficiency values that some industries do have consistently lower WCM efficiency in comparison to others. Thus greater efforts by regulators may be required for improvement of WCM efficiency of firms in such industries. Moreover it is also observed that in addition to changes in efficiency levels in individual industries, overall means and median of the overall sector has also shown variation over the years and thus there is need to further explore the same. This study thus graphically and statistically analysed this in subsequent sections.

4.3 Section B- Trend in WCM Efficiency

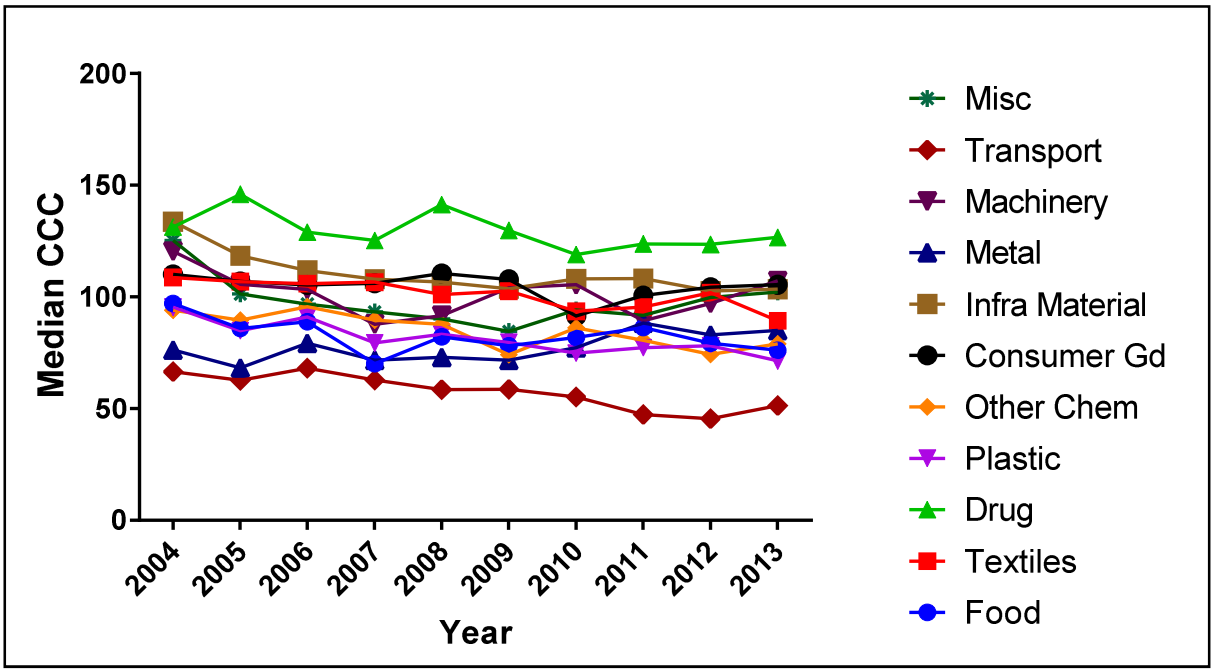
As mentioned in previous section there is need to analyse the variation in working capital management efficiency in firm/industries over the past years. To achieve this objective this section uses both traditional and new DEA based measure to analyse the trend in the efficiency over the ten year period (2004-2013). The trend is analysed using graphical analysis by plotting the WCM efficiency against time. Since each industry has its own set of accepted norms and requirements therefore each industry graph was plotted separately. This section is divided into three subsections which analyse the trend in each of WCM efficiency measure (CCC, NTC and DEA based measure) separately.

4.3.1 CCC

Figure 4.1 (a) and (b) show the plots of mean and median cash conversion cycle of each industry over the period 2004-2013. It shows that the CCC in most industries have undergone slight change over the years. In most industries both mean and medial CCC have somewhat decreased over a period of 10 years. Part (a) of graph shows that except a few all industries have shown a decrease in the average level of cash conversion cycle. Though the decrease doesn't seem to be much in part (b) of the graph but if one industry is considered at a time it can be seen that infra, textiles, transport, food, other chemicals and miscellaneous industries each one has shown a decrease in the median level of cash conversion cycle while other industries have remained at almost same level. It can be inferred that there has been a slight improvement in the overall WCM efficiency level of firms across industries.



(a) Mean Cash Conversion Cycle



(b) Median Cash Conversion Cycle

Figure 4.1: Trends in cash conversion cycle

Since the graphical analysis revealed that there was slight movement in the CCC values over the study period further statistical analysis was carried out to test whether the changes were substantial. One way ANOVA with repeated measures is generally used to examine the difference between groups when there are two or more than two levels of the same factor and when same entities are measured in different time period. This technique is most suitable for this case as WCM efficiencies of the same 1244 firms are measured for each year during 2004

to 2013. SPSS (by IBM) software is used to run the repeated measures ANOVA model with pooled data of all industries.

One of the most important assumptions of ANOVA is *sphericity*. Field (1998) defines sphericity as "the equality of variances of the differences between treatment levels". This assumption generally gets violated in repeated measures technique and has to be checked and corrected. For this Mauchly's Test of Sphericity is carried out as shown in Table 4.6, where the null hypothesis is that the sphericity assumption is not violated. The results show that the significance value is lower than 0.05 (95%) indicating that the sphericity assumption has been violated and therefore there is a need for correction.

Table 4.6: CCC: Test of sphericity

Mauchly's Test of Sphericity							
	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Year	0.094	2824.163	44	0.000	0.622	0.625	0.111

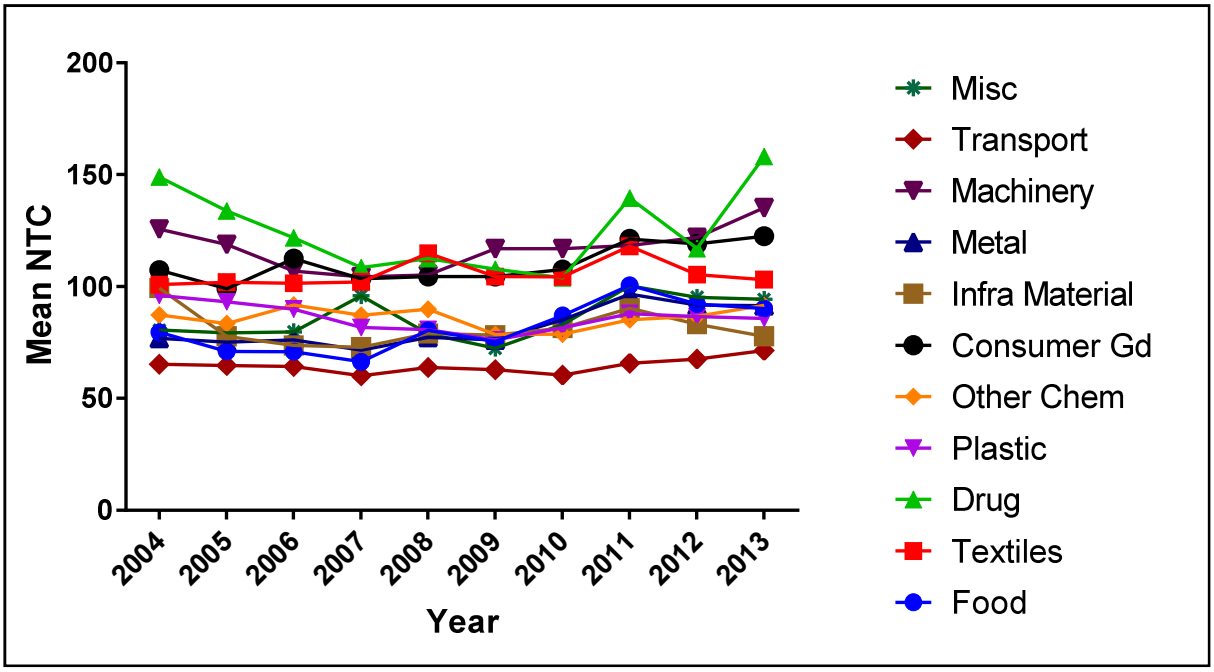
The result of one way ANOVA with repeated measures is shown in Table 4.7. Here two major types of results are presented. The row with title 'sphericity assumed' gives the ANOVA result without any correction for sphericity. Since it is known from the Mauchly's test that there is a violation of the sphericity assumption therefore ANOVA significance values in the row titled 'Greenhouse-Geisser' need to be taken. 'Greenhouse-Geisser' corrects the ANOVA result for violation of sphericity assumption. The significance value here is lower than 0.05 which shows that within-subject effect is significant, i.e. there is significant variation in levels of CCC in the years 2004-2013. This confirms the earlier graphical analysis conclusion that the WCM efficiency levels do vary significantly over the years.

Table 4.7: CCC: Within-subject effect

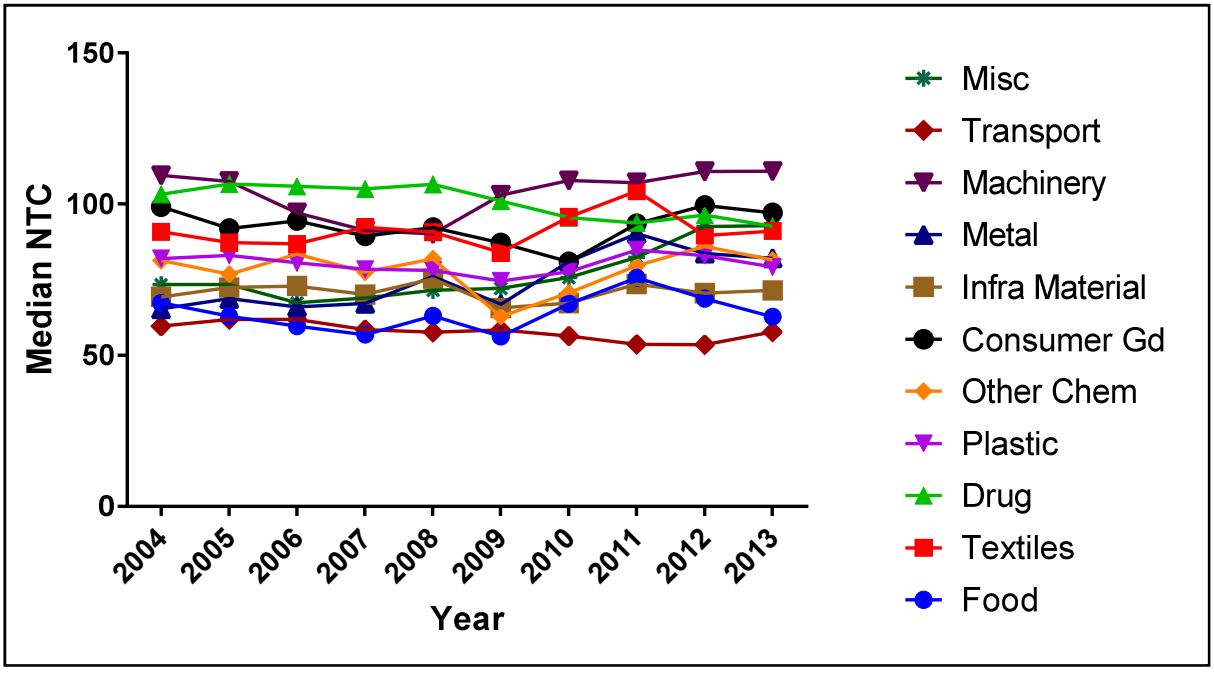
Tests of Within-Subjects Effects							
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Year	Sphericity Assumed	445020.013	9	49446.66	8.757	0.000	0.007
	Greenhouse-Geisser	445020.013	5.600	79470.23	8.757	0.000	0.007

4.3.2 NTC

A similar analysis was carried out for the measure NTC. Figure 4.2 (a) and (b) show the plots of mean and median net trade cycle of each industry over the period 2004-2013.



(a) Mean Net Trade Cycle



(b) Median Net Trade Cycle

Figure 4.2: Trends in net trade cycle

Figure 4.2 indicates that although NTC values have shown variations over the years, but most industries have almost same NTC levels in 2013 which they had 10 years back. Some of the

industries have shown drop in the NTC values in the middle years but have not been able to keep the NTC low, which has climbed back to the original level in the last 1-2 years. The mean NTC plot shows that mostly the industries have kept same level though there have been ups and downs over the years. The median NTC plots indicate that there has been some drop in the NTC levels and thus there has been some improvement in the efficiency levels.

Again to confirm the graphical results, one way repeated measures ANOVA was applied. Mauchly's test for sphericity was applied to check the sphericity condition as shown in Table 4.8. Table 4.8 shows that p value (sig.) is less than 0.05 indicating that sphericity condition is violated. Therefore in the ANOVA results the results under Greenhouse-Geisser row has to be checked. Table 4.9 shows the results of ANOVA (within subject effect). The significance value here is lower than 0.05 which shows that within-subject effect is significant, i.e. there is significant variation in levels of NTC in the years 2004-2013. This confirms that the NTC measure has undergone significant change over the 10 year period.

Table 4.8: NTC: Test of sphericity

Mauchly's Test of Sphericity[a]							
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
factor1	0.000	14031.386	44	0.000	0.227	0.227	0.111

Table 4.9: NTC: Within-subject effect

Tests of Within-Subjects Effects							
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Year	Sphericity Assumed	1217275.06	9	135252.785	4.388	0.000	0.004
	Greenhouse-Geisser	1217275.06	2.042	596108.733	4.388	0.012	0.004

In both CCC and NTC (as shown in Figure 4.1 and Figure 4.2) the graph of median values has been plotted along with mean values since the mean values of CCC and NTC are more liable to be affected by extreme values. Thus the median graphs are somewhat more trustworthy. In both the figures the difference in working capital management efficiency levels of different industries is clearly depicted. The industries such as drug and machinery have the highest

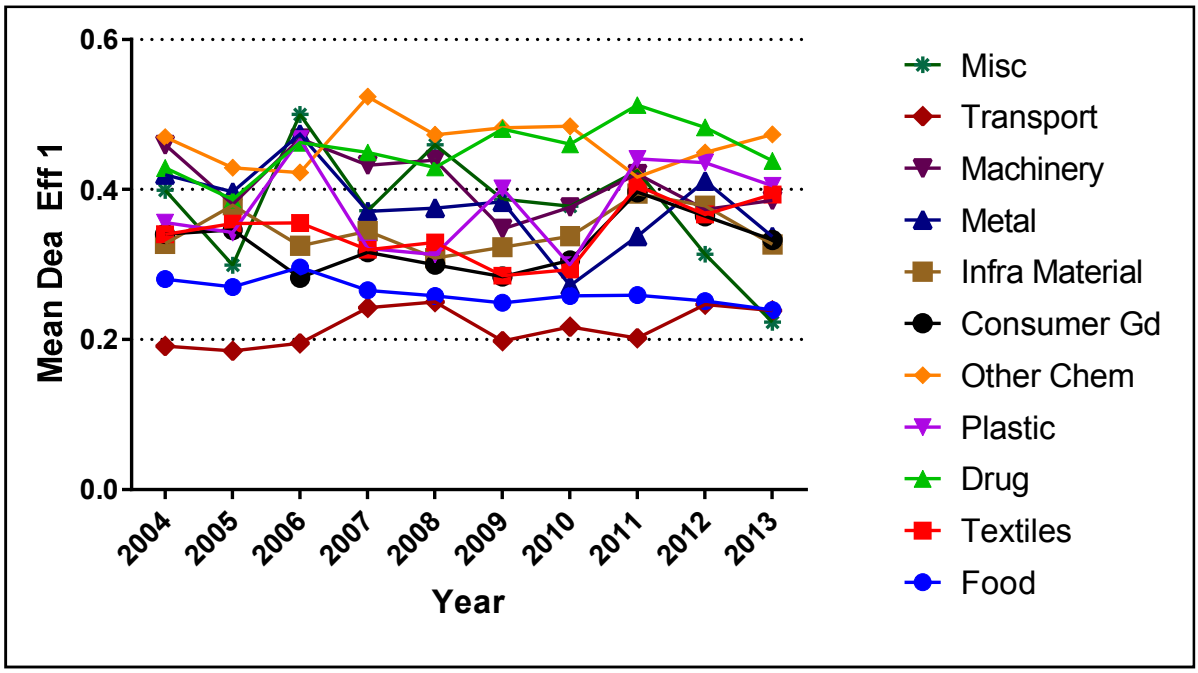
values of both CCC and NTC indicating that they have longer cycles and that the funds are blocked in these industries for longer durations. Similarly industries like transport equipment and food have lowest levels of CCC and NTC which indicates that these industries require WC investments for a shorter duration and thus the cycle time is shorter. The study found that there is quite a large difference in the levels of both NTC and CCC among industries and thus taking average or median of pooled data may not make any sense. The industries which have higher levels of NTC and CCC have values in the range of 120-130 while those having lower levels have in the range of 60-70. The industries more or less maintain their efficiency values in the range and there are almost no sharp movements. It is evident from the graphs that the industries which have lowest levels of NTC and CCC remain at the lowest levels all throughout the years and those with high levels remain at the top.

4.3.3 DEA Efficiency

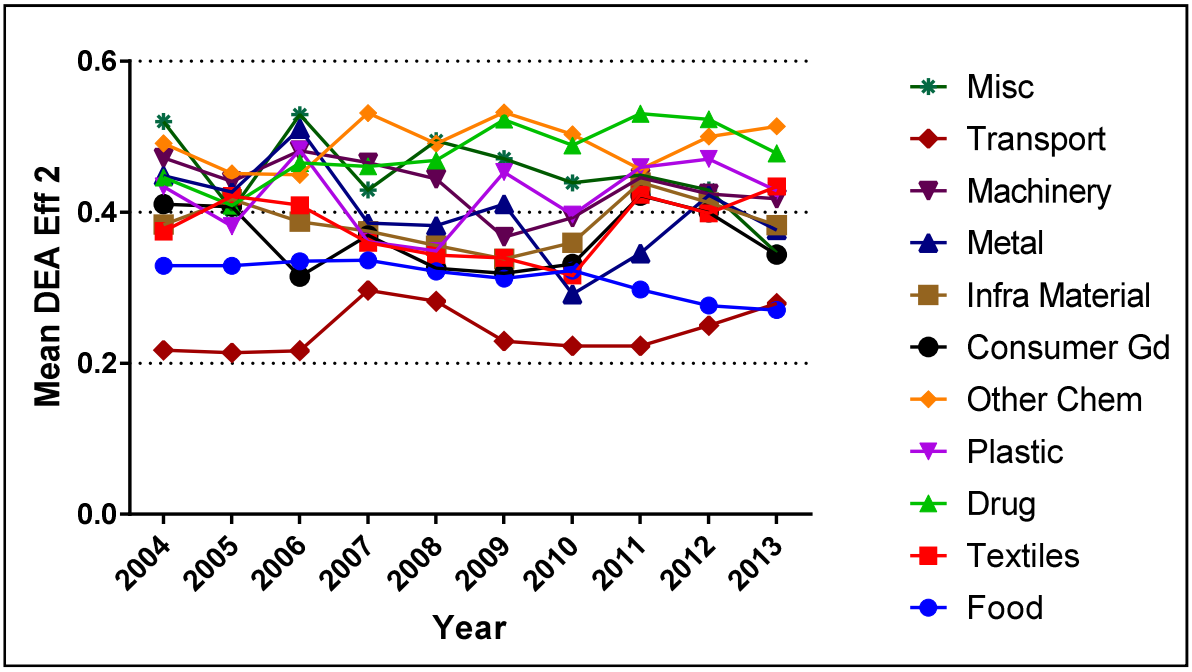
In the next step the study analysed the trend in DEA based WCM efficiency measure. The study plotted the graphs of mean and median WCM efficiency measured using DEA. As mentioned earlier two types of efficiencies were calculated; first with only sales as output variable (DEA Eff 1) and second with both sales and cash flow from operations as output variables (DEA EFF 2).

Figure 4.3 (a) and (b) shows the plot of mean values of both DEA based efficiency measures. Since the DEA based measures are relative and not absolute, therefore there are no extreme values and thus there no need to have separate plots of median values.

Figure 4.3 indicates that the WCM efficiency of almost all industries have improved over the past ten years. Except a few industries like food, consumer goods and miscellaneous which have shown a slight decline all other industries have shown some improvement. Here since efficiencies of all industries are ranged between 0 and 1 therefore unlike CCC and NTC the plots of DEA efficiency plots intermingle and cross each other suggesting that there is as such no defined range of efficiency for individual industry and that the efficiencies vary over a large range. Overall the plots indicate that though there have been ups and downs but the average efficiency in most industries has improved over the period of study.



(a) Mean DEA Efficiency 1

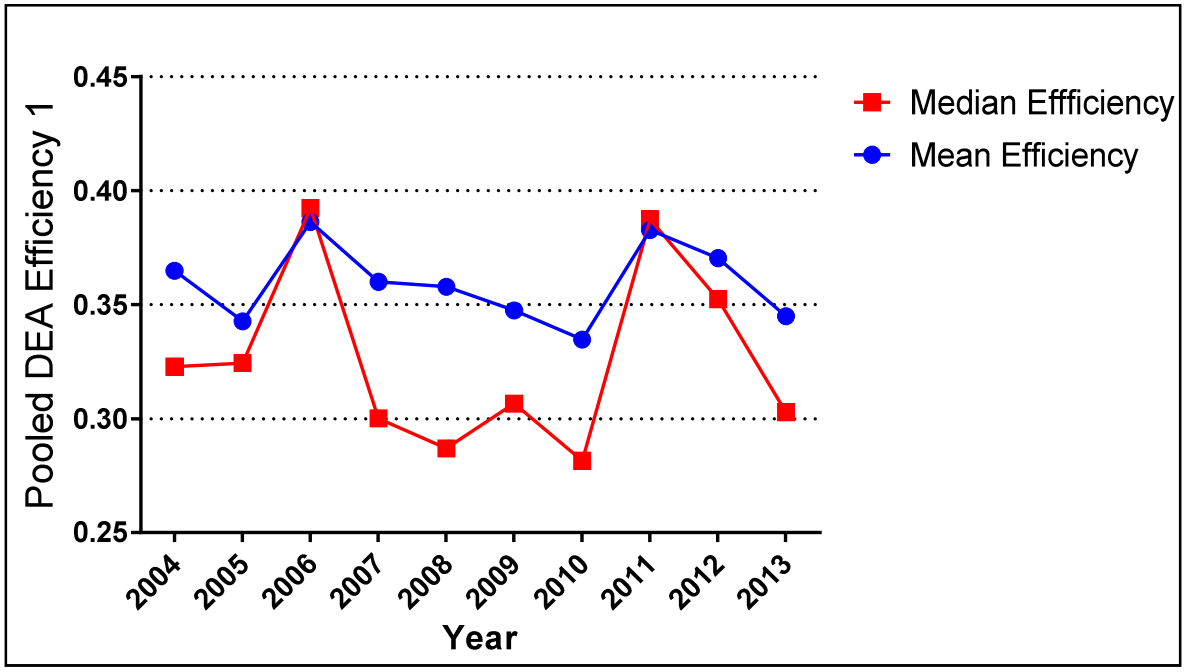


(b) Mean DEA Efficiency 2

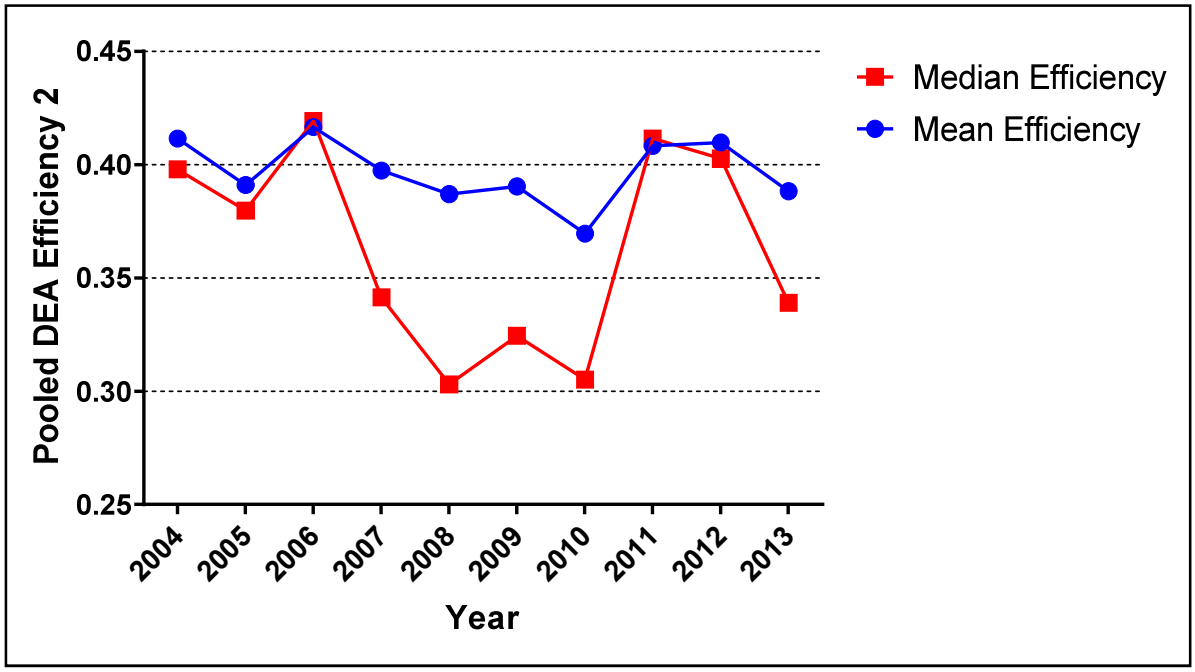
Figure 4.3: Trends in DEA based WCM efficiency

The DEA based efficiency scores of all industries are comparable since they all fall within a defined range (0-1). Moreover due to bootstrapping, each efficiency score represents efficiency relative to population. This allows for calculation of overall mean and median values of efficiency scores. Mean and median efficiency scores of all firms in the sample were thus calculated and plotted against time to examine the overall trend in the efficiency. Figure 4.4 (a)

and (b) shows the mean and median plot of DEA based WCM efficiency scores (DEA EFF 1 and DEA Eff 2).



(a) Pooled DEA Efficiency 1



(b) Pooled DEA Efficiency 2

Figure 4.4: Trends in DEA based WCM efficiency (Pooled Data)

From the figure it can be observed that there has been large variation in the WCM efficiency of firms over the period of study. The mean plot shows larger variations, but the median plot shows less extreme movements. However, both plots indicate that the overall efficiency is in

the range of 0.30 – 0.40. There seems to be a dip in WCM efficiency during the period 2008-2010. This dip might be the result of global financial crisis due to which the firms might have experienced lower sales and also there might have been large stock of unsold inventory stuck with the firms. During this period there was financial crunch and there was also shortage of credit available from suppliers (account payable). This could also have resulted in lower levels of working capital management efficiency. After the crisis was over in 2011, the efficiency levels in 2011 came back to their 2007 levels. The slight decrease in efficiency in 2012 and 2013 may be attributed to slowing down of Indian economy which must have again created a problem similar to that of the financial crisis and lead to decreased efficiency.

A point to remember here is that in case of CCC and NTC higher values indicate lower levels of WCM efficiency and in case of DEA Efficiency higher values indicate higher levels of efficiency. Therefore a dip in graph of CCC and NTC is desirable whereas in case of DEA efficiency graph a spike is desirable.

Similar to the case of CCC and NTC, in order to confirm our visual analysis from the graphs, one way ANOVA with repeated measures was applied to check whether there exists significant difference in efficiency scores across the period of 10 years. Table 4.10 shows the results of Mauchly's test for sphericity and Table 4.11 shows the results from one way repeated measure ANOVA.

Table 4.10: DEA Efficiency: Test of sphericity

Mauchly's Test of Sphericity							
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon[b]		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
DEA Eff 1	0.196	2022.921	44	0.000	0.683	0.687	0.111
DEA Eff 2	0.249	1724.203	44	0.000	0.706	0.710	0.111

Table 4.11: DEA Efficiency: Within-subject effect

Tests of Within-Subjects Effects							
Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Sqr
DEA Eff 1	Sphericity Assumed	3.078	9	0.342	29.428	0.000	0.023
	Greenhouse-Geisser	3.078	6.148	0.501	29.428	0.000	0.023
DEA Eff 2	Sphericity Assumed	2.247	9	0.250	16.292	0.000	0.013
	Greenhouse-Geisser	2.247	6.353	0.354	16.292	0.000	0.013

The results show that for both types of DEA efficiency (1 and 2) the sphericity condition gets violated. Therefore there was need to correct the ANOVA results by observing results under Greenhouse-Geisser head. The results here are similar to those obtained from CCC and NTC confirming that there has been significant variation in the efficiency level of firms across the period of study i.e. 2004-2013.

Overall the results from graphical analysis and ANOVA model of CCC, NTC and DEA based efficiency all suggest that though each industry has its own accepted norms for working capital management level but still the efficiency level of working capital management of firms does vary with time. This might be the result of several firm-specific and macro-economic factors.

The analysis from previous section poses the next question: what are the factors that influence and cause changes in the efficiency level of working capital management of firms over a period of time? To answer this question the next section analyses the extent of influence of a number of probable determinants of working capital management efficiency.

4.4 Section C- Determinants of WCM Efficiency

This section investigates the influence of various determining factors (both firm-specific and macroeconomic) on the working capital management efficiency of firms. The first step was to identify the factors that might influence working capital level of firms. Thereafter graphical and statistical analyses were carried out to explore the relationships between various variables and WCM efficiency.

4.4.1 Variables Used

Previous studies on determinants of WCM efficiency reveal a number of important factors which have been found to significantly influence a firm's working capital level. A number of

previous studies on determinants of working capital were studied and the key variables that were used in these studies were analysed. The main studies considered were Delannay and Weill (2005), Chiou et al. (2006), Moussawi et al. (2006), Smith and Fletcher (2009), García-teruel and Martínez-solano (2010), Taleb et al. (2010), Palombini and Nakamura (2012), Saarani and Shahadan (2012), Abbadi and Abbadi (2013) and Naser et al. (2013). Based on the importance given in literature the following variables were short listed to study their influence on WCM efficiency.

A) Firm-Specific Variables

(i) Age of firm (AGE):

$$\text{Age of firm} = \text{Year under study} - \text{Year of incorporation}$$

(ii) Size (SIZ)*:*

$$\text{Size} = \ln(\text{Total assets})$$

(iii) Fixed assets to total assets ratio (NFA):

$$\text{Fixed assets to total assets ratio} = \text{Net fixed assets} / \text{Total assets}$$

(iv) Debt ratio (DEB):

$$\text{Debt ratio} = \text{Total Borrowings} / \text{Total Assets}$$

(v) Sales Growth (SLG):

$$\text{Sales growth} = (\text{Sales in current year} - \text{Sales in past year}) / \text{Sales in past year}$$

(vi) Return on Assets (ROA):

$$\text{Return on Assets} = \text{Profit after tax} / \text{Total Assets}$$

(vii) Cash and Bank Balance to Total Assets (CAS):

Cash and Bank Balance to total assets = Cash and Bank Balance/ Total Assets

B) Macroeconomic Variables

(i) GDP growth (GDP):

Indian GDP growth rate at constant prices have been used for analysis.

(ii) Interest Rate (INT):

Average interest rates of central government (Indian) securities have been used as indicators of prevailing interest rates.

(iii) Inflation Rate (INF):

Average yearly wholesale price index (WPI) (all commodities) has been used for inflation rate.

(iv) Financial Crisis (CRS):

Dummy variable with value 1 for the years 2008, 2009 and 2010 and value 0 for other years have been used to measure the influence of financial crisis on WCM efficiency.

4.4.2 Graphical Analysis

In the first step, graphical analysis was employed for analysing the determinants of WCM efficiency. For each determining variable, average WCM efficiency values of firms with highest and lowest values of that variable (separately) were taken and plotted on a graph. For each year top 25% firms in each industry with highest values of that determining variable were taken and this was repeated for each industry. Then average WCM efficiency of all these firms were calculated (for each year separately) and plotted on graph against time. Similarly this process was repeated for bottom 25% firms. Since macroeconomic variables are same for all firms in a particular year therefore the graphical analysis only focused on firm-specific determinants. This was carried out for both types of DEA based WCM efficiency i.e. DEA Efficiency 1 and DEA Efficiency 2. Figures 4.5 to 4.11 show the plots of graphs where 1 represents DEA Efficiency 1 and 2 represent DEA Efficiency 2. For Example Large Size 1 represents average DEA efficiency 1 of largest sized firms. Small Size 2 represents average DEA Efficiency 2 for smallest sized firms. In all the graphs from Figure 4.5-4.11, the X-axis represents the years and Y-axis represents the WCM efficiency.

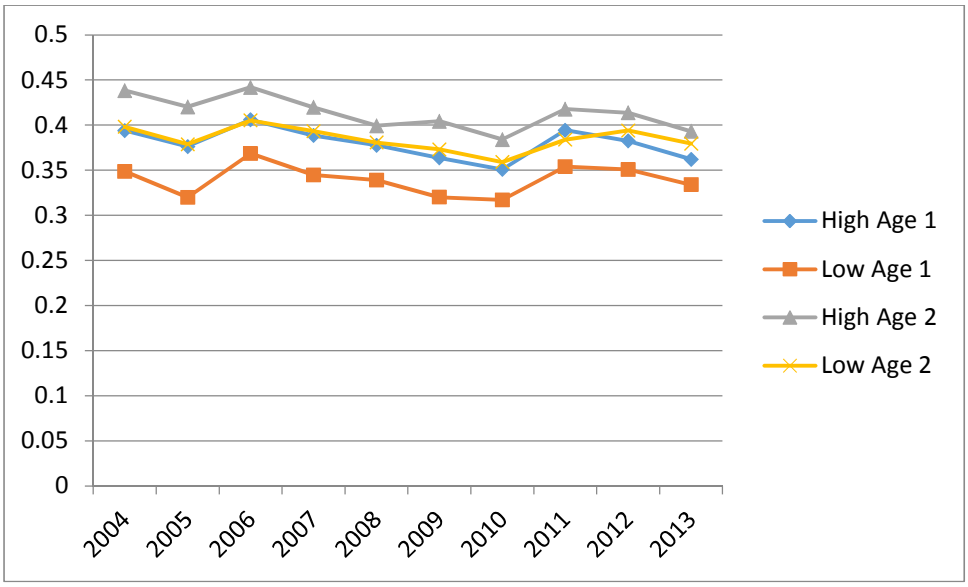


Figure 4.5: Effect of age of firm on WCM efficiency

Figure 4.5 shows the relation between age of firms and WCM efficiency. The figure shows that for all years the plot of High Age 1 is above the plot of Low Age 1 and similarly plot of High Age 2 is above the plot of Low Age 2. This shows that as age of firms increase the WCM efficiency of firms also increases. Thus age has positive relationship with WCM efficiency. This may suggest that with increase in age the firms become more expert and efficient in handling working capital.

Figure 4.6 shows the relation between size of firms and WCM efficiency. Here it was found that for all years the plot of Small Size 1 is above plot of Large Size 1 and plot of Small Size 2 is above plot of Large Size 2. This indicates that as the size of firms increase they become more relaxed and less aggressive in managing working capital. When firms are smaller in size they tend to be more aggressive and efficient in managing working capital. Therefore there seems to be a negative relation between size and WCM efficiency.

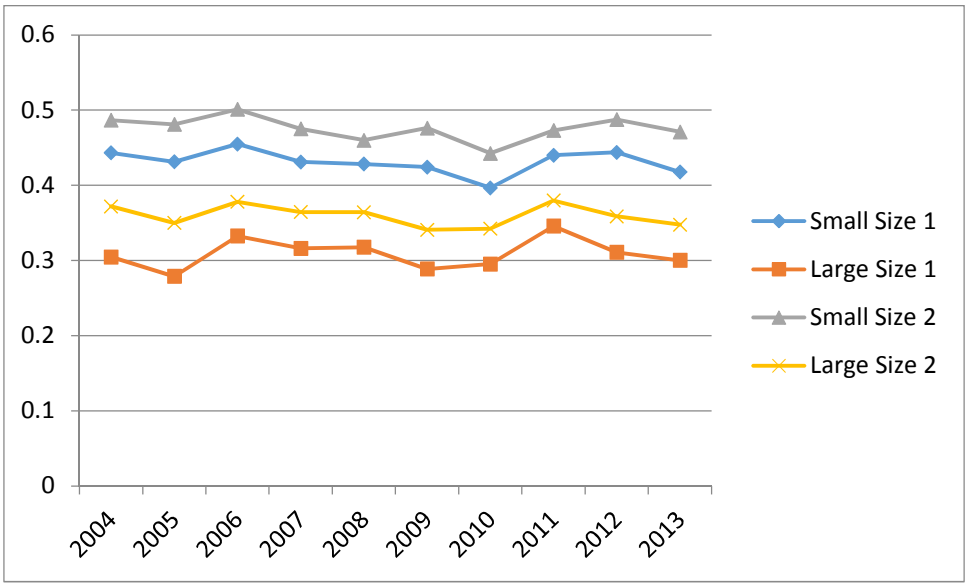


Figure 4.6: Effect of size of firm on WCM efficiency

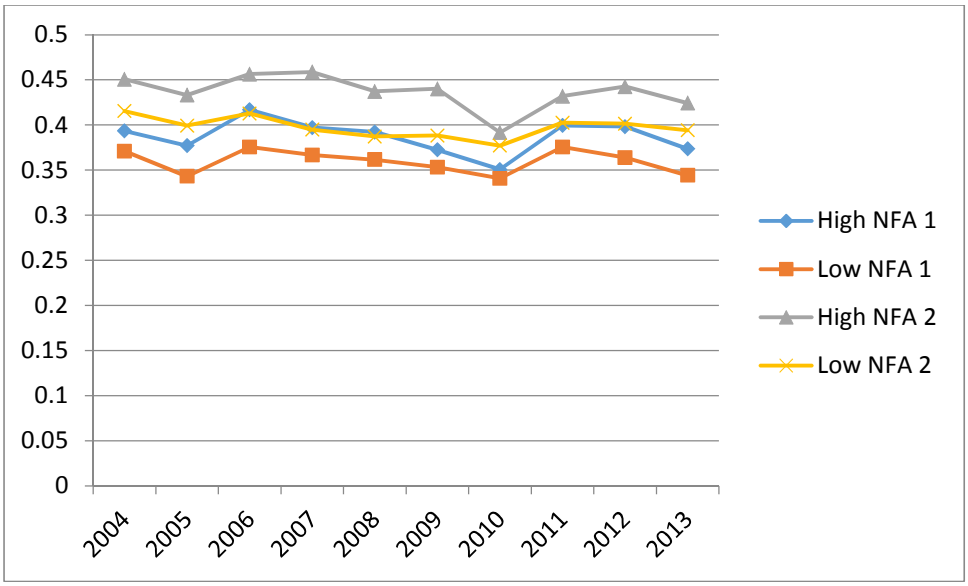


Figure 4.7: Effect of proportion of fixed assets on WCM efficiency

Figure 4.7 shows the relationship between working capital management efficiency and proportion of fixed assets. Here the figure shows that plot of High NFA 1 remains always above plot of Low NFA 1. Similarly plot of High NFA 2 is always above plot of Low NFA 2. This indicates that as firms increase their investment in fixed assets they become more aggressive in managing working capital and try to reduce the net investment in working capital, thus making them more efficient. Hence there seems to be positive relationship between proportion of fixed assets and WCM efficiency.

Figure 4.8 shows the relationship between debt and WCM efficiency of firms. The graph indicates that the debt has negative relationship with the WCM efficiency. It is clear from graph that plots of Low Debt 1 and Low Debt 2 are higher than plots of High Debt 1 and High Debt 2 respectively. This shows that as proportion of debt in a firm increases, it become more cautious and risk averse in managing working capital. It may thus prefer more liquidity and less risk which can be achieved through increase in current assets and decrease in current liabilities.

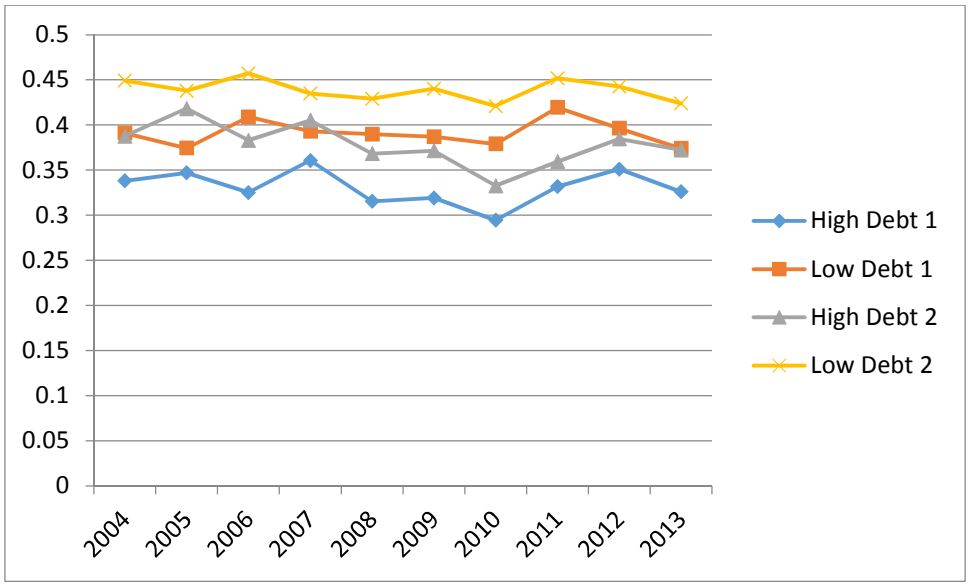


Figure 4.8: Effect of debt ratio on WCM efficiency

Figure 4.9 presents the relationship between sales growth rate and WCM efficiency. The figure shows that in most years higher sales growth has positive effect on WCM efficiency. Except for the initial two years (2004 & 2005) in all subsequent years, higher sales growth leads to higher WCM efficiency. The plot of High SLG 1 and High SLG 2 are above the plots of Low SLG 1 and Low SLG 2 in all years except the first two years. It can be inferred that as firms experience higher sales growth they also become more efficient in managing working capital. This may be due to increased usage of receivables and reduction in inventory due to increase in sales. Thus a positive relationship is observed between sales growth and WCM efficiency.

Figure 4.9: Effect of sales growth rate on WCM efficiency

Figure 4.10 shows the relationship between WCM efficiency and return on assets of firm. The graph indicates that higher ROA may lead to higher WCM efficiency of firms. For all years the plots of High ROA 1 and High ROA 2 are higher than plots of Low ROA 1 and Low ROA 2 respectively. Higher ROA signifies higher efficiency in asset utilisation and thus may also positively affect the efficiency in utilisation of short term funds. Thus ROA of firm has positive relationship with WCM efficiency.

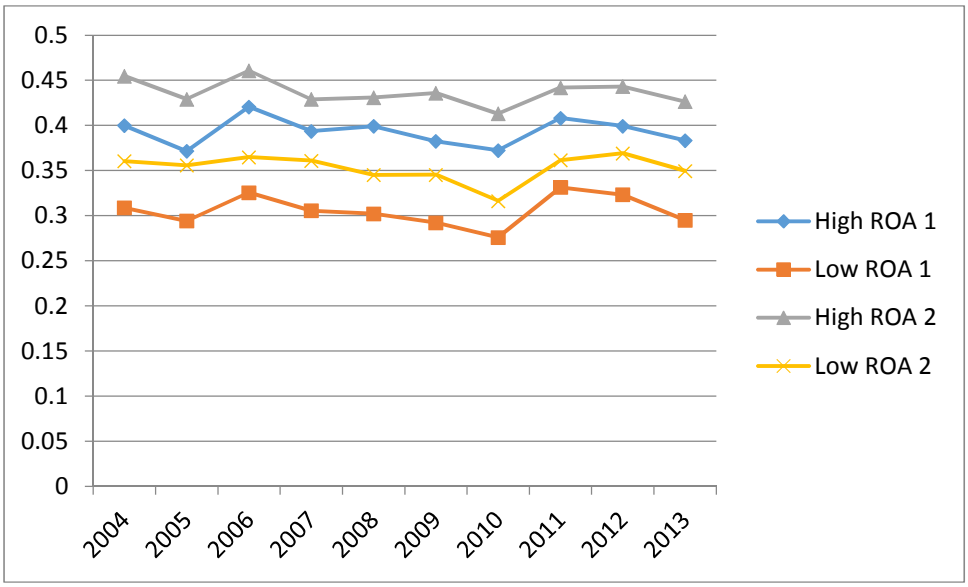


Figure 4.10: Effect of return on assets on WCM efficiency

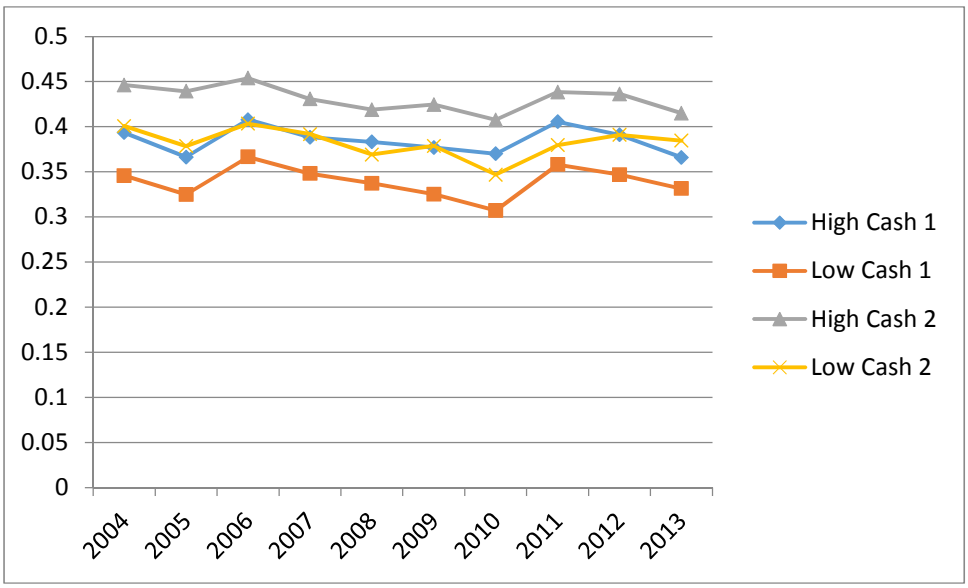


Figure 4.11: Effect of Cash and bank balance on WCM efficiency

Figure 4.11 shows the relationship between cash and bank balance of firm and WCM efficiency. The cash and bank balance are liquid assets and are considered alternatives to the

current assets. The plot of High Cash 1 is higher than plot of Low Cash 1 and similarly High Cash 2 is higher than Low Cash 2. Therefore there is a positive relationship between Cash holdings and WCM efficiency. This shows that as a firm increases its cash holdings, it reduces its investments in current assets which may lead to increase in efficiency of WCM. Cash Holdings are analysed separately in Chapter 6.

4.4.3 Statistical Analysis

The graphical analysis gave some idea about the relationships between working capital management efficiency and several firm-specific factors. To confirm that these relations are significant, the relationships also need to be analysed statistically.

The efficiency scores obtained in the first stage were used in the second stage to analyse the effect of exogenous factors. For the second stage of the two-stage DEA, some of the studies have used least square regression (LS) and others use Tobit regression but there is still no settlement on which method is better. However, Hoff (2007) states "LS may actually in many cases replace Tobit as a sufficient second stage DEA model" and thus LS regression is used in the analysis. The structure and working capital requirements of each industry is different and therefore each industry is analysed separately (i.e. 11 separate regressions). For each firm there are 10 years of data and there are more than one firm in each industry, therefore the data is in the form of panel data and hence panel data regression model has been used for the analysis.

4.4.3.1 Model Specification:

The primary aim is to analyse the effect of variation in several exogenous variables on the WCM efficiency of firms across the time period of study. Thus the requirement was to study the effect of time varying factors on the WCM efficiency of firms. Fixed effect model is suitable for such type of analysis since it only considers the effect of time varying factors. This model is also suitable in cases where there are omitted independent variables in the model. Since efficiency of WCM may be affected by several other factors in addition to the ones considered by us, therefore fixed effect model should be more suitable. However in order to be sure, Hausman test has been applied which tests the suitability of fixed effect model vs random effect model. The data was tested for problems of multicollinearity and autocorrelation in order to achieve a bias free result. Further, Generalized Least Squares (GLS) with cross section weights were used to account for heteroscedasticity since "the assumptions of GLS allow for heterogeneous variance within the residuals" (Burke and Term, 2010). For executing panel data regression model, EViews software package has been used.

Table 4.12: List of determinants tested for influence on WCM efficiency

Independent Variable (Abbrev. Used)
Age of firm (*AGE*)
Debt Ratio (*DEB*)
Fixed Assets to Total Assets (*NFA*)
Return on Assets (*ROA*)
Sales Growth (*SLG*)
Size (*SIZ*)
Cash and Bank Balance (CAS)
GDP (*GDP*)
Interest Rate (*INT*)
Inflation Rate (INF)
Financial Crisis (CRS)

Table 4.12 gives the list of independent variables and their abbreviations used in the model.

Thus, the regression model used was

$$Efficiency = \alpha + \beta_1 AGE + \beta_2 DEB + \beta_3 NFA + \beta_4 ROA + \beta_5 SLG + \beta_6 SIZ + \beta_7 CAS + \beta_8 GDP + \beta_9 INT + \beta_{10} INF + \beta_{11} CRS + e$$

This model was termed as ***Mod 1.***

The presence of macroeconomic factors may distort the actual relationship between firm-specific factors and WCM efficiency. To get a clear idea of the effect of firm-specific determinants, another regression model with only firm specific variables as independent variables was also employed.

$$Efficiency = \alpha + \beta_1 AGE + \beta_2 DEB + \beta_3 NFA + \beta_4 ROA + \beta_5 SLG + \beta_6 SIZ + \beta_7 CAS + e$$

This model was termed as ***Mod 2.***

Both DEA Eff 1 and DEA Eff 2 were used as dependent variable to ascertain the relationships. The regression equations/models used in the analysis are given in Table 4.13.

Table 4.13: Regression models for analysis of determinants (DEA Eff 1 and DEA Eff 2)

Dependent Variable	Model
DEA Eff 1 (Mod 1)	$= \alpha + \beta_1 AGE + \beta_2 DEB + \beta_3 NFA + \beta_4 ROA + \beta_5 SLG + \beta_6 SIZ + \beta_7 CAS + \beta_8 GDP + \beta_9 INT + \beta_{10} INF + \beta_{11} CRS + e$
DEA Eff 1 (Mod 2)	$= \alpha + \beta_1 AGE + \beta_2 DEB + \beta_3 NFA + \beta_4 ROA + \beta_5 SLG + \beta_6 SIZ + \beta_7 CAS + e$
DEA Eff 2 (Mod 1)	$= \alpha + \beta_1 AGE + \beta_2 DEB + \beta_3 NFA + \beta_4 ROA + \beta_5 SLG + \beta_6 SIZ + \beta_7 CAS + \beta_8 GDP + \beta_9 INT + \beta_{10} INF + \beta_{11} CRS + e$
DEA Eff 2 (Mod 2)	$= \alpha + \beta_1 AGE + \beta_2 DEB + \beta_3 NFA + \beta_4 ROA + \beta_5 SLG + \beta_6 SIZ + \beta_7 CAS + e$

In Mod 1 and Mod 2, β_i represents coefficients of the independent variables and e represents residual error.

Thus two structures of regression model were employed, one, having both firm-specific and macroeconomic determinants as independent variables and second, having only firm-specific variables as independent variables.

4.4.3.2 Analysis and Discussion:

Table 4.14 shows the descriptive statistics of all the independent variables used in the model. It can be observed that there is considerable variation in the sample which is good for analysis.

Table 4.14: Descriptive statistics of determinants

Variables	Mean	Median	Std. Dev.
AGE	34.255	27.000	20.616
SIZ	6.940	7.247	2.647
NFA	0.347	0.334	0.168
DEB	0.356	0.314	0.441
SLG	0.191	0.137	0.680
ROA	0.049	0.040	0.194
CAS	0.051	0.024	0.078
GDP	0.079	0.086	0.016
INT	0.075	0.079	0.009
INF	0.065	0.066	0.030
CRS	0.300	0.000	0.458

Hausman test was carried out for each case i.e. Mod 1 and Mod 2 with dependent variables as DEA Eff 1 and DEA Eff 2 separately and found that in each case the the null hypothesis that random effect model is better suited for the model was ejected. This thus confirmed that fixed-effect model is most suitable for analysis. In addition LLC Panel unit root tests for all regression variables were carried out to test for stationarity of individual data sets. The results

of LLC unit root test as given Table 4.15 showed that the probability values of all variables were less than 0.05 which rejected the null hypothesis at 95% confidence and proved that all the variables are stationary and thus suitable to be used in regression.

Table 4.15: LLC unit root test results

	Statistic	Prob.
AGE	-278.243	0.000
LNSIZE	-35.193	0.000
NFA2TA	-38.329	0.000
DEB	-228.221	0.000
SLG	-165.007	0.000
ROA	-71.864	0.000
CAS	-59.031	0.000
GDP	-72.051	0.000
INT	-51.405	0.000
INF	-77.340	0.000
CRS	-2.688	0.004

In order to avoid problem of multicollinearity, correlations between all pairs of independent variables were calculated. Table 4.15 shows the correlation matrix of independent variables using pooled data of all industries. A correlation value of above 0.50 or below -0.50 indicates high correlation between the independent variables which may lead to the problem of multicollinearity. Though multicollinearity doesn't have much influence on the explaining power of the model but may create serious problems in effect of individual variables. The results from Table 4.16 indicate that no two independent variables are highly correlated and thus the problem of multicollinearity does not exist in the sample.

Table 4.16: Correlation matrix of determinants

Correl.	AGE	SIZ	NFA	DEB	SLG	ROA	CAS	GDP	INT	INF	CRS
AGE	1										
SIZ	0.122	1									
NFA	-0.109	-0.007	1								
DEB	-0.080	0.008	0.197	1							
SLG	-0.036	0.006	-0.006	0.001	1						
ROA	0.023	0.005	-0.090	-0.106	0.022	1					
CAS	0.040	0.034	-0.305	-0.140	0.003	0.103	1				
GDP	-0.068	-0.053	0.017	0.018	0.039	0.054	0.027	1			
INT	0.112	0.111	-0.085	-0.035	-0.043	0.004	0.020	-0.144	1		
INF	0.057	0.056	-0.039	-0.028	0.010	0.018	0.013	0.309	0.234	1	
CRS	0.014	0.026	-0.009	-0.014	-0.050	0.023	0.008	0.131	0.140	0.007	1

Further in order to be sure that there is no problem of multicollinearity variance inflation factor (VIF) in each model (for each industry) was calculated. The rule of thumb is that a VIF value of 10 or more is an indication for existence of multicollinearity. VIF has been calculated only for Mod 1 since the model incorporates all variables and the presence of multicollinearity in this model automatically confirms the presence of same problem in the other model. Table 4.16 shows the values of VIF in each industry. It can be seen that VIF values for each variable in each industry is below the critical value of 10. Only in case of AGE, GDP and INT it reaches a high value of approx. 8 but in all other cases it is well below the danger zone. It can be safely concluded that there no serious issue of multicollinearity in the model.

Table 4.17: Variance inflation factor of independent variables

Dependent Variable: DEA Efficiency 1											
	AGE	**CAS**	**DEB**	**SIZ**	**NFA**	**ROA**	**SLG**	**GDP**	**INT**	**INF**	**CRS**
Food	7.589	1.092	1.158	2.567	1.070	1.234	1.028	7.439	7.584	5.159	1.248
Text	7.377	1.062	1.125	1.806	1.174	1.102	1.033	7.496	7.550	5.153	1.295
Drug	7.944	1.123	1.305	3.231	1.126	1.073	1.354	7.420	7.529	5.163	1.250
Plas	7.538	1.080	1.108	2.480	1.258	1.086	1.031	7.459	7.538	5.180	1.239
Chem	7.758	1.106	1.102	3.184	1.235	1.329	1.045	7.426	7.406	5.189	1.256
Cons	7.504	1.092	1.203	2.359	1.106	1.216	1.048	7.383	7.620	5.138	1.256
Infr	8.170	1.264	1.156	3.082	1.389	1.161	1.035	7.500	7.653	5.142	1.341
Meta	7.541	1.045	1.028	2.822	1.070	1.014	1.026	7.414	7.583	5.159	1.256
Mach	8.414	1.055	1.439	3.704	1.070	1.614	1.262	7.471	7.637	5.089	1.336
Trans	7.360	1.091	1.275	3.434	1.246	1.242	1.200	7.409	7.776	5.280	1.279
Misc	7.655	1.133	1.112	2.316	1.198	1.087	1.040	7.444	7.595	5.158	1.277
Dependent Variable: DEA Efficiency 2											
	AGE	**CAS**	**DEB**	**SIZ**	**NFA**	**ROA**	**SLG**	**GDP**	**INT**	**INF**	**CRS**
Food	8.130	1.076	1.156	3.761	1.067	1.199	1.010	7.525	7.714	5.200	1.247
Text	7.289	1.067	1.176	1.687	1.169	1.142	1.043	7.446	7.517	5.138	1.281
Drug	8.229	1.080	1.322	3.657	1.157	1.250	1.051	7.499	7.597	5.200	1.270
Plas	7.475	1.146	1.086	2.452	1.405	1.056	1.030	7.455	7.616	5.195	1.250
Chem	7.889	1.088	1.246	3.378	1.172	1.190	1.053	7.401	7.411	5.185	1.257
Cons	7.625	1.082	1.260	2.546	1.139	1.213	1.068	7.433	7.742	5.188	1.270
Infr	8.015	1.280	1.191	3.294	1.605	1.176	1.088	7.534	7.774	5.175	1.347
Meta	7.593	1.048	1.018	2.887	1.059	1.012	1.051	7.447	7.645	5.189	1.261
Mach	8.316	1.080	1.219	3.727	1.098	1.292	1.201	7.474	7.553	5.096	1.317
Trans	7.319	1.102	1.238	3.345	1.198	1.255	1.184	7.493	7.739	5.207	1.273
Misc	7.784	1.047	1.417	2.126	1.230	1.180	1.081	7.524	7.808	5.233	1.306

Autocorrelation is another serious problem that might exist in regression models and can distort the results. Durbin-Watson statistics for a model gives indication of autocorrelation in a model. The Durbin-Watson statistics should be close to 2.0 for no autocorrelation. In general, values between 1.5 and 2.0 for large samples are acceptable to rule out any major effect of autocorrelation. Therefore Durbin Watson statistics were calculated to test for problem of autocorrelation in the models. Table 4.18 shows the Durbin-Watson statistics and Adjusted R-square values for regression models of all industries. It can be seen that Durbin Watson statistics of all regression models are between 1.5 and 2.0. Thus, it confirms that the models do not suffer from autocorrelation problem. The adjusted R-square values in all regression models are in the range of 50% to 65%. This indicates that the independent variables and the model as a whole has high explanatory power and is able to explain approximately 50% to 60% of the variation in WCM efficiency.

Table 4.18: Adjusted R-square values and Durbin Watson Statistics of regression models

Adjusted R-Square				**Durbin Watson Statistics**			
DEA Eff 1		DEA Eff 2		DEA Eff 1		DEA Eff 2	
Mod 1	Mod 2	Mod 1	Mod 2	Mod 1	Mod 2	Mod 1	Mod 2
0.654	0.658	0.658	0.665	1.607	1.613	1.705	1.709
0.514	0.496	0.496	0.469	1.670	1.525	1.770	1.643
0.556	0.524	0.609	0.598	1.630	1.700	1.661	1.699
0.551	0.576	0.589	0.607	1.893	1.935	1.866	1.863
0.576	0.581	0.591	0.602	1.736	1.694	1.800	1.753
0.565	0.557	0.596	0.602	1.526	1.509	1.609	1.602
0.643	0.635	0.635	0.625	1.617	1.612	1.649	1.604
0.504	0.484	0.520	0.518	1.849	1.862	1.748	1.763
0.608	0.612	0.590	0.649	1.761	1.748	1.740	1.728
0.652	0.664	0.628	0.649	1.493	1.519	1.693	1.682
0.548	0.569	0.571	0.534	1.919	1.967	1.838	1.931

Thus both the models Mod1 and Mod 2 were both used for each industry using DEA Eff 1 and DEA Eff 2 separately as dependent variables and fixed effect regression model was employed. Table 4.19 and 4.20 shows results from the regression model. For each industry the first row shows the value of coefficients obtained by employing Mod 1 and second row shows the values of coefficients obtained using Mod 2.

In regression analysis, +ve or –ve sign attached to coefficient of an independent variable represent its relationship with the dependent variable. The relationship is of importance in model only if the variable is statistically significant in that model. Therefore, for any industry, there is need to analyse only those variables which are significant in that industry.

In Table 4.19 and 4.20 the highlighted or shaded coefficient values are those which have been found to be significant at 95% confidence.

Table 4.19: Coefficients of independent variables in Mod 1 & Mod 2 (Dependent Variable: DEA Eff 1)

	AGE	CAS	DEB	SIZ	NFA	ROA	SLG	GDP	INT	INF	CRS
Food	-0.004	0.071	-0.003	0.006	0.051	0.046	0.010	0.355	-0.137	0.021	0.004
	-0.005	0.041	-0.001	0.008	0.050	0.064	0.010				
Text	0.002	0.194	-0.008	-0.022	0.214	0.037	0.011	-0.825	0.852	0.126	-0.067
	0.006	0.202	-0.001	-0.037	0.160	0.027	0.017				
Drug	0.032	0.038	0.003	-0.031	0.077	0.064	0.012	2.726	-3.198	-0.986	-0.004
	0.011	0.035	0.005	-0.021	0.070	0.076	0.014				
Plas	0.040	0.114	0.010	0.015	0.097	0.064	0.031	3.682	-8.070	-1.903	-0.056
	0.002	0.088	0.011	0.010	0.181	0.054	0.026				
Chem	0.003	0.314	-0.006	-0.016	0.175	0.112	0.022	-0.263	1.051	-0.116	0.017
	0.006	0.296	-0.003	-0.015	0.162	0.109	0.028				
Cons	-0.008	0.317	-0.033	-0.016	0.131	-0.002	0.009	-0.962	0.748	0.755	-0.031
	0.000	0.299	-0.042	-0.020	0.124	-0.009	0.020				
Infr	0.008	-0.057	-0.015	-0.027	-0.040	-0.007	0.006	0.293	-1.452	0.262	-0.037
	0.006	-0.083	-0.009	-0.038	-0.003	-0.028	0.006				
Meta	0.001	0.149	-0.012	-0.026	0.004	0.004	0.004	1.175	0.925	-1.220	-0.046
	-0.004	0.136	-0.009	-0.029	-0.012	0.000	0.003				
Mach	-0.003	0.169	-0.070	-0.033	0.089	0.241	0.018	0.077	1.229	0.244	-0.035
	0.001	0.138	-0.080	-0.039	0.080	0.224	0.034				
Trans	-0.016	0.175	-0.047	-0.073	0.061	0.086	0.003	-1.549	4.616	0.544	0.005
	0.002	0.152	-0.043	-0.073	0.035	0.098	-0.001				
Misc	0.013	0.022	-0.128	-0.001	0.072	-0.005	-0.002	3.766	-3.234	-1.181	0.004
	-0.012	0.108	-0.146	0.016	0.087	0.011	-0.004				
Number of industries in which the independent variable is significant along with the direction of the relationship											
Mod 1 (Sig at 95%)	7	8	5	9	10	7	5	7	6	6	3
	+ve 4	+ve 7	+ve 0	+ve 1	+ve 9	+ve 7	+ve 5	+ve 4	+ve 2	+ve 2	+ve 0
	-ve 3	-ve 1	-ve 5	-ve 8	-ve 1	-ve 0	-ve 0	-ve 3	-ve 4	-ve 4	-ve 3
Mod 2 (Sig at 95%)	8	6	5	10	8	5	8	-	-	-	-
	+ve 5	+ve 5	+ve 0	+ve 2	+ve 8	+ve 5	+ve 8	-	-	-	-
	-ve 3	-ve 1	-ve 5	-ve 8	-ve	-ve 0	-ve 0	-	-	-	-
Relationship with WCM Efficiency 1	Mixed	Positive	Negative	Negative	Positive	Positive	Positive	Mixed	Mixed	Mixed	Insig

Table 4.20: Coefficients of independent variables in Mod 1 & Mod 2 (Dependent Variable: DEA Eff 2)

	AGE	CAS	DEB	SIZ	NFA	ROA	SLG	GDP	INT	INF	CRS
Food	-0.003	0.015	-0.012	0.013	0.055	0.068	0.002	0.259	-0.395	0.054	-0.004
	-0.004	0.026	-0.010	0.011	0.052	0.065	0.002				
Text	0.003	0.182	0.000	-0.018	0.144	0.043	0.022	-0.735	0.806	0.269	-0.060
	0.007	0.201	-0.003	-0.029	0.077	0.030	0.030				
Drug	0.043	0.105	0.013	-0.049	0.147	0.031	0.147	4.042	-5.126	-1.379	-0.020
	0.012	0.137	0.005	-0.039	0.163	0.033	0.159				
Plas	0.043	0.099	0.004	0.003	0.024	0.071	0.041	4.201	-6.761	-2.249	-0.083
	0.004	0.120	0.000	0.000	0.048	0.076	0.037				
Chem	-0.005	0.185	-0.012	-0.030	0.151	0.196	0.029	-0.958	2.442	0.324	0.022
	0.005	0.178	-0.014	-0.029	0.135	0.195	0.029				
Cons	-0.002	0.311	-0.022	-0.022	0.087	0.047	0.013	-0.722	0.400	0.646	-0.033
	0.002	0.287	-0.025	-0.017	0.074	0.037	0.024				
Infr	0.006	-0.007	-0.059	-0.022	0.025	0.045	0.006	0.248	-1.078	0.257	-0.029
	0.006	-0.017	-0.047	-0.031	0.058	0.025	0.006				
Meta	0.000	0.184	-0.013	-0.032	-0.008	0.003	0.004	1.143	1.613	-0.938	-0.044
	-0.003	0.179	-0.010	-0.032	-0.027	0.002	0.004				
Mach	0.001	0.201	-0.032	-0.028	0.056	0.199	0.039	0.625	0.486	-0.014	-0.027
	0.000	0.184	-0.039	-0.032	0.070	0.197	0.054				
Trans	-0.012	0.121	-0.048	-0.055	0.051	0.049	0.016	-1.254	3.742	0.528	0.006
	0.003	0.117	-0.032	-0.055	0.006	0.066	0.017				
Misc	0.026	-0.025	-0.127	-0.015	0.033	-0.004	0.008	6.021	-5.068	-1.611	-0.006
	-0.014	0.081	-0.160	0.014	0.070	0.002	0.004				
Number of industries in which the independent variable is significant along with the direction of the relationship											
Mod 1 (Sig at 95%)	5	7	4	10	7	9	9	9	6	9	10
	+ve 4	+ve 7	+ve 0	+ve 1	+ve 7	+ve 9	+ve 9	+ve 5	+ve 3	+ve 5	-ve 8
	-ve 1	-ve 0	-ve 4	-ve 9	-ve 0	-ve 0	-ve 0	-ve 4	-ve 3	-ve 4	+Ve 2
Mod 2 (Sig at 95%)	10	8	5	10	8	8	9	-	-	-	-
	+ve 7	+ve 7	+ve 0	+ve 2	+ve 8	+ve 8	+ve 9	-	-	-	-
	-ve 3	-ve 1	-ve 5	-ve 8	-ve 0	-ve 0	-ve 0	-	-	-	-
Relationship with DEA Efficiency 2	Positive	Positive	Negative	Negative	Positive	Positive	Positive	Mixed	Mixed	Mixed	Negative

The total number of industries in which each variable is significant is calculated and mentioned in the tables. Moreover the direction of the relationship (+ve or –ve) out of this total number is also mentioned. If a variable is significant in less than 5 industries, it is considered as *insignificant*. If a variable is significant in more than 5 industries but has approximately equal

mix of negative and positive relationship with WCM efficiency, then its relationship is considered *mixed* and it means that there is no clear direction of its relationship with WCM efficiency. In other cases when a variable is significant in 5 or more industries and there is clear indication of the direction of the relationship, then the relationship is marked as either *positive* or *negative* depending upon the nature of relationship.

From the results in Table 4.19 and Table 4.20 it can be seen that the results from both dependent variables DEA Eff 1 and DEA Eff 2 are more or less similar. The type of relationships of independent variables with WCM efficiency is somewhat consistent across both dependent variables. It can be seen that CAS, NFA, ROA and SLG have consistent positive relationship with WCM efficiency where as SIZ and DEB have consistent negative relationship with the efficiency measures. AGE was found to have mixed relationship with a bend towards positive relationship in case of DEA Eff 1 but was found to have almost consistent positive relationship in case of DEA Eff 2. Macroeconomic factors GDP, INT and INF were found to have mixed effect on the WCM efficiency as for some industries they had positive relation and for others the relationship was negative. The variable CRS was found to be insignificant in case of DEA Eff 1 but was found to have a consistent negative relationship with DEA Eff 2.

Further, there was need to confirm the relationships between various variables and WCM efficiency obtained using the new DEA based measure. The relationships obtained required to be double checked to ensure that there any flaw in the new efficiency measure had not distorted the relationships. In order to achieve this objective, traditional measure of WCM efficiency namely CCC and NTC were employed as dependent variables and Mod 1 and Mod 2 were used execute the regression model. Table 4.21 shows the models used.

Table 4.21: Regression models for analysis of determinants (CCC and NTC)

CCC (Mod 1)	$= \alpha + \beta_1 AGE + \beta_2 DEB + \beta_3 FTA + \beta_4 ROA + \beta_5 SLG + \beta_6 SIZ + \beta_7 CAS + \beta_8 GDP + \beta_9 INT + \beta_{10} INF + \beta_{11} CRS + e$
CCC (Mod 2)	$= \alpha + \beta_1 AGE + \beta_2 DEB + \beta_3 FTA + \beta_4 ROA + \beta_5 SLG + \beta_6 SIZ + \beta_7 CAS + e$
NTC (Mod 1)	$= \alpha + \beta_1 AGE + \beta_2 DEB + \beta_3 FTA + \beta_4 ROA + \beta_5 SLG + \beta_6 SIZ + \beta_7 CAS + \beta_8 GDP + \beta_9 INT + \beta_{10} INF + \beta_{11} CRS + e$
NTC (Mod 2)	$= \alpha + \beta_1 AGE + \beta_2 DEB + \beta_3 FTA + \beta_4 ROA + \beta_5 SLG + \beta_6 SIZ + \beta_7 CAS + e$

Table 4.22 and Table 4.23 show the results from regression models using CCC and NTC as dependent variables respectively.

Table 4.22: Coefficients of independent variables in Mod 1 & Mod 2 (Dependent Variable: CCC)

	AGE	CAS	DEB	SIZ	NFA	ROA	SLG	GDP	INT	INF	CRS
Food	-1.52	-39.75	16.35	12.36	-32.22	-23.92	-2.30	10.50	-482.92	2.34	-3.79
	-2.48	-44.84	10.30	10.99	-25.89	-17.63	-2.69				
Text	-2.22	-46.15	10.40	13.02	-88.83	-10.68	-16.37	98.68	-174.91	-1.38	-0.20
	-2.90	-45.69	10.62	12.56	-90.51	-10.04	-15.41				
Drug	-13.61	-32.49	1.25	55.73	-166.86	-97.88	-27.34	-341.38	20.55	52.80	-4.78
	-10.95	-34.26	5.62	48.46	-153.24	-85.30	-28.13				
Plas	-3.63	-157.71	-22.88	18.75	-64.12	-22.73	-16.00	-25.42	-263.99	13.13	-4.98
	-4.11	-167.84	-22.80	19.15	-59.00	-25.10	-14.15				
Chem	-8.30	-78.54	-4.54	19.73	-48.85	-61.57	-37.73	-162.60	1005.57	67.91	3.38
	-5.82	-87.25	-18.34	23.57	-75.75	-76.69	-39.74				
Cons	0.56	-150.38	60.68	12.68	-97.22	-14.75	-49.71	-322.01	-268.22	12.04	-7.30
	3.17	-167.90	52.37	1.87	-57.28	-44.89	-49.82				
Infr	-2.22	18.77	2.02	24.07	-55.22	-34.84	-28.43	-86.68	-1006.85	-18.35	-4.49
	-3.04	16.60	12.77	14.57	-53.50	-53.22	-29.04				
Meta	2.43	-25.58	2.66	8.42	-1.92	-0.07	0.04	208.05	-607.22	-70.04	-4.66
	0.24	-23.43	3.10	6.88	0.51	-0.46	-0.04				
Mach	-0.25	-112.49	86.80	11.27	-101.89	-42.03	-44.39	-3.87	-1119.45	-63.81	-4.01
	-2.72	-128.21	81.38	6.28	-88.23	-59.27	-46.87				
Trans	-1.55	-117.94	97.41	11.27	-105.71	-14.45	-55.66	68.74	-436.37	3.51	-2.33
	-2.90	-105.99	107.51	11.56	-101.89	-9.68	-56.49				
Misc	1.50	23.47	64.22	-14.82	-83.32	-63.91	-13.66	-365.83	-147.95	152.28	-5.42
	3.64	31.05	66.96	-22.14	-82.27	-75.44	-13.69				
Number of industries in which the independent variable is significant along with the direction of the relationship											
Mod 1 (Sig at 95%)	5	7	7	11	10	6	10	2	4	0	6
	+ve 1	+ve 0	+ve 6	+ve 10	+ve 0	+ve 0	+ve 0	+ve 1	+ve 0	0	+ve 0
	-ve 4	-ve 7	-ve 1	-ve 1	-ve 10	-ve 6	-ve 10	-ve 1	-ve 4	0	-ve 6
Mod 2 (Sig at 95%)	9	6	8	10	10	7	9	-	-	-	-
	+ve 1	+ve 0	+ve 6	+ve 9	+ve 0	+ve 0	+ve 0	-	-	-	-
	-ve 8	-ve 6	-ve 2	-ve 1	-ve 10	-ve 7	-ve 9	-	-	-	-
Relation with CCC	Negative	Negative	Positive	Positive	Negative	Negative	Negative	Insig	Insig	Insig	Negative
Relation with WCM Eff.	Positive	Positive	Negative	Negative	Positive	Positive	Positive	Insig	Insig	Insig	Positive

Table 4.23: Coefficients of independent variables in Mod 1 & Mod 2 (Dependent Variable: NTC)

	AGE	CAS	DEB	SIZ	NFA	ROA	SLG	GDP	INT	INF	CRS
Food	1.00	-44.89	14.58	8.43	-39.12	-5.77	-3.32	41.29	-344.10	31.66	-3.54
	0.28	-59.61	14.26	7.65	-42.39	-4.61	-3.11				
Text	-0.58	-44.50	10.91	14.66	-99.59	3.47	-6.74	157.76	-135.67	44.28	0.60
	-1.31	-43.79	9.01	16.00	-99.55	3.10	-5.16				
Drug	-6.65	-46.39	44.48	46.92	-125.03	7.30	-20.16	-168.51	-261.68	-5.05	-6.67
	-6.65	-45.86	33.10	44.77	-107.86	-14.69	-16.66				
Plas	-1.94	-156.44	-8.25	20.54	-73.98	-11.21	-15.43	129.09	-401.09	38.50	-3.53
	-3.29	-167.16	-8.39	22.62	-75.01	-10.82	-12.22				
Chem	-1.46	-71.62	16.16	12.04	-27.27	-12.90	-8.04	65.93	134.96	-4.90	-7.12
	-1.46	-74.03	16.85	11.49	-26.92	-11.40	-6.27				
Cons	3.15	-126.79	44.35	6.45	-55.20	-5.32	-28.19	-71.64	-331.73	10.01	-7.66
	2.61	-124.17	41.88	5.31	-64.58	-15.84	-27.92				
Infr	-2.07	8.32	33.03	12.89	-49.94	8.09	-6.34	-216.76	-287.91	92.25	-9.18
	-1.35	-1.40	36.82	7.40	-34.30	-0.19	-5.49				
Meta	2.73	-24.99	0.90	10.35	-16.35	1.58	0.38	155.43	-706.56	13.70	-3.16
	0.74	-30.52	1.06	8.96	-13.15	1.39	0.49				
Mach	-1.96	-153.32	70.01	24.16	-123.82	-60.43	-25.34	-132.20	-635.08	5.61	-4.30
	-2.46	-153.12	73.29	20.01	-104.03	-65.81	-25.72				
Trans	0.15	-88.48	60.62	40.18	-73.47	2.36	-31.43	29.01	-231.14	31.05	-4.82
	-0.43	-86.24	63.24	40.22	-72.67	2.90	-25.74				
Misc	0.77	-31.83	59.69	12.75	-65.76	22.96	-10.53	-233.42	-282.57	52.56	-11.14
	1.52	34.74	69.89	10.04	-88.60	24.09	-5.04				
Number of industries in which the independent variable is significant along with the direction of the relationship											
Mod 1 (Sig at 95%)	4	8	10	11	11	2	9	0	3	0	10
	+ve 2	+ve 0	+ve 9	+ve 11	+ve 0	+ve 0	+ve 0	+ve 0	+ve 0	+ve 0	+ve 0
	-ve 2	-ve 8	-ve 1	-ve 0	-ve 11	-ve 2	-ve 9	-ve 0	-ve 3	-ve 0	-ve 10
Mod 2 (Sig at 95%)	10	9	10	10	11	2	9	-	-	-	-
	+ve 3	+ve 0	+ve 9	+ve 10	+ve 0	+ve 0	+ve 0	-	-	-	-
	-ve 7	-ve 9	-ve 1	-ve 0	-ve 10	-ve 2	-ve 9	-	-	-	-
Relation with NTC	Negative	Negative	Positive	Positive	Negative	Insig	Negative	Insig	Insig	Insig	Negative
Relation with WCM Eff.	Positive	Positive	Negative	Negative	Positive	Insig	Positive	Insig	Insig	Insig	Positive

A point to remember is that higher values of CCC and NTC mean lower levels of WCM efficiency. Therefore, the relationships obtained in regression models using CCC and NTC as dependent variables need to be reversed in order to obtain the correct relationship with WCM efficiency. Therefore the second last row in Table 4.22 and Table 4.23 show the relationship with CCC and NTC whereas the last row shows the actual relationships.

Table 4.24 shows the summary of the relationships obtained using various dependent variables. For each industry the table shows the relationship with WCM efficiency obtained using the various WCM efficiency measures. The last column shows the final resultant overall relationship obtained after taking into account the results from all WCM efficiency measures.

Table 4.24: Relationship of determinants with WCM Efficiency measures

Determinant	**WCM Efficiency Measure**				
	DEA Eff 1	**DEA Eff 2**	**CCC**	**NTC**	**Overall**
Firm-specific variables					
AGE	Mixed	Positive	Positive	Positive	**Positive**
CAS	Positive	Positive	Positive	Positive	**Positive**
DEB	Negative	Negative	Negative	Negative	**Negative**
SIZ	Negative	Negative	Negative	Negative	**Negative**
NFA	Positive	Positive	Positive	Positive	**Positive**
ROA	Positive	Positive	Positive	Insignificant	**Positive**
SLG	Positive	Positive	Positive	Positive	**Positive**
Macroeconomic variables					
GDP	Mixed	Mixed	Insignificant	Insignificant	**Inconclusive**
INT	Mixed	Mixed	Insignificant	Insignificant	**Inconclusive**
INF	Mixed	Mixed	Insignificant	Insignificant	**Inconclusive**
CRS	Insignificant	Negative	Positive	Positive	**Inconclusive**

Table 4.24 shows that all of the firm-specific determinants were found to have consistent relationships with WCM efficiency across all the efficiency measures tested. The variables which were found to have positive (negative) relationship in case of DEA Eff 1 and DEA Eff 2 were also found to have positive (negative) relationship with traditional measures. However the relationships of all macroeconomic variables with WCM efficiency were found to be inconclusive. It was found that their relationships were either mixed or their effect was not significant in most industries. The overall analysis of impact of various determinants is given below.

AGE was found to have a positive relationship with the WCM efficiency. Except in case of DEA Eff 1, were it exhibited mixed relationship, the relationship with all other measures was positive. This indicates that as a firm becomes older it becomes expert and more efficient in handling working capital. With time a firm may be able to learn the tricks of the trade and thus is able to keep a better control on its level of current assets. Moreover, firms which have been operating in the market for longer duration may be able to build up a good reputation which may permit them to obtain longer and larger credit from their suppliers. Older firms are hence able to get better deals for short term credit and thus able to keep higher levels of payables. This allows such firms to increase their level of current liabilities more in comparison to increase in current assets and hence improve their WCM efficiency. The results are similar to those of García-Teruel and Martínez-Solano (2010) but are in contrast to those obtained by Chiou et al. (2006).

CAS showed a consistent positive relationship with the efficiency of WCM. It can be inferred from this result that as firms increase their level of cash and bank balances, they tend to reduce their investments in other liquid assets which are cash alternatives. Firms have limited funds that can be kept liquid and used in day to day operations. Hence when firms increase their cash holdings they may be forced to reduce their stock of inventories and receivables. This would lead to decrease in current assets and thus increase in the WCM efficiency. Moreover it is also possible that as firms become cash rich, the suppliers feel safer in extending larger credit to these firms. Such firms may thus be able to negotiate better terms for credit purchases and hence increase their level of current liabilities which may also lead to an increase in WCM efficiency of firms.

DEB exhibited a negative relationship with the WCM efficiency of firms. It can be deduced that as firms increase their level of debt, their WCM efficiency goes down. An increase in level of debt increases the risk of firm and it increases the chances of distress and bankruptcy. Such firms may want to avoid further risk and may thus be inclined to keep a lower level of current liabilities (to reduce short term debt). Besides they may also desire to keep a higher level of current assets to maintain higher liquidity and avoid any illiquidity risk. Both the actions (decreasing current liabilities and increasing current assets) would result in decrease in the level of WCM efficiency. Moreover, some portion of the increase in debt may be used by the firm to finance its current assets resulting in reduction in the need of financing through current liabilities. This may also be responsible for negative relationship between debt and WCM

efficiency. Our results are similar to the results obtained by Naser et al. (2013) but were in contrast to the results obtained by Nazir and Afza (2009).

SIZ was found to have a negative relationship with WCM efficiency. This suggests that as the total size of firms increase they become less efficient in managing working capital. This phenomenon may be due to the fact that with increase in size, the firm doesn't need to be aggressive in managing liquidity. When firms are smaller in size they tend to be more aggressive and efficient in managing working capital in order to save costs. As a firm becomes larger, its objective may change from aggressive and efficient management of funds to increasing market share and attaining market leadership. A large firm may have sufficient financial stability and thus can keep large stocks of inventory for future demands and ready availability of products. It may also not mind extending large and longer credit to customers to maintain its market share and leadership. This increase in current assets (inventory and receivables) would result in decrease in WCM efficiency. Chiou et al., (2006) had obtained results similar to this study but the results obtained by Naser et al. (2013) were in contrast.

NFA was found to have a positive effect on WCM efficiency. This implies that as firms invest more in their fixed assets, they become more aggressive in managing working capital resulting in higher WCM efficiency. It is possible that when a large amount of investment has already been made by the firm in the form of fixed assets, the management of such firms may become more vigilant and aggressive in managing working capital so as to minimise the investments in current asset. Such firms may try to increase their level of current liabilities to finance short term assets and to free up firm's own funds. When firms make large investments in fixed assets, higher value of funds are at stake and thus firms feel the pinch to improve their efficiency in fund management and may thus push for higher efficiency in WCM. These results are in agreement with the results obtained by other studies including Moussawi et al. (2006).

ROA showed a positive relationship with the WCM efficiency measures. This indicated that as the return on assets of firm improves, its efficiency in managing working capital also improves. Return on assets may also be considered as an efficiency measure and increase in ROA implies an increase in overall efficiency in asset utilisation. Increase in ROA may thus also imply increase in efficiency in the utilisation of current assets resulting in higher WCM efficiency. Moreover, an increase in ROA may also boost the confidence of firm's suppliers and they may be inclined to extend larger and longer credit to the firm. This will increase the level of current

liabilities, reduce the required investment in working capital and in turn increase WCM efficiency. Vaidya (2011) obtained similar results, but results of Delannay and Weill (2005) were in contrast to ours.

SLG too exhibits a positive relationship with WCM efficiency. It indicates that as there is an increase in sales growth of firms, the efficiency to manage working capital is also improved. As stated earlier high sales growth may make a firm anticipate higher sales in future. Such firm may try to make maximum use of its limited resources to scale up operations and thus may increase the level of payables by pushing the suppliers to give more credit. Although firms may also infuse more funds in current assets but the firm's management would want that increase in current liabilities should be higher than the increase in current assets. Moreover, suppliers too feel more confident in lending to firms with higher sales growth. All this will lead to a higher increase in current liabilities and therefore would result in improvement of WCM efficiency. The results were similar to the results obtained by Palombini and Nakamura (2012) and Naser et al. (2013).

In case of macroeconomic variables, none of the determinants depicted any consistency in the relationship with WCM efficiency. It can be seen from Table 4.24 that GDP, INT and INF showed mixed relationships with WCM efficiency when DEA based measures were used as dependent variables. However in case of CCC and NTC the determinants were not even found to be significant in most industries. CRS showed different results with different WCM measures. While financial crisis showed negative effect on DEA based WCM efficiency, on the other hand there were evidences of a positive relation with WCM efficiency measured using CCC and NTC. The outcome is that the relationship thus remains inconclusive. Overall no conclusion can be drawn about their effect on WCM efficiency. However, it can be said that different industries are affected by the macroeconomic factors in different manner. While an increase in these factors may improve the WCM efficiency of some industries, for others it may have opposite effect.

It can be concluded that in the sample of firms tested the firm-specific variables are found to have significant effect on working capital management efficiency whereas the macroeconomic factors failed to show any significant effect. It can be inferred from the results that few of the factors that impact WCM efficiency are directly within the firm's control while few can be fine-tuned indirectly. However, it is clear that a firm's actions do have bearing on the liquidity management and thus management should take decisions taking into consideration its impact on efficiency of WCM.

This chapter examines the WCM efficiency of firms using a new approach. It then analyses the change in efficiency and the determining factors influencing this change. The efficiency scores indicated that the average WCM efficiency is around 40%, and that there is a vast difference between maximum and minimum efficiencies. The trend analysis indicated that efficiency level of working capital management of firms does vary with time which might be the result of several factors. The results also suggest that the working capital management efficiency of firms do get influenced by a number of factors, however not all the factors are within a firm's control. The next chapter tries to further analyse the change in WCM efficiency of firms using Malmquist Productivity Index.

CHAPTER 5

ANALYSIS OF WCM EFFICIENCY CHANGE AND LINKAGES BETWEEN FIRM PERFORMANCE & WCM EFFICIENCY

Preview

This chapter examines the change in WCM efficiency and also explores the relationship between WCM efficiency and firm performance. This chapter is divided into two parts. Section A analyses change in efficiency of working capital management using Malmquist Productivity Index (MPI) and its constituents pure efficiency (PE), scale efficiency (SE) and technology change (TC). It also examines the influence of change in various firm-specific and macroeconomic variables on MPI, PE and SE. Section B explores the linkages between WCM efficiency and firm performance. Using a variety of firm performance measures, the section analyses the impact of change in WCM efficiency on accounting and market performance of firm.

CHAPTER 5
ANALYSIS OF WCM EFFICIENCY CHANGE AND LINKAGES BETWEEN FIRM PERFORMANCE & WCM EFFICIENCY

5.1 Introduction

This chapter focuses on objectives 4 and 5 of the study and aims to carry out further analysis of WCM efficiency measured in previous chapter. Here the study analyses the structure and pattern of change in WCM efficiency of Indian manufacturing over the past 10 years. For this DEA based Malmquist productivity index and its components (pure efficiency, scale efficiency and technology change) are used. Further, it examines how the variation in WCM efficiency influences the accounting and market performance measures of firms. A variety of performance measures have been used for robust analysis.

Thus this chapter focuses mainly on two aspects and is therefore divided into two sections: Section A deals with analysis of efficiency change in WCM over the years and examines the structure of the change using Malmquist productivity index. This section also analyses the influence of change in various variables on MPI and its components. Section B examines the linkages between WCM efficiency and performance of firm.

5.2 Section A - Analysis of WCM Efficiency Change

5.2.1 Malmquist Productivity Index

Malmquist Productivity Index (MPI) makes use of the efficiency calculated using DEA to analyse the change in efficiency. It is used to measure the change (progress or regress) in efficiency of DMUs along with the change in technology over time. Productivity is defined here as the ratio between two efficiencies, as calculated by the DEA, for the same production unit in two different time periods (Odeck, 2000). Fare et al. (1994) (FGNZ) decomposed the Malmquist productivity index into three parts, representing (i) change in pure efficiency (PE) (ii) change in scale efficiency (SE) and (iii) change in technology (TC).

As mentioned in chapter 3, PE measures the change in technical efficiency of DMU i.e. improvement in efficiency due to improvement in the process. Since the firm becomes more

technologically capable, it is able to gain many benefits (Srivastava and Gnyawali, 2011) (Zhou et al., 2014). On the other hand SE measures change in efficiency due to change in scale of operations. The combination of PE and SE is called as the catching up effect and they together measure the change in technical efficiency of firm. “Pure efficiency change measures the relative ability of operators to convert inputs into outputs while scale efficiency measures the extent to which the operators can take advantage of returns to scale by altering the size towards optimal scale”(Neupane, 2013). TC is the change in efficiency due to change or improvement in technology which affects the efficiency of all firms. In other words it is the change in variable return to scale (VRS) reference technology. Therefore, a productivity index is decomposed into its two main components, technical efficiency change which reveals the convergence or divergence of DMUs or any firm from the best practicing frontier; and the technological change which depicts improvement or deterioration in DMUs (Casu et al., 2004). If MPI or any of its components has a value greater than 1.0, it indicates that there has been improvement or increase in efficiency whereas a value less than 1.0 indicates a decrease in efficiency. A value of 1.0 indicates no change.

MPI along with its components PE, SE and TC have been used by many researchers to study the change in efficiency in various areas. However, in spite of its effectiveness in analysing efficiency change, none of the studies have employed MPI to study WCM efficiency. In this chapter, MPI along with its components PE and SE is used to study the change in efficiency of WCM in Indian manufacturing sector over ten years (2004-2013). The focus is on PE and SE because the study is interested in studying only the catching up effect of efficiency change. This is because PE and SE are changes which are specific to the firm and aid in analysing the performance of specific firms. This chapter also analyses the determinants of changes in PE and SE to study the causes of WCM efficiency change.

The second section of the chapter deals with the relationship between WCM efficiency and performance of firm. Here a number of firm performance measures are tested for their association with WCM efficiency and its change. The performance indicators considered constitute of both accounting performance indicators and market performance indicators.

5.2.2 Efficiency Change Analysis

The DEA based WCM efficiency was calculated using DEA Eff 2 i.e. inputs consisted of inventory, receivables and modified payables and output consisted of sales and cashflow from operations. The inputs and output variable selected were used to calculate the DEA based

WCM efficiency using BCC model. These efficiency scores were then used to calculate MPI and its components as follows.

Using following notations:

For each i,j = 1,2 where 1 and 2 are first and second period of study respectively

C_{ij} = Efficiency at time i relative to technology at time j assuming CRS

V_{ij} = Efficiency at time i relative to technology at time j assuming VRS;

The Malmquist productivity index (MPI) is then defined by

$$MPI = \left(\frac{C_{21}}{C_{11}} \times \frac{C_{22}}{C_{12}}\right)^{1/2}$$

Malmquist productivity index is divided the into three parts, representing (i) change in pure efficiency (PE) (ii) change in scale efficiency (SE) and (iii) change in technology (TC) Fare et al. (1994).

$$PE = \frac{V_{22}}{V_{11}}$$

$$SE = \frac{C_{22}/V_{22}}{C_{11}/V_{11}}$$

$$TC = \left(\frac{C_{21}}{C_{22}} \times \frac{C_{11}}{C_{12}}\right)^{1/2}$$

$$MPI = PE \times SE \times TC$$

It has been pointed out by many previous studies that requirements and norms of working capital management differ with industry. Moreover since DEA estimates efficiency of a firm relative to other firms in the group therefore to obtain correct results and avoid industry bias, WCM efficiency needs to be calculated independently for each industry. Moreover, the efficiency needs to be calculated separately for each year in order to avoid any bias due to effect of exogenous factors. The MPI and its constituents PE, SE and TC are calculated for each industry and for each successive pair of years i.e. 2004-05, 2005-06 etc. Therefore there are nine sets of data (2004-05 to 2012-13) for each industry depicting change in WCM efficiency in each year. 'FEAR' package by P.W. Wilson is used to calculate Malmquist productivity index and its components: pure efficiency change, scale efficiency change and technology change. The software is able to directly calculate MPI and there is no need to first calculate DEA based efficiency and then MPI. Table 5.1 shows the average values of MPI and it components PE, SE and TC for each industry every year. The last column shows the overall average values for each year.

Table 5.1: Average MPI, PE, SE and TC values

	Food	Text	Drug	Plas	Chem	Cons	Infr	Meta	Mach	Tran	Misc	Avg
	AverageMPI											
2004-05	1.274	1.044	1.054	1.036	1.082	1.162	1.403	1.152	1.126	0.966	1.117	**1.129**
2005-06	1.228	0.956	1.188	1.305	1.008	1.099	1.148	1.007	1.182	1.056	1.079	**1.114**
2006-07	1.146	1.695	1.273	1.118	1.108	1.191	1.195	1.113	1.154	1.130	1.120	**1.204**
2007-08	1.198	1.738	1.045	1.060	1.055	1.131	1.057	1.015	1.076	1.304	1.123	**1.164**
2008-09	1.434	1.193	1.152	1.285	3.274	1.228	1.103	1.230	1.025	1.176	1.240	**1.395**
2009-10	1.085	1.155	1.158	0.993	0.985	2.604	1.093	0.991	1.231	3.077	1.041	**1.401**
2010-11	1.178	1.037	1.302	1.008	1.038	0.985	1.348	1.017	0.998	0.989	1.168	**1.097**
2011-12	1.201	1.117	1.086	1.073	1.060	1.034	1.220	1.119	1.908	1.128	1.167	**1.192**
2012-13	1.715	1.049	1.049	2.769	1.091	1.103	1.068	1.761	1.014	1.097	1.026	**1.431**
	Average PE											
2004-05	1.217	1.207	1.019	0.916	0.975	1.077	1.367	1.015	1.009	1.095	0.892	**1.072**
2005-06	1.146	0.982	1.177	1.377	1.060	0.838	0.973	1.268	1.150	1.072	1.458	**1.136**
2006-07	1.119	1.181	1.075	0.823	1.248	1.251	0.994	0.826	1.039	1.553	0.892	**1.091**
2007-08	1.103	1.040	1.051	1.041	0.965	0.944	1.014	1.026	1.026	1.125	1.348	**1.062**
2008-09	1.196	1.077	1.168	1.467	1.152	1.055	1.046	1.144	0.874	0.928	1.029	**1.104**
2009-10	1.220	1.163	0.988	0.992	0.998	1.074	1.168	0.843	0.946	1.055	0.999	**1.041**
2010-11	1.075	1.461	1.126	1.259	1.001	1.442	1.315	1.271	1.259	1.020	1.113	**1.213**
2011-12	1.049	0.927	1.055	1.074	1.181	0.997	0.976	1.256	1.041	1.233	1.164	**1.087**
2012-13	1.133	1.171	0.985	1.089	1.068	0.927	1.143	0.984	1.063	1.172	0.920	**1.060**
	Average SE											
2004-05	1.020	0.944	0.975	1.140	1.052	0.989	1.173	1.004	0.965	0.971	1.004	**1.021**
2005-06	1.040	1.049	1.070	1.218	1.023	1.007	0.975	1.031	1.063	1.002	1.160	**1.058**
2006-07	1.023	1.062	1.012	0.990	1.050	1.032	1.065	1.013	0.988	1.048	0.999	**1.025**
2007-08	1.110	1.040	0.973	1.006	0.985	1.109	0.965	1.020	1.034	1.061	1.001	**1.028**
2008-09	1.052	1.006	1.015	1.029	1.014	1.130	1.192	1.048	1.027	1.035	1.004	**1.050**
2009-10	0.989	0.957	1.024	0.990	1.014	0.984	1.044	0.982	1.073	0.998	0.975	**1.003**
2010-11	1.042	1.101	1.026	1.040	1.017	1.013	1.014	1.058	1.006	1.033	1.155	**1.046**
2011-12	1.002	0.997	0.970	1.010	1.333	0.986	1.127	0.976	0.990	1.029	0.983	**1.037**
2012-13	0.993	1.007	0.991	0.998	1.014	1.044	0.932	1.005	1.010	1.013	1.200	**1.019**
	Average TC											
2004-05	1.134	0.940	1.083	1.071	1.119	1.062	0.960	1.164	1.230	0.971	1.257	**1.090**
2005-06	1.030	0.957	0.938	0.823	0.986	1.330	1.247	0.802	0.998	0.992	0.768	**0.988**
2006-07	1.039	1.136	1.100	1.491	0.900	0.948	1.185	1.386	1.145	0.783	1.277	**1.126**
2007-08	1.047	1.694	1.021	1.004	1.123	1.134	1.133	0.996	1.023	1.117	0.881	**1.107**
2008-09	1.181	1.193	0.985	0.974	3.136	1.089	1.040	1.081	1.152	1.270	1.195	**1.300**
2009-10	0.968	1.104	1.161	1.070	1.039	2.548	0.938	1.279	1.150	3.061	1.059	**1.398**
2010-11	1.118	0.676	1.094	0.812	1.117	0.736	1.132	0.795	0.826	0.984	0.929	**0.929**
2011-12	1.247	1.304	1.081	1.008	0.833	1.059	1.142	0.936	1.903	0.910	1.053	**1.134**
2012-13	1.698	0.911	1.117	2.700	1.200	1.172	1.112	1.816	0.965	0.957	1.882	**1.403**

From Table 5.1 it can be observed that on an average the MPI values vary between 1.0 and 1.4. This indicates that the WCM efficiency of firms has improved each year and on an average there is around 20 to 25 percent improvement in a year. However, it can be observed that the pure efficiency change in not very high. The average value of PE ranges from 1.0 to 1.2 with most values being around 1.0. This indicates that most firms have only marginally improved their efficiency and thus have moved only slightly towards the efficient frontier.

Similarly it can be observed that the scale efficiency also has average value of around 1.0. This again indicates that the scale of operations of firms has improved only slightly over the duration of the study. In fact if PE, SE and TC are compared it can be seen that the lowest average values are for SE. This shows that the improvement in WCM efficiency as observed from MPI values is not due to the improvement in scale of operations. Thus most firms of the sample have only slightly changed their scale of operations towards the optimal size and thus over the years the average value of scale efficiency has remained at around 1.0.

The technology change (TC) values have shown most variation with values ranging from 0.98 to 1.4. This shows that the improvement in WCM efficiency (MPI values) is mostly due to the overall change or improvement in technology and thus there has not been much change in relative performance.

To further analyse the change in WCM efficiency, cumulative values of MPI, PE, SE and TC were calculated and plotted on a graph. The cumulative values were calculated by taking the average values of MPI, PE, SE and TC (from last column of Table 5.1) and then multiplying the value of each year. e.g. from MPI the cumulative value of each year were calculated as shown in Table 5.2. Similar method was used to calculate cumulative change in PE, SE and TC.

Table 5.2: Calculation of cumulative MPI

Year	Avg. MPI	Calculation	Cumulative MPI
2004-05	1.129	=1.129	1.129
2005-06	1.114	=1.114*1.129	1.258
2006-07	1.204	=1.258*1.204	1.514
2007-08	1.164	=1.514*1.164	1.762
2008-09	1.395	=1.762*1.395	2.457
2009-10	1.401	=2.457*1.401	3.443
2010-11	1.097	=3.443*1.097	3.777
2011-12	1.192	=3.777*1.192	4.502
2012-13	1.431	=4.502*1.431	6.442

The cumulative values calculated were plotted on a graph as shown in Figure 5.1. The figure shows that there is almost continuous improvement in efficiency over the years and the overall efficiency in 2013 is more than four times to what it was in 2004. As inferred from Table 5.1 much of this change is due to change in technology or frontier change as the graph of TC is steepest among all components of MPI. This is followed by PE plot which shows that pure efficiency of firms has almost doubled in the last 10 years. This clearly depicts that firms have become almost twice as efficient in handling working capital and this may be mainly attributed to more efficient working capital management process.

The plot of SE shows that there has been only a small amount of increase (1.4 times) in scale efficiency and indicates that as inferred from the results of Table 5.1, the improvement in efficiency due to change in scale of operations is very small. Hence the overall change in efficiency is mainly due to change in technology which has shown the highest jump among the components of MPI.

Overall it can be inferred that MPI has grown significantly over the last 10 years signifying a large change in overall WCM efficiency of firms. However most of this change is due to the change in technology which has affected all firms. A small amount of WCM efficiency change is due to the improvement in technical efficiency of individual firm. An almost insignificant change in WCM efficiency is due to improvement in scale of operations.

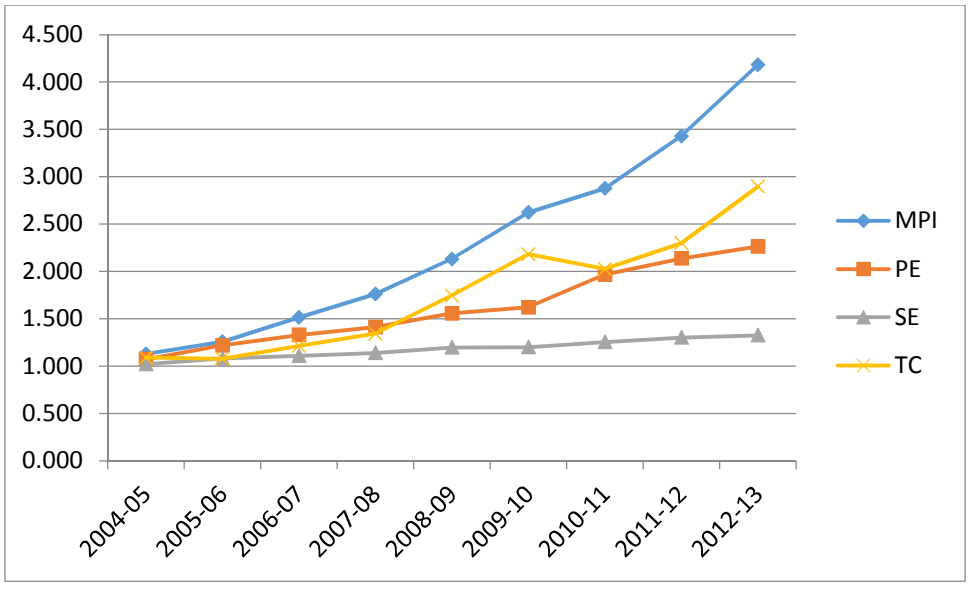


Figure 5.1: Cumulative values of MPI and it components

5.2.3 Determinants of WCM Efficiency Change

The next part of the analysis focuses on examining the associations between change in various firm-specific variables and MPI components pure technical efficiency (PE) and scale efficiency (SE). The variables used were the same as used while analysing determinants of WCM efficiency in chapter 4. However since the analysis is for determinants of change in WCM efficiency (and not WCM efficiency itself) therefore change in values of variables in subsequent years were used as independent variables. In other words, the difference between value of variables in previous year and this year were used. Thus the independent variables used are, age change (AGEC), size change (SIZC), change in fixed assets to total assets ratio (NFAC), debt change (DEBC), change in sales growth (SLGC), change in cash and bank balance to total Assets (CASC) and change in return on assets (ROAC). Since change in age of firm will always be one year therefore this variable (AGEC) was eliminated from the analysis. The dependent variables used were MPI, PE and SE of the current year.

Graphical Analysis

In the first step graphical/visual analysis was carried out to get an idea of the overall cause of change in WCM efficiency. In this the data of all industries were pooled and was sorted in increasing order of each independent variable (average value). e.g. the firms were sorted in order of lowest average increase in size to highest average increase in size. The firms were then divided in to deciles (10 parts) and average values of cumulative PE and SE were calculated for each decile. These average values for each decile were plotted on graph. Figure 5.2 to Figure 5.7 depict the various relationships.

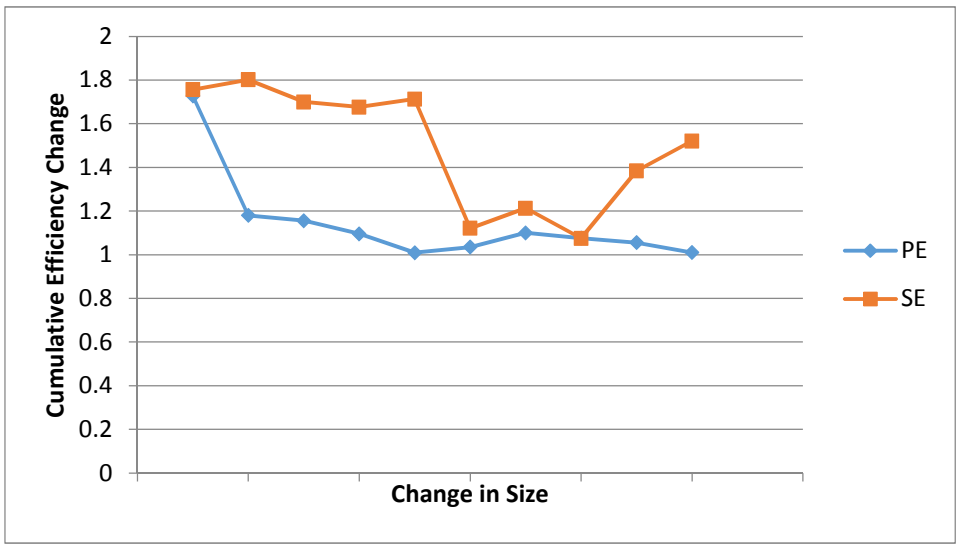


Figure 5.2: Relation between efficiency change and change in size

Figure 5.2 shows the relationship of PE and SE with change in size of firm. It can be observed that overall there seems to be a negative relation of change in size with both PE and SE. The relation of change in size with scale efficiency change is not very clear although there has been drop in cumulative SE 1.8 to 1.1 in the first 8 years. Similarly in case of PE the cumulative values have shown an almost continuous decline from 1.3 to 1.0. Thus it can be inferred that as there is increase in size of firms, the increase in pure and scale efficiencies decline.

Figure 5.3 shows the relationship of PE and SE with change in proportion of net fixed assets. The graph shows that there is no clear trend in relationship but the overall the PE graph shows an upward drift. This indicates that as there is increase in proportion of fixed assets, the efficiency of firms also improves. The scale efficiency also shows that an overall upward shift but the trend in not consistent. This indicates that an increase in NFA improves the scale efficiency but the relationship is not consistent.

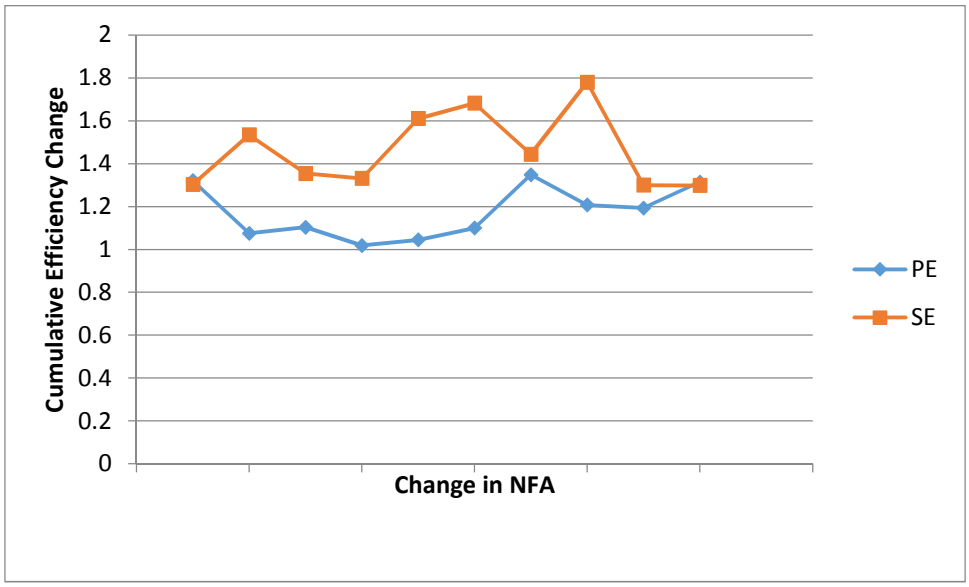


Figure 5.3: Relation between efficiency change and change in proportion of fixed assets

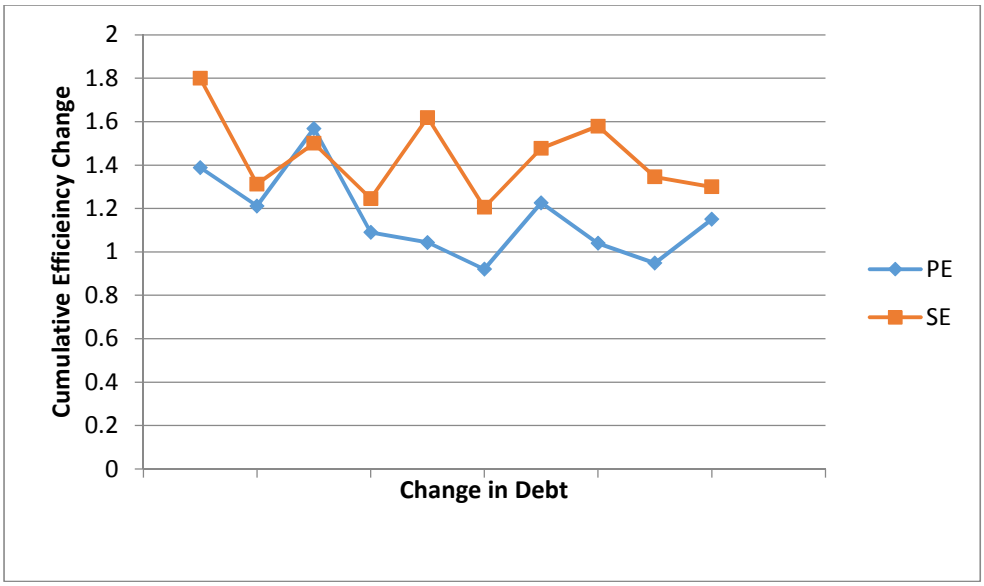


Figure 5.4: Relation between efficiency change and change in debt

Figure 5.4 shows the relationship between change in debt and cumulative change in efficiency. From the figure it is clear that although the trend is more prominent in PE, both PE and SE have shown a downward trend. This shows that as there is increase in debt, efficiency gets hampered. Thus firms which on an average have lower increase in debt are able to improve the WCM efficiency more than those which experience higher increase in debt during the same period.

Figure 5.5 shows the relationship between change in growth rate of sales and the WCM efficiency change (PE and SE). The figure does not show any clear trend and both PE and SE plots remain at more or less same position. Thus the graphical analysis is not able to predict any explicit relationship between efficiency change and change in sales growth.

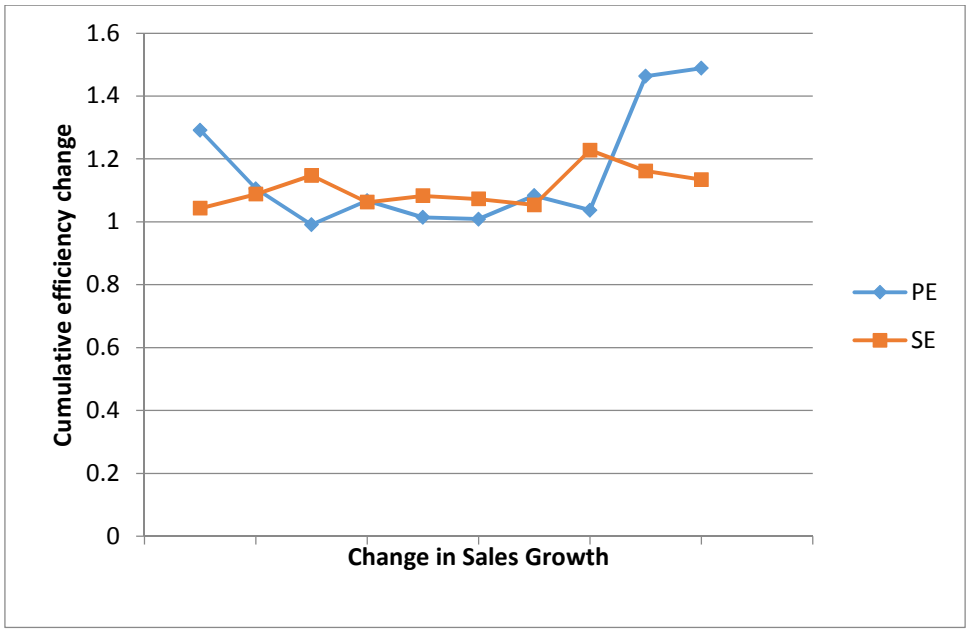


Figure 5.5: Relation between efficiency change and change in sales growth

Figure 5.6 shows the relationship between change in cash holdings and WCM efficiency change. The graph presents a somewhat upward trend in both PE and SE with increase in cash holdings change. This indicates that firms with higher increase in cash and bank balances experience a higher increase in both pure and scale efficiency over the period. For PE the cumulative value is around 1.0 for low average cash holding firms as against around 1.4 for high holdings. The increase is not considerable but suggests that there is slight improvement of 15-20% in WCM efficiency over a period of 10 years in those firms which increase their cash and bank balances.

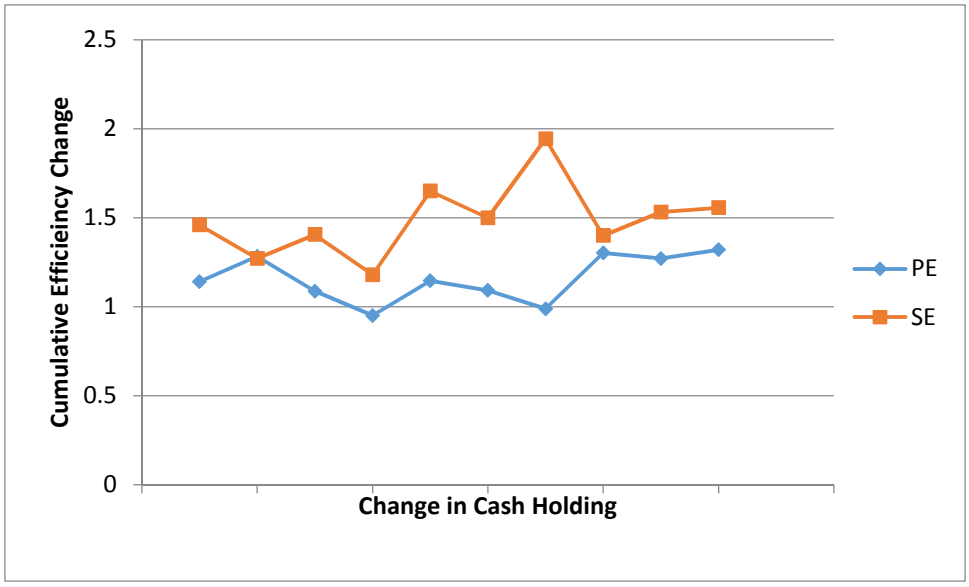


Figure 5.6: Relation between efficiency change and change cash holding

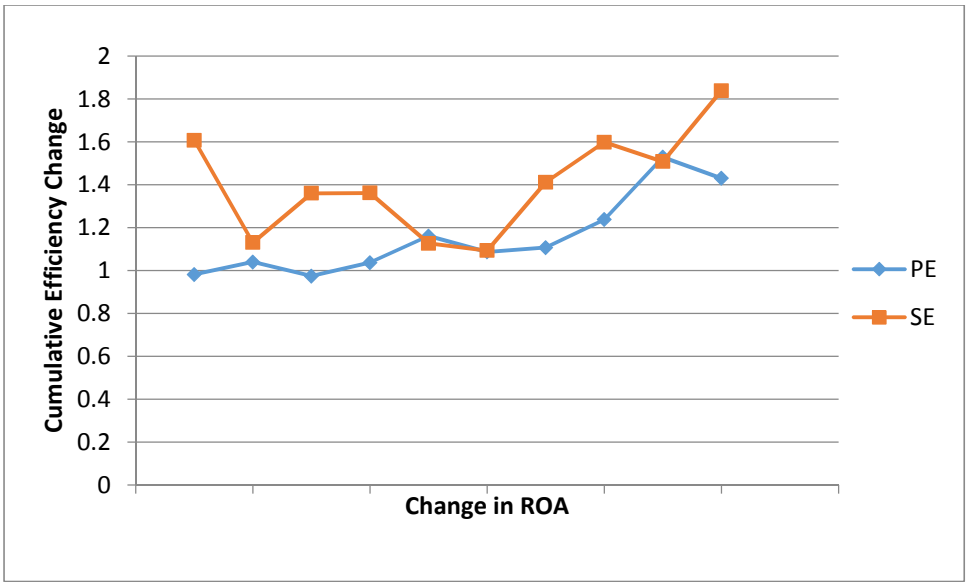


Figure 5.7: Relation between efficiency change and change in ROA

Figure 5.7 shows the relationship between change in ROA and cumulative change in WCM efficiency. The plots of both PE and SE show a clear upward trend indicating a significant increase in efficiency change with increase in return on assets. The relationship shows that firms which experience a higher increase in ROA are also able to increase their WCM efficiency more and this is true for both pure technical and scale efficiency.

The graphical analysis presents an overall idea of the type of relationships between change in various variables and change in WCM efficiency. The next subsection of the study carries out statistical analysis in order to confirm these observed relationships.

Statistical Analysis

The relationships inferred from the graphical analysis were further examined using the statistical analysis in this section for confirmation. Similar to the analysis in chapter 4, here too the data is in the form of panel data. Therefore panel data regression analysis is applied to examine the relationship of MPI, PE and SE with the various firm-specific factors i.e. size change (SIZC), change in fixed assets to total assets ratio (NFAC), debt change (DEBC), change in sales growth (SLGC), change in cash and bank balance to total assets (CASC) and change in return on assets (ROAC). In addition macro-economic factors i.e. change in GDP growth rate (GDPC), change in interest rate (INTC) and change in inflation rate (INFC) were also tested for possible influence on MPI and its components PE and SE.

Hausman test was applied and it was found that the probability value was less than 0.05 indicating that the fixed-effect model was most suitable (macroeconomic variables needed to be

removed from the model to apply Hausman test since the test failed because of cross section test invariance). The correlation matrix was obtained to check for problem of multicollinearity in the model. Table 5.3 shows the correlation table. A correlation value of above 0.5 or below -0.5 indicates high correlation and can cause multicollinearity problem. It was found that there is high correlation between GDPC and INFC (0.690). It was therefore necessary to remove one of the variables to remove the problem. INFC was therefore removed from the analysis and only two macroeconomic variables GDPC and INTC were used in the model. The variance inflation factors were calculated for the remaining variables for each model (dependent variable MPI, PE and SE) to check for any further multicollinearity problem. Table 5.4 shows the VIF values and it can be observed that the VIF values are well below the danger zone of 10. This confirms that the model is free from any multicollinearity problem. GLS weights with cross section weights were used in the model to avoid heteroscedasticity problem.

Table 5.3: Correlation table of independent variables

Correlation	CASC	DEBC	NFAC	ROAC	SIZC	SLGC	GDPC	INTC	INFC
CASC	1								
DEBC	-0.029	1							
NFAC	-0.184	0.044	1.000						
ROAC	0.052	-0.467	-0.057	1.000					
SIZC	0.083	0.046	-0.136	-0.027	1.000				
SLGC	-0.007	-0.005	-0.005	0.027	0.086	1.000			
GDPC	0.039	-0.022	-0.058	0.042	0.113	0.014	1.000		
INTC	0.017	0.008	-0.075	0.017	0.102	0.021	0.364	1.000	
INFC	0.009	-0.027	-0.047	0.040	0.060	0.027	0.690	-0.200	1

Table 5.4: VIF values for regression model

	MPI	PE	SE
CASC	1.053	1.066	1.040
DEBC	1.292	1.285	1.263
NFAC	1.074	1.091	1.096
ROAC	1.297	1.297	1.239
SIZC	1.110	1.121	1.177
SLGC	1.049	1.050	1.069
GDPC	1.170	1.178	1.182
INTC	1.169	1.175	1.170

Thus the regression model used was

$$Efficiency\ Change = \alpha + \beta_1 CASC + \beta_2 DEBC + \beta_3 NFAC + \beta_4 ROAC + \beta_5 SIZC + \beta_6 SLGC + \beta_7 GDPC + \beta_8 INTC + e$$

The model was named *Mod 3* for reference.

MPI, PE and SE were used as dependent variable as measures of Efficiency Change.

Table 5.5 shows the results of the analysis for the regression model with MPI, PE and SE as dependent variables.

Table 5.5: Results from regression *Mod 3*

	MPI		PE		SE	
Independent Variable	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
CASC	0.808	0.000	0.378	0.000	0.004	0.741
DEBC	-0.139	0.000	-0.141	0.000	-0.017	0.019
NFAC	0.211	0.000	0.256	0.000	-0.015	0.088
ROAC	0.214	0.000	0.016	0.499	0.036	0.000
SIZC	-0.337	0.000	-0.183	0.000	-0.009	0.021
SLGC	0.214	0.000	0.079	0.000	0.009	0.000
GDPC	-1.121	0.000	0.172	0.205	-0.049	0.160
INTC	-3.355	0.000	3.706	0.000	-0.022	0.840
C	1.308	0.000	1.116	0.000	1.070	0.000
Adjusted R-squared Values	0.123		0.010		0.054	
Durbin-Watson Statistics	2.367		2.478		2.498	

From Table 5.5 it can be observed that the Durbin Watson statistics in all the three cases were around 2.4. This value is somewhat high but is still within the required range of 1.5 - 2.5. Therefore it can be safely assumed the all the three regressions are free from problems of autocorrelation.

The adjusted R-squared values were on the lower side with the maximum value of 0.123 for MPI and minimum of 0.01 for PE. The low value of adjusted R-squared for PE suggests that change in pure efficiency is caused by improvement in technical process of the firms and only slightly affected by other exogenous factors. The adjusted R-squared value in case of SE is slightly higher at 0.05 which suggests that change in scale efficiency is more effected by the selected determinants in comparison to change in pure efficiency. The result is on expected lines because the scale of operations may be more affected by various internal and external factors in comparison to pure efficiency which mainly reflects the efficiency of the management and is generally less affected by outside factors.

Table 5.5 also shows the coefficients of various independent variables along with their probability values. The coefficients which were found to be significant at 95% confidence interval have been highlighted. The sign of coefficients indicates whether there is negative or positive relation with the dependent variable. However, the direction of relationship is important only if the variable is statistically significant in the model.

In case of MPI, it was found that all the independent variables were significant. The variables CASC, NFAC, ROAC and SLGC were found to have a positive relationship with MPI whereas DEBC, SIZC, GDPC and INTC exhibited negative relationship. The direction of the relationships of firm-specific variables was same as those found in previous chapter (in the analysis of WCM efficiency determinants).

In case of PE not all the variables were found to be significant. While CASC, NFA, SLGC and INTC were found to be positively related to PE, in contrast, DEBC and SIZC exhibited negative relationship. ROAC and GDPC were not found to be statistically significant (at 95%). The variables that were significant in the model exhibited same direction of relationship as in case of MPI.

Only four variables were significant in case of SE. ROAC and SLGC exhibited positive relationship whereas DEBC and SIZC showed negative relationship. CASC, NFAC, GDPC and INTC were found to be insignificant.

Overall following can be inferred about each independent variable:

Change in cash has positive influence on overall change in WCM efficiency. The effect is however statistically significant only in MPI and PE. Both graphical and regression analysis suggests that when firms experience higher increase in cash holdings, there is an accelerated increase in working capital management efficiency. This is consistent with the earlier findings in chapter 4 where a positive relationship was observed between WCM efficiency and cash holdings. Since current assets such as inventory and receivables are liquid alternatives of cash therefore it is expected that firms which increase their cash may decrease their investment in other current assets. This would result in a greater increase in WCM efficiency if the sales and cash flow from operations remain same. However its effect on improvement in scale efficiency was not found to be significant.

Change in debt exhibited negative effect on WCM efficiency change and the variable was foun to be significant in MPI along with its constituents PE and SE. The graphical analysis suggested a negative relation and this was confirmed by the results of regression analysis. The

results suggest that increased use of leverage may lead to negative change in WCM efficiency. This is consistent with the earlier results where a negative relationship between WCM efficiency and leverage was observed. Since increase in debt increases the risk exposure of firms therefore if there is a large increase in debt then such firms would try to reduce other risk exposures. Such firms would like to maintain sufficient liquidity and may not push for increase in current liabilities or for reduction in current assets. Thus the efficiency of WCM in such firms may show sluggish improvement. Although it is expected that firms which take higher debt may exhibit improvement in scale of operations due to larger availability fund. However, SE exhibited a negative relation with debt change, which suggests that higher scale of operations is not translating into higher scale efficiency in this case.

Change in net fixed assets exhibited a positive relationship with change in WCM efficiency. The results from the graphical analyses suggested the existence of somewhat positive influence of NFAC on PE and inconsistent effect on SE. The regression confirmed these results since NFAC was found to have significant effect on MPI and PE but insignificant effect on SE. This suggests that increased investment in fixed assets does not necessarily improve the scale of operations towards the optimal level. The results indicate that when there is large increase in fixed assets, firms may experience shortage of funds and thus forced to reduce their investments in current assets and increase their dependence on current liabilities. Hence it may lead to increase in efficiency of WCM due to reduction in net current assets. The results are also in line with the results obtained in chapter 4 where a negative relationship between debt and WCM efficiency was observed.

Change in ROA was found to have a positive influence on WCM efficiency change. The graphical analysis exhibited a strong positive relation of 'ROA change' with PE and SE. However in regression analysis ROAC was found to be significant only in case of MPI and SE. It was expected that an increase in ROA suggests increase in overall efficiency in asset utilisation and thus would lead to higher cumulative increase in pure efficiency. The results however show that though overall efficiency change is positively affected by an increase in ROA but PE remains insignificantly affected. Improvement in ROA was found to significantly improve the scale efficiency, indicating that improvement in ROA enables the firm to increase its scale of operations towards the optimal level.

Change in size exhibited negative effect on the WCM efficiency change. The effect was evident from the graphical analysis and was also confirmed statistically by the regression analysis. This suggests that when there is large increase in size of firm, it has negative effect on

the increase in WCM efficiency. This phenomenon may be due to the fact that as firm increase in size they become less aggressive in managing liquidity. The results from chapter 4 also exhibited similar relationship where size was found to have negative effect on WCM efficiency. As stated earlier, as a firm becomes larger its objective may change from aggressive management of funds to increasing of market share and attainment of market leadership. A large firm may have sufficient financial stability and thus can keep large stocks of inventory for future demands and ready availability of products. It may also not mind extending large and longer credit to customers to maintain its market share and leadership. It was expected that an increase in size would positively affect the scale of operations and thus would have positive effect on scale efficiency. However the results show that SE too gets negatively affected when there is an increase in size of firm.

Change in sales growth exhibited a positive relation with WCM efficiency change. The graphical analysis suggested that firms that have higher increase in sales growth experience higher increase in WCM efficiency. The regression analysis confirmed that an increase in sales growth rate positively influences MPI along with PE and SE. The results are on expected lines since the increase in sales growth would increase the sales of firms. This would result in higher WCM efficiency if the level of current assets and liabilities remain same. Increase in sales growth creates high expectation for future sales and the firm may thus try to make maximum use of its limited resources by pushing the suppliers in giving more credit in order to scale up operations. Moreover, an increase in sales growth increases confidence of suppliers as they feel more assured in lending to such firms. Thus change in both technical and scale efficiencies are positively affected by increase in sales growth.

Similar to the results obtained in chapter 4, none of the variables showed consistent effect in case of macroeconomic variables. Change in GDP exhibited negative effect on MPI but in case of PE and SE it was found to be insignificant. Moreover the direction of the relationship was also inconsistent. Thus the effect of GDP change on WCM efficiency change cannot be stated with confidence. Similarly change in interest rates was found to have negative influence on MPI but exhibited positive effect on PE and was found to be insignificant in case of SE. The impact of interest rates are thus also not clear from the analysis.

5.3 Section B - Linkages between WCM efficiency and firm performance

5.3.1 Introduction

Improvement in efficiency of management is beneficial only if it gets translated into improved performance. Similarly, any improvement in the efficiency of working capital management must result in improved firm's performance. Since it has been established that manufacturing technology intensity and its structure affect a firm's performance (Gupta et al., 1997), therefore it is also expected that as firms become more efficient in managing working capital, they would perform better and this would be evident in their financial results and stock returns.

In this section the focus is on examining the association between the WCM efficiency measures and firm's performance measures. It is clear from the analysis in chapter 2 that there are very few studies that have explored the relationship between WCM efficiency and financial performance of firms. The studies which tried to examine this have mostly used accounting based ratios as measures of performance. It is necessary to include both market ratios and accounting measures for accurate assessment of a factor's effect on firm's performance (Soana, 2011). Moreover most of the studies have utilised an extremely small sample of firms and thus the results cannot be generalised for the whole industry. Even the results were found to be mixed and contradictory to each other. Although a large number of studies have been conducted using data from other countries but their results cannot be reliably applied to Indian firms. Therefore, this section of the thesis tries to examine if the performance of firm is significantly influenced by the efficiency of working capital management.

5.3.2 Methodology and Analysis

To examine the influence of WCM efficiency, the new DEA based measure (DEA Eff 2) along with the traditional measures were used for approximating WCM efficiency. The results in previous chapters indicated that the characteristics of DEA Eff 1 and DEA Eff 2 do not differ significantly and since DEA Eff 2 had more output variables therefore DEA Eff 2 was chosen for the analysis. Both accounting and market performance measures were used for estimating firm performance.

The following measures were used for assessing the firm's performance:

Return on Equity (ROE): $ROE = (Net\ Profit)/(Book\ Value\ of\ Equity)$

ROE measures the returns earned on investments made by equity shareholders. Its relationship with WCM efficiency would indicate, whether an improvement in efficiency of WCM translates into improved earnings per unit of equity investment.

Return on Sales (ROS): $ROS = (Net\ Profit)/(Net\ Sales)$

ROS is the most common performance measure and it measures the efficiency of firm in generating returns from its sales. Improvement in efficiency of WCM may result in cost savings which may improve the profitability of firm.

Tobin's Q: $TQ = (Mkt\ value\ of\ (Equity + Preferred\ Stock + Debt))/(Total\ Assets)$

Tobin's Q is an indicator of market performance of firm and shows the valuation position. Its relationship with WCM efficiency measures would show whether the improvement in WCM efficiency improves the perceived value of firm by the investors.

Price to Earnings Ratio (PE): $PE = \ (Price\ per\ share)/(Earnings\ per\ share)$

PE is another valuation measure and is an indicator of the perceived value of firm. It is expected that any positive change in the WCM efficiency of firm may improve the investors' perception and hence they may be willing to pay more for each dollar of firm's earnings.

Market Value Added (MVA):
$MVA = (Mkt\ value\ of\ (equity + debt)) - (Book\ value\ of\ (equity + debt))$

MVA is used as proxy for wealth creation/destruction of value. The relationship between MVA and WCM efficiency would indicate whether change in efficiency of WCM affects the wealth creation. It would indicate whether the improved efficiency gets translated into improved market value of firm's assets. MVA deflated by total assets is used in the analysis.

Thus the analysis comprises of two accounting measures of performance, two market performance measures and one wealth creation measure.

To analyse the relationship between various firm performance measures and WCM efficiency measures, regression models were used with WCM efficiency as independent variable and firm's performance as independent variable. In addition few firm specific characteristics were also used as control variables. Separate models were used for each performance measure and for each WCM efficiency measure.

Thus the regression model has the following general form:

$$Firm\ Performance = \alpha + \beta(WCM\ Efficiency) + \gamma \sum (firm\ characteristics) + \epsilon$$

This model is termed as *Mod 4*

Where

α represents intercept.

β represents coefficients of WCM efficiency

γ represents coefficients of control variables and ϵ represents residual error.

Firm performance is measured using *ROE, ROS, TQ, PE* or *MVA*

WCM Efficiency is measured using *DEA EFF 2, CCC* or *NTC*

And firm characteristics comprises of *ln(AGE), ln(Total Assets) and Debt Ratio*

Table 5.6: Regression models for relation between firm performance and WCM efficiency

1	$ROA = \alpha + \beta(DEA\ EFF\ 2) + \gamma \sum (firm\ characteristics) + \epsilon$
2	$ROS = \alpha + \beta(DEA\ EFF\ 2) + \gamma \sum (firm\ characteristics) + \epsilon$
3	$TQ = \alpha + \beta(DEA\ EFF\ 2) + \gamma \sum (firm\ characteristics) + \epsilon$
4	$PE = \alpha + \beta(DEA\ EFF\ 2) + \gamma \sum (firm\ characteristics) + \epsilon$
5	$ROE = \alpha + \beta(DEA\ EFF\ 2) + \gamma \sum (firm\ characteristics) + \epsilon$
6	$ROA = \alpha + \beta(CCC) + \gamma \sum (firm\ characteristics) + \epsilon$
7	$ROS = \alpha + \beta(CCC) + \gamma \sum (firm\ characteristics) + \epsilon$
8	$TQ = \alpha + \beta(CCC) + \gamma \sum (firm\ characteristics) + \epsilon$
9	$PE = \alpha + \beta(CCC) + \gamma \sum (firm\ characteristics) + \epsilon$
10	$ROE = \alpha + \beta(CCC) + \gamma \sum (firm\ characteristics) + \epsilon$
11	$ROA = \alpha + \beta(NTC) + \gamma \sum (firm\ characteristics) + \epsilon$
12	$ROS = \alpha + \beta(NTC) + \gamma \sum (firm\ characteristics) + \epsilon$
13	$TQ = \alpha + \beta(NTC) + \gamma \sum (firm\ characteristics) + \epsilon$
14	$PE = \alpha + \beta(NTC) + \gamma \sum (firm\ characteristics) + \epsilon$
15	$ROE = \alpha + \beta(NTC) + \gamma \sum (firm\ characteristics) + \epsilon$

Since each industry may have different characteristics therefore regression analysis was carried out for each industry separately. In each industry each of the firm performance measure (total 5) was regressed on each of WCM Efficiency measure (total 3) and hence a total of (5x3)15 regression models were applied for each industry. Table 5.6 shows the list of the 15 regression models used in each industry.

The fixed effect regression model was applied in order to examine the effect of only time varying factors. Hausman test was carried out to ensure the suitability of fixed effect model over the Random effect model. For all the regression models it was confirmed through Hausman test that fixed effect model was more suitable. In addition LLC Panel unit root test for regression variable was carried out to test for stationarity of individual data sets. Table 5.7 gives the results of LLC unit root test and shows that all the variables are stationary.

The fixed effect regression model was applied with GLS weights to avoid the problem of heteroscedasticity. Moreover Durbin-Watson statistics was calculated for each of the model to ensure that the problem of autocorrelation is not present. It was found that the Durbin Watson statistics of all models were between 1.5 and 2.5 indicating absence of autocorrelation problem. The adjusted R-squared values and Durbin-Watson statistics is given in Annexure II.

Table 5.7: LLC unit root test results

	Statistic	**Prob.**
MVA	-43.29	0.000
PE	-54.25	0.000
ROE	-41.01	0.000
ROS	-95.55	0.000
TQ	-40.41	0.000
DEA Eff	-61.06	0.000
CCC	-42.95	0.000
NTC	-41.63	0.000

The results of the regression analysis were segregated into three parts with each part showing results of one WCM efficiency measure. Table 5.8, 5.9 & 5.10 show the results for DEA Eff 2, CCC and NTC respectively. In each of these tables coefficient values of WCM efficiency measures are given. The shaded cells represent coefficients which were found to be significant at 95% confidence. Each table also shows the total number of industries in which the WCM efficiency measure was found to be significant (for each performance measure). The interest of study mainly lies in the direction of the relationship. The overall direction of the relationship is confirmed if the direction of relationship is same for more than 5 industries. If less than 5

industries show one direction of relationship then the relationship has been marked as insignificant.

Table 5.8 shows the values of coefficients and direction of the relationship between DEA Eff 2 and various firm performance measures. It shows that the DEA EFF 2 has positive relationship with four out of the five performance measures used. Only in the case of PE, the relationship was found to be insignificant. This shows that both the accounting measures viz. ROS and ROE are positively influenced by WCM Efficiency (as measured by DEA Eff 2). In addition the market performance measure TQ and wealth generation measure MVA is also found to increase with improvement in WCM efficiency. Overall the results of Table 5.8 suggest that the firm performance is improved when there is increase in DEA Eff 2 (WCM efficiency). The results also show that DEA Eff 2 is a good measure of WCM efficiency since it has significant relationship with firm performance.

Table 5.8: Regression results: Firm performance and DEA Eff 2

	ROS	**TQ**	**PE**	**MVA**	**ROE**
Food	0.051	0.458	-1.617	0.395	0.328
Text	0.012	0.046	-6.580	0.148	-0.050
Drug	0.025	0.110	1.453	0.133	0.016
Plas	0.042	0.029	-4.648	0.007	0.028
Chem	0.000	0.028	-0.723	0.068	0.000
Cons	0.040	0.377	0.478	0.240	0.172
Infr	0.007	-0.195	-1.402	-0.013	0.500
Meta	0.003	0.010	-9.363	-0.085	0.102
Mach	0.086	0.406	-0.170	0.456	0.229
Tran	0.011	0.199	7.088	0.201	0.045
Misc	0.074	0.019	-1.058	0.268	0.243
Number of industries in which DEA Eff 2 is significant along with the direction of the relationship					
Sig at 95%	6	7	3	9	5
	+ve 6	+ve 7	+ve 0	+ve 8	+ve 5
	-ve 0	-ve 0	-ve 3	-ve 1	-ve 0
Relation with DEA Eff 2	Positive	Positive	Insignificant	Positive	Positive

Table 5.9 shows the relationship of CCC with various firm performance measures. It can be seen from this table that three out of five performance measures were found be significantly related to CCC. CCC was found to significantly affect ROS, TQ and MVA while its effect on

PE and ROE were inconsistent. Thus one accounting performance measure, one market performance measure and wealth creation measure were found to be significantly affected by CCC. In all these measures the relationships were found to be positive between WCM efficiency and firm performance. The results are similar to the results obtained in Table 5.8 and again suggest that with increase in WCM efficiency there is improvement in returns as well as firm valuation. However unlike case of DEA Eff 2 where ROE exhibited positive relationship with WCM efficiency, the relationship in case of CCC was inconclusive.

Table 5.9: Regression results: Firm performance and CCC

	ROS	**TQ**	**PE**	**MVA**	**ROE**
Food	-5.26E-05	-1.00E-03	3.48E-02	-3.93E-04	6.75E-04
Text	-4.13E-05	-8.41E-06	3.15E-02	-1.22E-04	4.90E-05
Drug	-1.67E-04	7.10E-05	2.26E-03	3.17E-05	-3.99E-05
Plas	-1.12E-04	-8.78E-05	1.50E-03	-2.29E-04	-1.62E-04
Chem	-1.10E-04	-8.80E-06	-6.20E-04	-5.83E-05	-6.97E-05
Cons	-1.70E-04	-1.50E-04	-3.31E-04	-1.47E-04	-1.92E-04
Infr	-1.21E-04	-1.31E-05	-3.29E-03	7.94E-06	-3.18E-04
Meta	-1.37E-04	-4.19E-04	2.50E-02	-9.68E-04	-5.62E-04
Mach	-2.47E-04	-5.37E-04	-7.99E-03	-9.59E-04	-3.41E-04
Tran	-1.41E-06	-6.72E-08	2.34E-04	-9.50E-07	-7.73E-07
Misc	-6.16E-03	9.71E-05	2.27E-04	5.72E-05	8.77E-03
Number of industries in which CCC is significant along with the direction of the relationship					
Sig at 95%	10	5	3	6	6
	+ve 0	+ve 0	+ve 3	+ve 0	+ve 2
	-ve 10	-ve 5	-ve 0	-ve 6	-ve 4
Relation with CCC	Negative	Negative	Insignificant	Negative	Insignificant
Relation with WCM Eff	Positive	Positive	Insignificant	Positive	Insignificant

Table 5.10 shows the relationship between NTC and various firms' performance measures. Here only ROS and MVA showed consistent relationship with NTC and none of the market valuation measure was found to be significantly affected by NTC. The relationship of both of

these measures was positive which again confirms that a positive change in working capital management efficiency does positively affect the firm performance. The results suggest that a positive change in NTC will surely improve the returns and would promote wealth creation but the effect on valuations is not confirmed.

Table 5.10: Regression results: Firm performance and NTC

	ROS	TQ	PE	MVA	ROE
Food	-5.95E-05	5.68E-05	2.08E-02	-2.07E-04	5.16E-04
Text	-2.50E-04	-2.46E-04	-4.93E-02	-1.27E-04	1.51E-03
Drug	-1.27E-04	-9.05E-05	7.58E-03	-1.28E-04	1.90E-04
Plas	-1.09E-04	-2.91E-04	1.34E-02	-6.64E-04	-1.80E-04
Chem	1.79E-04	-8.90E-05	-1.08E-03	-6.81E-04	-3.43E-04
Cons	-1.89E-04	-1.36E-04	-1.94E-04	-1.35E-04	-1.40E-04
Infr	-5.45E-04	-2.66E-04	-4.58E-03	-4.19E-04	-1.11E-03
Meta	-9.12E-05	-3.20E-04	2.82E-02	-1.09E-03	2.85E-04
Mach	-3.14E-04	-1.12E-03	-1.73E-02	-1.87E-03	-9.04E-04
Tran	1.57E-05	-1.20E-04	2.07E-02	-8.92E-05	-1.35E-06
Misc	1.39E-05	8.35E-05	-1.75E-03	1.05E-04	-2.10E-04
Number of industries in which NTC is significant along with the direction of the relationship					
Sig at 95%	7	4	4	7	5
	+ve 1	+ve 0	+ve 3	+ve 1	+ve 2
	-ve 6	-ve 4	-ve 1	-ve 6	-ve 3
Relation with NTC	Negative	Insignificant	Insignificant	Negative	Insignificant
Relation with WCM Eff	Positive	Insignificant	Insignificant	Positive	Insignificant

The overall relationships between the various measures of WCM efficiency and different measures of firm performance are given on Table 5.11. It can be clearly observed that DEA Eff 2 is significantly related to most of the performance measures. In general it can be observed that if a performance measure is significantly related to any of the WCM efficiency, it would be definitely related to DEA Eff 2. The only measure that was not found to be related to any of the WCM efficiency measure was price-earnings ratio. All other performance measures were related to at least one WCM efficiency measure. This gives a clear indication that WCM efficiency does have effect on the performance and valuation of firms and that improvement in

WCM efficiency would to a large extent help in improving the performance and valuation of firms.

Table 5.11: Relationship of WCM Efficiency measures with firm performance

Performance Measure	Efficiency Measure			
	DEA	**CCC**	**NTC**	**Overall**
ROS	Positive	Positive	Positive	**Positive**
TQ	Positive	Positive	Insignificant	**Positive**
PE	Insignificant	Insignificant	Insignificant	**Insignificant**
MVA	Positive	Positive	Positive	**Positive**
ROE	Positive	Insignificant	Insignificant	**Insignificant**

Overall the observations for relationship between WCM efficiency and firm performance can be inferred as follows:

Return on sales (ROS), which is the most commonly used measure to gauge the performance of firms is found to be positively affected by WCM efficiency and most importantly all the measures of efficiency show consistency. A total of 6, 10 and 7 industries were found to have significant relationship of ROS with DEA Eff 2, CCC and NTC respectively. Zariyawati et al. (2009), Sharma and Kumar (2011), Kaur and Singh (2013) and others have found similar results in studies on different industries and countries. The results of the study are robust as three different WCM efficiency measures are tested. The results suggest that an improvement in efficiency of WCM can significantly improve the profitability of firms across most industries.

Return on Equity (ROE) is another accounting based measure which measures the return earned per unit of shareholders' funds. It is found that ROE is more or less significantly related with DEA Eff 2 but is not found to be significantly related to any other WCM efficiency measure. Actually, ROE is found to be affected by CCC and NTC in 5 and 6 industries respectively but the direction of the relationship was found to be mixed and thus no inference could be drawn from these results. In case of DEA Eff 2 ROE was significantly affected in 5 industries and the direction of the relationship was also consistent. This also proves the superiority of the new DEA based measure since the relationships appear to be more consistent. Overall the result indicates that ROE is not significantly affected by WCM efficiency in a

consistent way but roughly there is a positive relationship. The results are similar to those obtained by Danuletiu (2010).

Tobin's Q (TQ) measures the market valuation or market performance of firm and is found to be significantly positively related to two out of the three measures viz. DEA Eff 2 and CCC. TQ was found to be significant in 7 and 5 industries respectively in case of DEA Eff 2 and CCC with all industries suggesting a positive relationship between WCM efficiency and TQ. In case of NTC too, the direction of the relation was same but was significant in 4 out of 11 industries. The overall inference from the results is that with improvement in efficiency of WCM, the market valuation of the firm improves. This indicates that WCM efficiency is valued highly by the investors as they assign more value to firms which efficiently manage their short term assets. Mohamad and Saad (2010) and Vural et al. (2012) obtained results similar to those obtained here.

Price to earnings ratio (PE) is another valuation measure which measures the value assigned by investors in comparison to the earnings of the firm. This is the only performance measure which showed insignificant relationship with all efficiency measures and most industries. Even in the few industries where the relationship was significant, the direction of the relation was mixed. Thus no specific conclusion can be drawn from the results. It is possible that since an increase in WCM efficiency improves both market valuation and earnings, therefore the ratio (market price to earnings) might not undergo significant change and hence the relation of PE with WCM efficiency is found to be inconsistent. Overall in can be inferred that PE is not affected by change in WCM efficiency.

Market Value Added (MVA) is market performance measure and measures the wealth creation by firm. MVA showed significant relationship with all the three WCM efficiency measures and exhibited significant relationship in 9, 6 and 7 industries in case of DEA Eff 2, CCC and NTC respectively. This suggests that an improvement in the utilisation of short term assets aids in wealth creation and improves market valuation of firm. Since MVA is roughly the difference between market and book value of debt and equity, it indicates how much value has been created due to the functioning of firm. It can be inferred here that an improvement in the efficiency of working capital management improves the overall functioning of firms and hence leads to creation of value/wealth and higher valuation by investors.

Overall it can be inferred that an increase in the WCM efficiency is an essential ingredient for improvement in the performance of firm. Both accounting based performance measures and

market valuation based measures exhibit significant relationship with WCM efficiency. In other words not only the firm shows improvement in financial performance but even its perceived value by the investors is improved if the working capital is managed more efficiently. These results while on one hand highlight the significance of efficient management of working capital, at the same time they stress for greater attention to short term funds management by the managers for fulfilling the objective of shareholders' wealth maximisation. Thus Indian manufacturing firms which rank low on WCM efficiency, must pull up their socks and improve their liquidity management process if they aim to compete in the global market.

Present chapter dealt with two aspects of WCM efficiency. In the first section the chapter explored the structure of WCM efficiency change. WCM efficiency change was analysed using MPI and its components PE, SE and TC. It was observed that some of the determinants had influence on only one of the component of WCM efficiency like pure efficiency change or scale efficiency change while others had effect on all components of WCM efficiency. The second section dealt with WCM efficiency's influence on firm's performance. It was observed that most of the measures of firm's performance were significantly improved when there was increase in efficiency of WCM. This indicated that firm's accounting performance, market valuation and wealth creation improves when short term capital is managed efficiently.

CHAPTER 6

ANALYSIS OF CASH HOLDINGS DYNAMICS

Preview

This chapter analyses the dynamics of corporate cash holdings in Indian manufacturing firms. It examines the pattern of cash holdings and compares it with results from previous studies. It analyses the mean reversion property of cash holdings and examines the existence of an optimal cash level. It then models the optimal cash holding level and examines the pattern of deviations from this optimal level. Finally the chapter analyses the impact of change in cash holdings on the market performance of firms.

CHAPTER 6

ANALYSIS OF CASH HOLDINGS DYNAMICS

6.1 Introduction

Modigliani and Miller state that in a perfect financial world, it is irrelevant whether or not firms hold large amounts of cash. This is because in such a perfect scenario, firms can easily raise funds from the markets with almost zero transaction cost as and when required. However, it is known that in reality there are substantial costs involved in raising funds and therefore firms hold some amount of cash to finance their future needs. It thus becomes important to study the cash holdings pattern, its optimal level and its effect on performance of firm.

A number of studies, including Opler et al. (1999), Saddour (2006), Ferreira and Vilela (2004), Lee and Powell (2011), Kusnadi and Wei (2011), Lau and Block (2012), Tong (2014) and others have analysed the cash holding of firms in various countries. These studies mainly examine two aspects: the determinants of cash holdings and the effect of cash holding on the firms' market performance. Few studies like Dittmar (2010) and Venkiteshwaran (2011) examine the adjustment behaviour and the adjustment cost of cash accruals. However, almost all the authors have limited their study to developed economies like USA (Opler et al., 1999), Australia (Lee and Powell, 2011), EMU countries (Ferreira and Vilela, 2004) and France (Saddour, 2006).

Firms from growing economies are expected to behave much differently than those of developed economies due to different macroeconomic dynamics, unreliable corporate governance (Saibaba and Ansari, 2011& 2013) and corruption (Saha and Gounder, 2013). However, very few studies have been conducted on firms from such countries to study the cash holding pattern and its implications. Xingquan and Jie (2007), Yifeng et al. (2008) and few others have analysed corporate cash holdings in China but the Chinese economy has moved ahead of most other growing economies and thus Chinese firms may operate much differently in comparison to firms from other developing economies.

A few studies have also found that cash holdings and their pattern differ from country to country. Ferreira and Vilela (2004) compared the cash holdings across a number of EMU (Economic and Monitory Union) countries. They found that capital market development and investor protection provisions do significantly affect the cash holding levels. Drobetz and

Grüninger (2007) too proved that cash holding patterns significantly vary across countries and found that Swiss firms hold about twice the level of cash as held by US and UK firms. Kusnadi and Wei (2011) have found evidence that corporate cash holding in countries where investor legal protection is weak differs from those where it is strong. The results of Ferreira and Vilela, Drobetz and Grüninge and Kusnadi and Wei suggest that the cash holding models applicable to firms of one country has little applicability in other countries since the market development and law enforcement scenarios differ. The results from these studies suggest that the cash holding pattern of firms from developing countries like India which is still in early stages of corporate governance (Arya et al., 2006) (Kumari and Pattanayak, 2014a and 2014b) may differ from pattern of other countries and hence there is need to examine the same. It is therefore important to study the cash holding practices, their dynamics and impact in the Indian scenario.

This chapter focuses on analysing the corporate cash holdings in Indian firms. The study first examines the cash holding levels in Indian manufacturing firms. It then investigates for evidences of mean reversal and proof of existence of a target/optimal of cash. The study then models and estimates the optimal level of cash holdings and analyses the pattern of deviations from this optimal level. In addition, the impact of cash holding and excess cash holdings on the market performance of firm is analysed.

6.2 Descriptive Statistics

The study is focused on manufacturing sector firms because according to Venkiteshwaran (2011), investment friction is more relevant in such firms. The sample was same as that used in earlier chapters and comprised of all those firms whose data were available for all the 10 years (2004-2013). However due to unavailability of market data and missing values in some of the variables the sample size had to be reduced. After cleaning the data for outliers 924 firms were left in the sample, thus there were a total of 9240 (924 x 10) observations. Table 6.1 exhibits the descriptive statistics of the cash holdings in pooled sample.

Table 6.1: Descriptive statistics of cash holdings

	Minimum	Maximum	Mean	Median	Std. Dev.
Cash/Assets	0.00	0.78	0.04	0.02	0.06

It can be seen from the above table that the mean value of cash holdings in sample firms is 4%. This is much lower than the values reported by Venkiteshwaran (2011) and Dittmar and Mahrt-Smith (2007) who reported mean values of 19% and 22% respectively. Similarly the median

value in the sample is 2% which is considerably lower than those reported by the above studies (9% and 6% respectively). Ozkan and Ozkan (2004) too reported mean cash holding of 9.9% and the median value to be 5.9%. It is felt that this difference is due to differences in the macroeconomic environment. Previous studies had used samples of US and UK firms while this study considered a sample of Indian firms and it is known that the economic environment differs vastly. Moreover, Indian firms rank high in the Global Manufacturing Competitiveness Index (GMCI) and high competitiveness may be one of the other reasons to keep low operating cash so that more investment can be made in expansion activities. Another reason may be that in comparison to developed economies, interest rates are significantly higher in India making it more expensive to hold cash. Any combination of the above reasons may be responsible for holding of significantly lower cash by Indian manufacturing firms in comparison to their counterparts in USA and other developed countries.

Two major theories explain the cash holdings by firms. The trade-off theory states that there are costs and benefits of holding cash. Firms adjust their cash holdings such that they are able to maximize the benefits and minimize the costs. On the other hand, the pecking order theory states that the cash holding level is just the result of investment and financing decisions. Therefore according to the theory, the preference/choice of firms (among sources of funds) governs the cash holdings.

A few authors like Venkiteshwaran (2011) have suggested that firms have been found to follow a target cash level. This cash level is the level at which the firms are most comfortable and if there is any deviation from this level, the firms try to bring their holdings back to this target. This phenomenon of bringing the cash holdings back to its target level by reducing deviations is known as mean reversion.

6.3 Mean Reversion Property of Cash Holdings

Ozkan and Ozkan (2004) surveyed UK firms and found evidence that firms' responses to changes in cash holdings are dynamic in nature and they try to readjust their cash accruals towards a target level. This was an important outcome as it proved that there is a target optimal level of cash accruals which the firms try to achieve by adjusting their holdings. García-Teruel and Martínez-Solano (2008) used a sample of SME firms in Spain and found that the firms have a target level of cash to which they try to converge. Dittmar (2010) also found evidence in support of a target level of cash and found that the speed of adjustment shows a large dispersion across firms. Venkiteshwaran (2011) also studied US firms and found that firms'

behaviour is somewhat consistent with trade-off theory. He estimated that firms dynamically correct deviations from their target cash levels and a typical firm eliminates the gap in two years. Lee and Powell (2011) investigated cash holdings in Australian firms and found evidence that the trade-off model is able to explain the level of cash holdings in firms. Recently Tong (2014) also analysed US firms and found that firm maintain a target level of cash holding and that there is evidence in support of the trade-off theory. There is no such study in the Indian context and hence there is need to investigate whether such behaviour of targeted cash holding is exhibited by Indian firms.

This phenomenon was investigated in this study by analysing the holdings for tendency to return to a target level, i.e. whether there was any proof of mean reversion. For this, the method given by Venkiteshwaran (2011) was followed. The sample firms were sorted into deciles of cash holdings (from low to high cash holdings) each year. Thereafter, change in cash holdings in subsequent years for each decile was observed i.e. the percentage change in cash holding from last year was measured. Mean and median value of this change was calculated for each decile of cash holdings and was plotted on graph as shown in Figure 6.1.

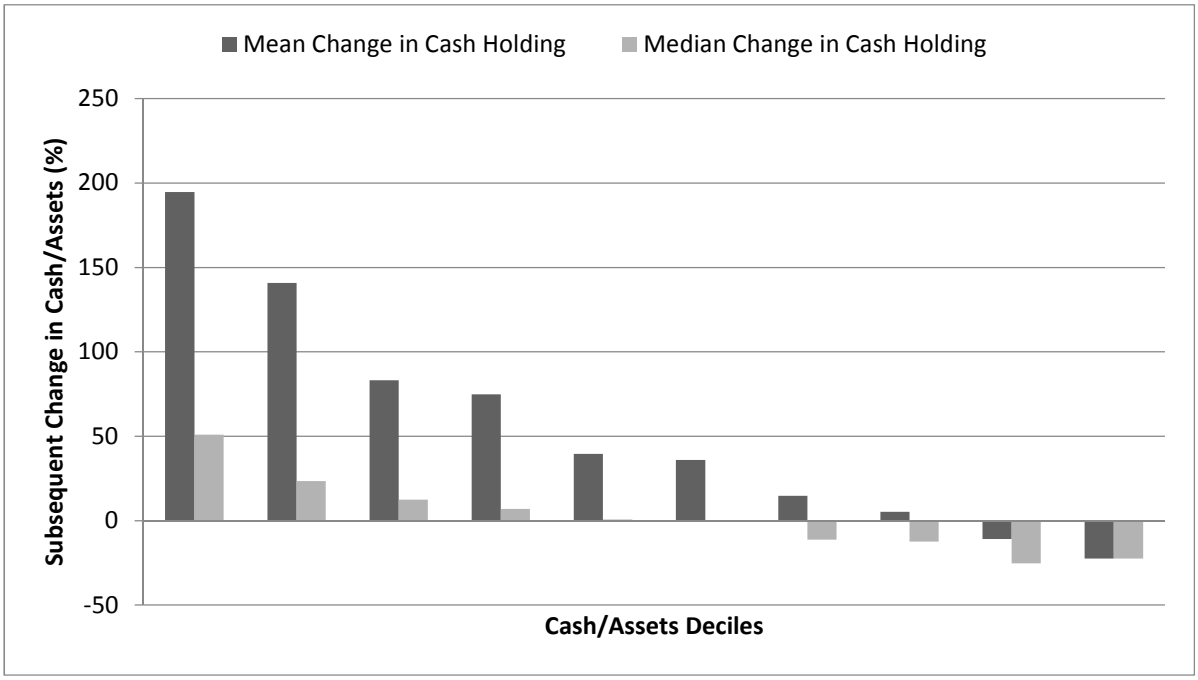


Figure 6.1: Change in cash holdings in the subsequent year

In Figure 6.1, the Y-axis represents the percentage change in cash holding and X-axis represents deciles of cash holdings in increasing order. It can be observed from the graph that firms with lower levels of cash holdings tend to increase their cash holdings in subsequent years whereas firm with high levels try to decrease it. The quantum of subsequent increase in cash holdings declines as one moves along the x-axis and in the last few deciles of cash

holdings the change is negative, i.e. the cash holdings decrease. Overall, firms which have lower than average cash holdings tend to increase their cash holdings in subsequent year while those which hold higher than average cash tend to reduce it. The figure also shows that the firms in fifth and sixth deciles do not change their holding in next year. This may be because their holdings are approximately equal to the desired level of cash holdings. This clearly indicates that firms try to readjust the cash holdings to a target level (which may be near about the average cash holdings). In other words, if the cash holdings deviate from the target level, the firms attempt to correct the same in subsequent years by increasing or decreasing the holdings.

It can also be observed from the graph that percentage change in cash holdings is higher in firms with low cash holding levels as compared to firms with high levels of holdings. This indicates that firms which fall short of target cash holdings put more effort in reducing the deviations in next year than those firms which have excess cash. This might suggest that firms are more concerned when they have lesser cash in comparison to when they have excess cash.

The result from graphical analysis is further examined by employing an auto regressive statistical model. Here, absolute value of "change in cash holdings' is regressed on its lagged value (previous year). The model used is given below:

$$\Delta Cash\ Holding_t = \alpha + \beta\ \Delta Cash\ Holding_{t-1} + \varepsilon$$

α represents intercept, β represents coefficient of independent variable ε represents residual error. The cash holdings are measured by cash divided by total assets. As in earlier chapters panel data fixed effect model is employed to control the effect of change in cross section and to only concentrate on time varying effect. The results are shown in Table 6.2.

Table 6.2: Test results for mean reversion property of cash holdings

Dependent Variable: Change in Cash Holding				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Lagged Change in Cash Holding	-0.352	0.011	-32.501	0.000
Constant	0.000	0.000	4.087	0.000
Adjusted R-squared	0.070			

The results shows in Table 6.2 were very similar to those of earlier studies, especially Venkiteshwaran (2011) and Opler et al. (1999). It is observed that the coefficient of lagged cash holding is negative and significant, indicating that the firms try to reverse the changes in

cash holding to bring them to a target level. It can be inferred that cash holdings have mean reversion property. As the cash holdings deviate from a perceived optimal level, firms try to reverse the change and bring it back to that level. Thus the change in cash holdings is found to negatively affect the future change in holdings. This means that if a firm's cash holdings increased in a particular year, then in the next year it will try to reduce the holdings to bring it back to its desired level and vice versa.

Overall, the above results show that firms which have lower levels of cash in a particular year try to increase their cash holding in the subsequent year while firms with high levels try to reduce them. The percentage increase in accruals (in the subsequent year) tends to reduce as the level of cash holdings increases. According to the trade-off theory, firms try to balance the cost and benefits of holding cash. This means that there is an optimal level of cash holding which is targeted by firms. The firms are thus aware of the optimal level of cash accruals and consciously try to reduce deviations from this target level. It suggests that firms adjust their cash levels in order to balance the costs and benefits associated with the cash holding and thus support trade-off theory.

6.4 Optimal Cash Holdings

After having established that firms try to bring their cash holding to a target level, there is need of a model to estimate the optimal values of cash holdings in Indian manufacturing firms. Opler et al. (1999) were one of the first to study the cash holding pattern of firms and examined both determinants and implication of cash holdings. They found that there is no clear cut distinction between the trade-off theory and pecking order theory, but there is some evidence in support of the trade-off theory model. They also state that firms having higher growth opportunities and uncertain cash flows hold comparatively higher level of cash. Faulkender (2002) studied small firms in USA and found that firms having high debt tend to have high cash holdings mainly for preventive purposes. They also found that older firms tend to hold more cash and increase in size of firms leads to decrease in cash holdings. Almeida et al. (2004) analysed the cash flow sensitivity of cash in US manufacturing firms over the period 1971-200 and found that cash holdings of financially constrained firms increase when increment in cash flows.

Saddour (2006) studied the determinant of cash holdings in French firms by dividing firms into two groups namely growth firms and mature firms. They argued that since cash facilitates firms to undertake profitable projects therefore firms which need to grow would behave differently than the mature ones. Their results show that both pecking order and trade-off theory play

significant roles in explaining the cash holding and that size, liquidity and short term debt do affect the cash holding levels. Further, Bates et al. (2009) found that precautionary motive is successful to a large extent in explaining the levels of cash accruals. They found evidence that reduction in inventory levels and the volatility in cash flows explain increase in cash holdings.

Thus a number of studies have tried to model the optimal cash holdings in developed economies and have used a number of variables for the same. Taking clues from the past studies such as those by Opler et al. (1999), Saddour (2006), Venkiteshwaran (2011) and others, the following variables were shortlisted to analyse their effect and to model the optimal cash holding levels.

Cash flow (CF):

Cash flow= Net cash flow from operations/Total Assets

It is expected that an increase in cash flows would lead to increase in availability of cash to firm and therefore may result in increased cash holdings. However, the trade-off theory states that additional cash flows can be used as a substitute for cash holding for making investments and therefore should have a negative relationship with cash holdings. Hence there can be two opposite effects of cash flows.

Leverage (DEB):

Leverage = Total Debt/Total Assets

There can also be two opposite effects of leverage. Leverage increases financial discipline since it discourages hoarding of cash by firms through strict monitoring. On the other hand, leverage can increase the probability of financial distress to firms, driving them to hold large amounts of cash to reduce risk. The pecking order theory states that there should be negative relation between debt and cash holdings since a firm is expected to use debt funds only after it has exhausted its own holdings.

Net Working Capital (NWC):

Net working capital = (Current Assets – Current Liabilities)/Total Assets

Liquid assets can easily be converted into cash and so it is expected that firms which keep large amount of net current assets or have higher liquidity would keep less cash. Therefore there should be a negative relationship between the cash and liquid assets substitutes of cash.

Receivables (REC):

Receivables = Debtors/Total Assets

Receivables are often seen as substitutes to cash, therefore a firm having high level of receivables is expected to keep lesser amounts of cash since it anticipates cash inflows on maturity of receivables. Thus, a negative relationship is expected between the amount of receivables and cash accruals.

Demand Shock (SLSCHNG):

Demand Shock = Lagged mean change in net sales (basis points)

Demand shock was measured using the lagged median change in sales. It is expected that a firm with more demand shocks will not be able to accumulate large amounts of cash. Therefore, a negative relationship between the two is expected.

Size (SIZ):

Size = *ln* (Total assets)

Size was measured by the natural log of total assets. For small firms it is relatively more difficult and expensive to raise funds as and when required, in comparison to larger firms which have easier access to funds. Thus small firms are expected to hold more cash for precautionary purpose. Moreover, large firms may have a lower probability of financial distress because of diversification and thus may keep lesser cash. Thus, a negative relationship between cash holding and size is expected.

Growth Opportunities (PE):

Growth Opportunities = Price to Earnings Ratio

Price to earnings ratio (PE) can be used as a proxy for growth opportunities (Goyal et al., 2002). Firms with higher growth opportunities have to incur higher cost of cash shortage because of costs associated with lost opportunities. Moreover, Ferreira and Vilela (2004) point out that “firms with better investment opportunities have greater financial distress costs because the positive NPV of these investments disappears”. It is therefore expected that the firms having higher growth opportunities will keep large amounts of cash and thus there should be positive relation between PE ratio and cash holdings.

Table 6.3 shows the descriptive statistics of the variables described above which have been used to model the optimal cash holdings.

Table 6.3: Descriptive statistics of cash holding determinants

	Minimum	Maximum	Mean	Median	Std. Dev.
Cash Flow/Assets	-2.42	15.08	0.14	0.13	0.20
Net Working Capital/Assets	-0.92	0.75	0.05	0.06	0.20
Debt/ Assets	0.00	0.95	0.38	0.34	0.45
Log Total Assets	1.48	14.97	7.65	7.54	1.78
Receivables/Assets	0.00	0.87	0.19	0.17	0.13
Lagged mean change in sales	-0.747	27.67	0.178	0.146	0.478
Price Earnings Ratio	-29.29	97.98	10.67	7.38	14.69
Number of Observations	9240				

Initially graphical analysis was carried out to understand the relationship of cash holdings with various firm characteristics. For each year the sample firms were sorted into deciles of cash holdings (from low to high cash holdings). Mean and median values of the various determinant variables were calculated for each decile of cash holding and plotted them on a graph. That is mean and median values of debt, cashflow, net working capital etc. were calculated for each decile of cash holding and a graph was plotted showing these median and mean values for each decile. All the graphs plotted didn't show a significant trend and only those graphs which exhibited some noticeable trend are presented here. Figure 6.2 shows three plots - (a) to (c), each of these has deciles of cash holdings (cash/assets) in increasing order on the x-axis, i.e. moving from left to right, cash/assets increases.

From Figure 6.2 we can see that as cash holdings increase, net working capital levels also increase. This indicates that firms which keep large cash accruals also like to have a large amount of current assets and small amount of current liabilities, i.e. they prefer higher liquidity.

Cash flow also shows an increasing trend with an increase in cash holdings. This is consistent with the results of earlier studies and indicates that firms having higher cash flows are likely to hold higher amounts of cash.

Price to earnings ratio also shows a somewhat upward trend. This signifies that investors expect higher growth from firms that hold more cash and consider them for attractive investments.

To obtain a statistical model for calculating the optimal level of cash holdings and to estimate the relationship of various variables with the cash holdings, regression analysis was employed.

The model employed was:

$$Cash/Assets = \alpha + \beta_1 Cashflow/Total\ Assets + \beta_2 Borrowings/Ttal\ Assets + \beta_3 NWC/Total\ Assets + \beta_4 Receivables/Total\ Assets + \beta_5 LaggedMedianSales/Total\ Assets + \beta_6 Ln(Total\ Assets) + \beta_7 PE\ Ratio + \epsilon$$

A correlation analysis of independent variables is necessary to ensure that the model is free from the problem of multicollinearity. Table 6.4 shows the correlation between the independent variable used in model. It can observed that no two variables have correlation value of more than 0.5 or less than -0.5 and the correlation between the variables is not significant and thus model is free from multicollinearity problem.

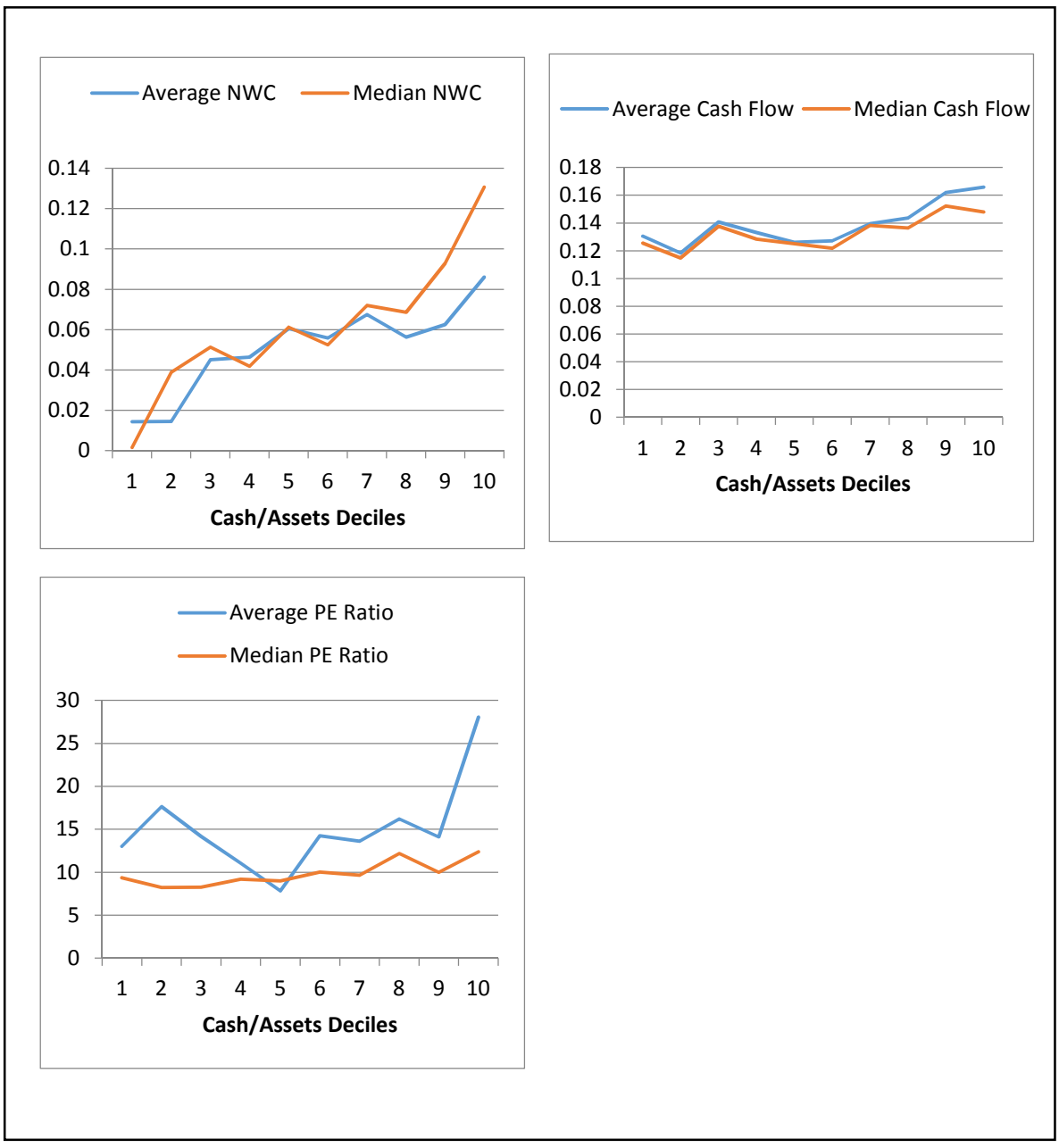


Figure 6.2: Change in firm characteristics with change in cash holdings

Table 6.4: Correlation between the independent variables

Correlation	CF	DEB	NWC	PE	REC	SLSCHNG	SIZ
CF	1.000						
DEB	-0.080	1.000					
MV2BV	0.091	-0.117					
NWC	0.055	-0.347	1.000				
PE	-0.011	-0.013	0.001	1.000			
REC	0.007	-0.059	0.294	-0.023	1.000		
SALCHANGE	0.026	0.005	0.042	0.044	0.057	1.000	
SIZ	0.015	-0.054	-0.113	0.011	-0.279	0.021	1.000

In order to ensure robust analysis, both pooled data model and panel fixed effect model using cash deflated by total assets as dependent variable and the above mentioned variables as independent variables were employed. Table 6.5 shows the result from the models. It shows the values of coefficients along with the probability values for both pooled data and fixed effect model

Table 6.5: Regression results for the optimal cash holdings model

Dependent Variable: Cash/Assets				
	Pooled Data Model		**Fixed Effect Model**	
Variable	Coefficient	Prob.	Coefficient	Prob.
Cash Flow/Total Assets	0.0133	0.0000	0.0076	0.0017
Borrowings/Total Assets	0.0021	0.1561	0.0048	0.0030
NWC/Total Assets	0.0794	0.0000	0.1376	0.0000
Receivables/Total Assets	-0.0603	0.0000	-0.1545	0.0000
Lagged Median Sales Change	0.0001	0.9686	-0.0013	0.2280
Log Assets	-0.0004	0.3611	-0.0004	0.6324
PE Ratio	0.0001	0.0000	0.0001	0.0000
Constant	0.0486	0.0000	0.0657	0.0000
Adjusted R-squared	0.074		0.541	

Table 6.5 shows that the sign of coefficients remains same in both models. The only major difference is that ‘borrowing’ was not significant at 95% in pooled data model, but became significant in panel fixed effect model. It can be observed that cash flow, borrowings, net working capital and PE ratio have a positive relationship with a firm’s cash holdings whereas receivables, demand shock and size have a negative relationship.

It is also observed that barring net working capital, the direction of relationships between cash holdings and most independent variables were in agreement with expectations. Net working capital displayed a positive relation with cash holdings as against the expected negative relationship.

The adjusted R-squared value was 0.54 in case of panel fixed effect model as against 0.074 for pooled data model. The panel data model was thus selected to calculate optimal cash holdings for further analysis.

The graphical analysis (Figure 6.2) and regression analysis (Table 6.5) aid in understanding the relationship between cash accruals and other firm characteristics. Most of these results were in agreement with trade-off theory; however, some results were in contrast to the theory's principles.

Receivables which are considered by many firms as closest substitutes to cash were found to bear a negative relation with cash. This was consistent with the trade-off theory which states that cash substitutes serve as alternatives to cash and therefore are negatively related. Firm which have high receivables may not feel the need to keep high cash to maintain liquidity and thus there is a negative relation between the two.

Negative relationship is observed between cash holding and size of firm. According to the trade-off theory, small firms have a higher probability of financial distress and it is also more expensive for them to raise borrowings. They may therefore keep higher amounts of cash in order to avoid distress and reduce borrowing expense.

According to both trade-off theory as well as pecking order theory, firms having strong growth opportunities are expected to hold large amounts of cash. This aids the growing firms in seizing on the investment opportunities (as and when they come) thereby reducing the probability of losing out the prospect. The results above also show a similar trend i.e. the PE ratio which has been used as proxy for growth opportunities was found to be statistically significant and positively related to cash holdings.

The relationship of leverage with cash accruals is not clear according to the trade-off theory as two opposite effects influence this relationship. Higher leverage increases market discipline and therefore firms with less leverage can hold more cash without being subject to checks. On the other hand, high debt increases chance of distress and therefore may force the firms to keep large amounts of cash in order to avoid the risk. The pecking order theory however suggests

that a firm would look for debt only when its internal holdings have been exhausted and therefore there should be a negative relation between cash holding and leverage. The regression results suggested a positive relation between debt and cash and thus were not consistent with pecking order theory.

A positive relation between cash flow and cash holdings of firms was observed. The results were in contrast to the trade-off theory which states that cash flows are a substitute to cash holding and hence there should be a negative relationship between them. However, according to the pecking order theory high cash flows result in financing profitable projects, repaying borrowings and finally in cash accruals. Thus, according to the pecking order theory cash holding and cash flow should have a positive relation and the results seem to be in agreement with it.

Net working capital indicates the liquidity position of a firm and the trade-off theory views other liquid assets as substitutes to cash holdings. Therefore, more liquid firms should hold less cash. The results were not in agreement with this theory as both graphical and statistical analyses show that more liquid firms are holding more cash. The explanation of this may be that the firms that are holding more working capital are somewhat risk averse and high cash accruals help these firms to avoid risk of distress and liquidity crunch. Such firms may also be tempted to keep a high amount of other liquid assets as part of precautionary and risk avoidance measures.

The trade-off theory specifies that demand shocks, which result in high volatility in revenue, may force the firms to keep large amounts of cash in order to avoid the possibility of cash shortage. However, our results did not find any significant relationship between demand shock and cash accruals.

Thus out of seven determinants tested, the relationships of four were found to agree with trade-off theory, two determinant's relationship agreed with pecking order and one was found to be insignificant. Overall it can be said that the trade-off theory is able to explain most of the behaviour of cash holdings, however some of the aspects are not in agreement with principles of the theory.

The regression model obtained above was used to calculate the optimal level of cash holdings in firms and further to examine the deviation in actual holdings from this optimal level.

6.5 Deviation from Optimal Cash Level

After development of model to estimate the optimal/target level of cash holding the next step was to examine the deviations from this optimal level. Firstly it was investigated that whether those firms which hold comparatively higher level of cash (in comparison to others), hold cash in excess to the target/optimal level. Using the results from Table 6.5 the optimal cash holdings for all firms in each year were calculated. Further, percentage deviation of actual cash holdings (Cash/Total Assets) from the estimated optimal levels (Cash/Total Assets*) was estimated. Hence, for all firms,

$$\frac{(Cash/Total\ Assets^{*} - Cash/Total\ Assets)}{(Cash/Total\ Assets)}$$

was calculated. For each year the firms were then sorted into deciles according to the actual cash holding levels (i.e. from low to high cash holding level, as it was done in Figure 6.1). Median and mean values of the deviation were calculated for each decile and for each year. Thus there were 10 values for each decile corresponding to each year. Thereafter an overall average of mean values and median of median values was calculated for each decile. Thus 10 values of mean and 10 values of median deviations were left, corresponding to the 10 deciles. These values were plotted on graph with Y-axis representing percentage deviation and X-axis representing deciles of cash holding in increasing order. The plotted graph is shown in Figure 6.3.

Figure 6.3 shows that firms with low levels of cash holding fell short of target cash levels while firms with the highest levels of holdings exceeded the target levels. It also shows that firms fall short of cash targets much more than they exceed the target. The figure indicates that firms with lowest cash levels fell short by 16% whereas firms with highest cash levels exceeded target cash levels by only 1%. This means that firms do not excessively exceed the target cash level but can fall significantly short of the optimal level. This might suggest that exceeding the target cash holding may be more costly than falling short of the target. Overall, it indicates that cash shortfall (target - actual) is negatively related to the cash holding level.

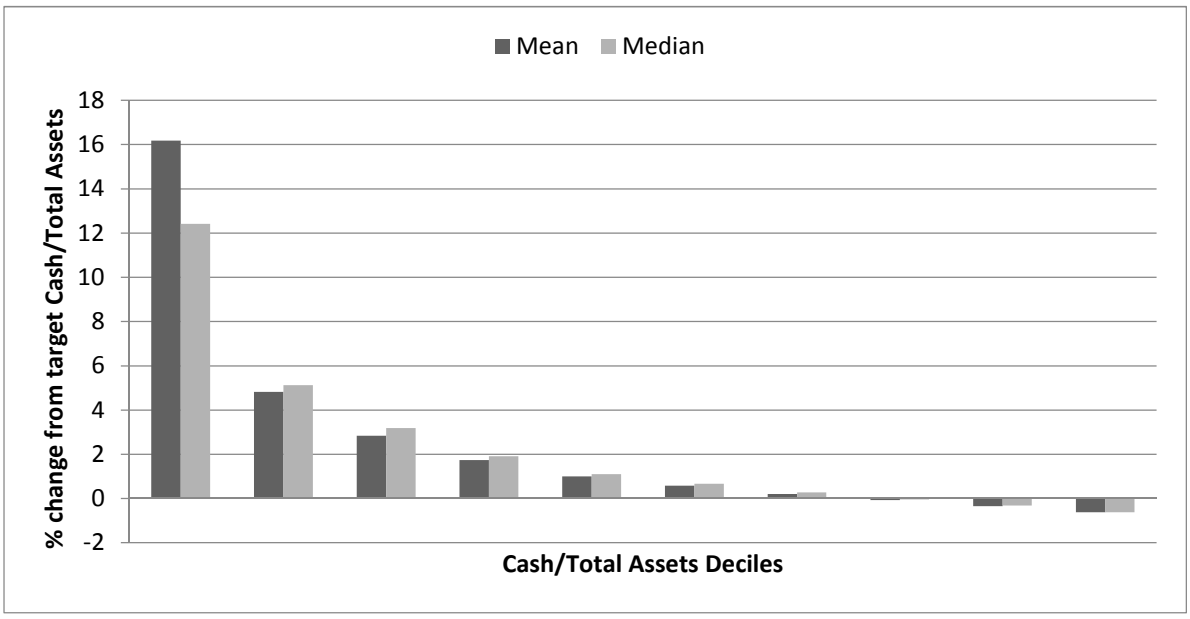


Figure 6.3: Deviation of actual cash accruals from optimal level

Since firms try to achieve a target/optimal level of cash, it is essential to examine whether the firms try to close the gap between actual cash holding and target cash holding, i.e. whether they try to reduce the deviations from the target level. To study this, another regression model was employed. Here the dependent variable used was deviation from target, i.e. (Cash/Assets*$_t$ - Cash/Assets $_t$) and lagged deviation from target i.e. (Cash/Assets*$_{t-1}$- Cash/Assets $_{t-1}$) was used as independent variables. Thus the model was modelled as:

$$(\text{Cash/Assets} *_t - \text{Cash/Assets}_t) = \alpha + \beta(\text{Cash/Assets} *_{t-1} - \text{Cash/Assets}_{t-1})$$

α represents intercept, β represents coefficient of independent variable ε represents residual error. This model is expected to provide an understanding of the relationship between present level of deviation and previous level of deviation. Fixed effect regression model was used to control for effect of other time invariant factors. The results of the analysis are shown in Table 6.6.

Table 6.6: Regression results for relation between present and lagged deviation from target

Dependent Variable: (Cash/Assets*$_t$ - Cash/Assets $_t$)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
(Cash/Assets*$_{t-1}$- Cash/Assets $_{t-1}$)	0.7333	0.0076	96.2451	0
Constant	-0.0006	0.0005	-1.2291	0.2191
Adjusted R-squared	0.5269			

Results shown in Table 6.6 indicate that the coefficient of lagged deviation from target is positive, less than one and is statistically significant. This suggests that the deviation from the target level in the current period is smaller than the deviation in the previous period. Thus, it can be inferred that in subsequent time periods, firms try to reduce the difference between actual and optimal cash holdings and thus move towards the optimal level.

Since it is clear that in general firms try to move towards the optimum level and try to reduce the deviation between actual and target cash levels. The next step of the analysis was to find the adjustment rate by estimating the proportion of deviation that is adjusted in the subsequent year.

To achieve this objective, another regression model was employed which used 'change in cash levels in the current year (t) from last year (t-1)', i.e. (Cash/Assets $_{t}$ - Cash/Assets $_{t-1}$) as dependent variable. For independent variable deviation from target cash level in previous year is used i.e. (Cash/Assets*$_{t-1}$- Cash/Assets $_{t-1}$). This model is expected to give information about the proportion of last year's deviation (from target cash level) that is covered/eliminated in actual cash holdings change. Again the fixed effect regression model was employed and the model used was:

$$(\text{Cash/Assets}_t - \text{Cash/Assets}_{t-1}) = \alpha + \beta(\text{Cash/Assets}*_{t-1} - \text{Cash/Assets}_{t-1})$$

The result of the regression run is given in Table 6.7.

Table 6.7: Regression results for relation between cash change and lagged deviation from target

Dependent Variable: (Cash/Assets $_{t}$ - Cash/Assets $_{t-1}$)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
(Cash/Assets*$_{t-1}$- Cash/Assets $_{t-1}$)	0.4963	0.0099	50.2255	0.0000
Constant	0.0004	0.0001	3.2431	0.0012
Adjusted R-squared	0.1912			

Table 6.7 shows that the adjusted R^2 value is 0.1912 and lagged deviation from target is a significant variable (at 95 % level) with a coefficient value of 0.49. This shows that almost 50% of the gap between target and actual cash levels is closed in subsequent years. Thus it can be expected that a firm will be able to eliminate the deviation and achieve the target cash level in approximately two years. These results are very similar to that of Venkiteshwaran (2011) who got the coefficient value at 0.52 with R^2 value of 0.1955. Thus this phenomenon of eliminating the deviation in two years is common in both developed and developing countries.

Overall, the result from this section indicated that as cash holding increase, the difference between target cash and actual cash goes on decreasing and it becomes negative for firms with higher levels of accruals. This proves that there is an inverse relationship between deviation and actual holdings. Statistical analysis revealed that during the course of time, firms try to reduce deviations from the target level. It was found that for an average firm, the deviation from the target in a year is a fraction of its value in the previous year, indicating that firms move towards the target and reduce the gap in subsequent years. A Further investigation revealed that the change in cash holding in one year is almost 50% of the deviation from target in the previous year, i.e. about half of the gap between the target cash level and the actual cash level is covered in the next one year. This result can be used to predict that on an average, a firm is expected to eliminate the deviation from target in two years.

6.6 Impact of Cash Holdings on Performance

Although there is still no clarity on reasons behind stock market movements and studies like Burton et al. (2003) have found non-existence of any effect of financing announcements but still studies like Faulkender and Wang (2006) argue that more liquid firms are rewarded with higher valuations by the market. Their results, however, also show that there is an upper limit to cash holding and after crossing that limit, the value of firm starts declining. Similar results were reported by Saddour (2006) who establish that the market value of firms increases with an increase in cash levels. Ferreira and Leal (2010) found that holding high levels of cash is conducive for maximization of shareholder's wealth. Simutin (2010) have also documented evidence of a positive relationship between future stock returns and excess cash holding. However, their results also indicate that though firms with excess cash invest more in future, they do not experience high future profitability. Similar to Faulkender and Wang's results Lee and Powell (2011) also found that transitory excess cash holdings are able to give higher market return, but persistent excess cash is penalized by the market. Their results show that the marginal value of cash decreases with higher cash accruals and longer period of holding. Martínez-Sola et al. (2011) establish a concave relationship between cash holdings and firm value proving the existence of an optimum cash level. Sodjahin (2013) found that firms with positive change in cash holdings result in higher risk-adjusted returns in comparison to firms with negative change in cash holdings. Recently, Tong (2014) found that from a shareholder's perspective, the marginal value of cash is higher when the cash holdings move towards the optimum level.

Since it is clear that firms try to bring their cash holdings towards an optimal level therefore it can be inferred that the variation in cash holdings level must have some effect on the performance of firms. This subsection tries to investigate the effect of cash holding changes on the market performance of the firm. To achieve this objective, first the effect of cash holdings on the market to book value of the firm was examined. Market to book value (MV to BV) is commonly used to measure the value of the firm (Martínez-Sola et al., 2011) and higher market to book value indicates that the investors assign relatively higher value to the firm.

The cash holdings were sorted in deciles (increasing order) and a graph was drawn by plotting mean and median values of MV to BV ratio for each decile. The graph is shown in Figure 6.4.

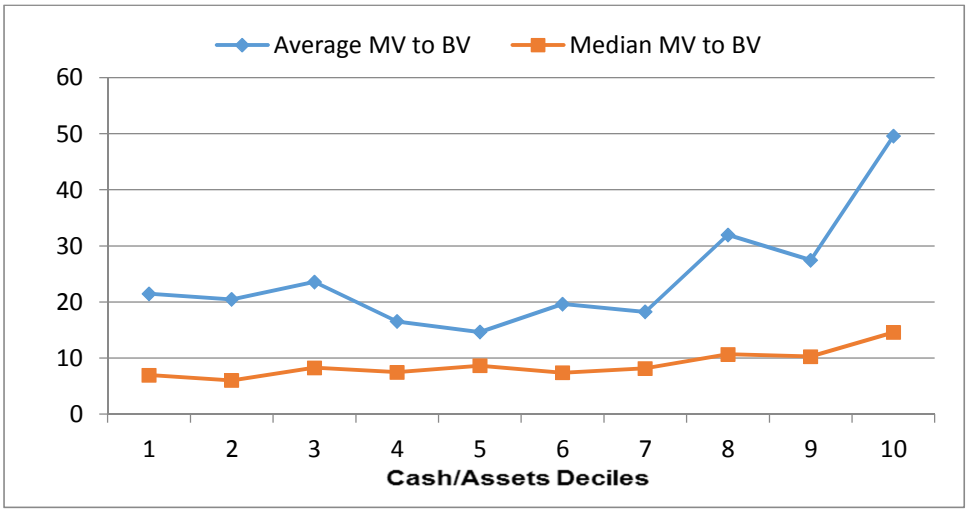


Figure 6.4: Relation between MV to BV and cash holdings

Figure 6.4 shows that the plot has a somewhat upward trend and thus with increase in cash holdings the market value of firms increases. According to earlier studies, market value of firms increase with increase in cash but too much of cash holdings may result in lower market value. The results from the graph above seem to give an incomplete picture as there no evidence of decrease in MV2BV for excessive cash holdings. Thus to further confirm the relationship statistical analysis was carried out.

Market to book value (MV to BV) was used as dependent variable and cash holding (Cash/Total Assets) was used as independent variable. Following Martínez-Sola et al. (2011), the square of cash holdings $(Cash/Assets)^2$ was used as a second independent variable to test for any nonlinear relationship between cash holding and MV to BV ratio. Further, the following variables were used as control variables: cash flow (yearly net cash flow as the ratio of total assets), borrowings (total borrowings as the ratio of total assets) and size (log of total assets).

Panel data fixed effects regression model was employed for the analysis to focus only on time varying factors.

Thus the model applied was:

$$MVtoBV = \alpha + \beta_1(Cash/Assets) + \beta_2(Cash/Assets)^2 + \beta_3(CashFlow/Assets) + \beta_4(Borrowings/Assets) + \beta_5(\ln(Assets))$$

α represents intercept, β represents coefficient of independent variable ε represents residual error. The results from the regression model are shown in Table 6.8.

Table 6.8: Regression results for relation between MV to BV and Cash

Dependent Variable: MV2BV				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Cash/Assets	21.098	2.090	10.097	0.000
Cash/Assets Squared	-20.944	3.936	-5.322	0.000
Cash Flow	3.309	0.389	8.515	0.000
Borrowings	-1.264	0.249	-5.082	0.000
Size	4.446	0.150	29.669	0.000
C	-10.363	1.169	-8.868	0.000
Adjusted R-squared	0.748			

In any regression model, a positive relationship of the dependent variable with an independent variable and negative relationship with the squared value of the same independent variable indicates that the value of the dependent variable increases with an increase in independent variable, but after a limit, any further increase in the independent variable results in decline of the dependent variable. A similar relationship was expected between MV to BV and cash i.e. increase in cash holding upto a level results in better market performance but any increase beyond this level may be detrimental.

Table 6.8 shows that the relationship between cash and market to book value was similar to those obtained in previous studies. The model had an adjusted R^2 value of 0.748 and all the independent variables are significant at 95% confidence. The coefficient of Cash/Assets was positive and that of $(Cash/Assets)^2$ was negative. This indicates that investors attach more value to a firm that has more cash. However, beyond a level, any increase in cash holdings is considered unnecessary hoarding and the value of the firm starts declining. Overall, it suggests the existence of an inverted U shaped relation between the value of the firm and cash accruals as shown in Figure 6.5.

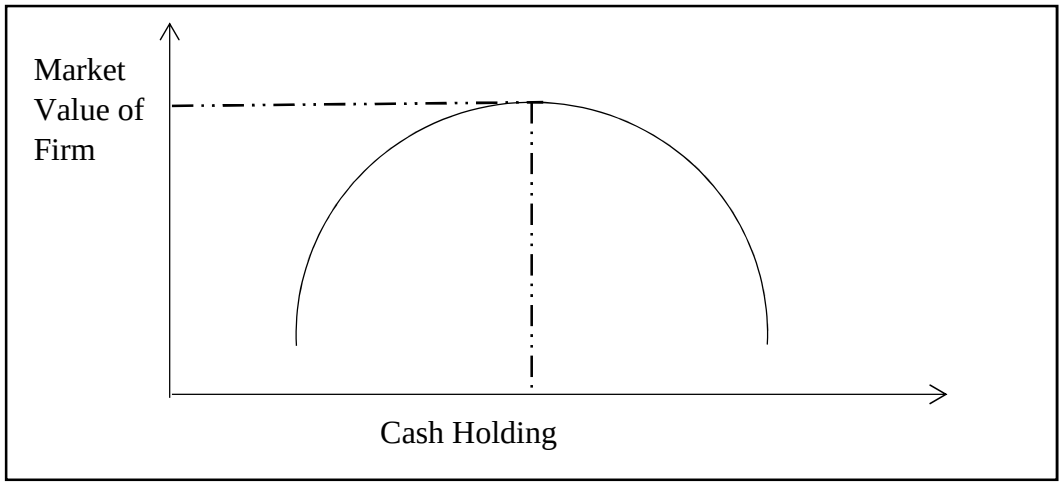


Figure 6.5: Relation between market value and cash holding

Next it was examined whether the firms which exceed target cash levels are rewarded by investors with excess market returns. For this analysis the effect of increase in excess cash on excess stock returns was observed. Yearly stock returns were measured by $R_t = (S_t - S_{t-1}) / S_{t-1}$ where S_t and S_{t-1} are stock prices at the end of years t and t-1 respectively, and. Then the excess market return was estimated by subtracting the returns on benchmark index from the stock returns, i.e. $R_t - B_t$ where B_t is market return on benchmark index. For benchmark index of Bombay Stock Exchange (BSE) SENSEX was used. This excess market return was used as the dependent variable in analysis.

For independent variable change in excess cash was estimated, i.e. $E_t - E_{t-1}$ where E_t and E_{t-1} are excess cash at times t and t-1 respectively (actual cash holding minus optimal cash holding). This measures the increase in deviation from target cash levels.

Change in actual cash holdings was used as second independent variable to measure the influence of absolute change in cash holdings on stock returns. Since the dependent variable uses market value of firm as denominator therefore all independent variables too were deflated using the market value of equity. Thus excess cash is measured as (Cash/Mkt.Value* - Cash/Mkt.Value) and increase in cash holding is measured as (Cash/Mkt.Value $_t$ - Cash/Mkt.Value $_{t-1}$). In addition to these, change in total assets (size), change in cash flow, change in sales and change in debt (borrowings) were used as control variables. All these variables were also deflated by market value of equity. Thus the model used was:

$$Excess\ Market\ Returns = \alpha + \beta_1(\Delta Excess\ cash) + \beta_2(\Delta Cash) + \beta_3(\Delta Size) + \beta_4(\Delta Sales) + \beta_5(\Delta Cashflow) + \beta_6(\Delta Borrowings)$$

where

$$\Delta Excess\ Cash = (\text{Cash/Mkt. Value}_t^* - \text{Cash/Mkt. Value}_t) - (\text{Cash/Mkt. Value}_{t-1}^* - \text{Cash/Mkt. Value}_{t-1})$$

$$\Delta Cash = \text{Cash/Mkt. Value}_t - \text{Cash/Mkt. Value}_{t-1}$$

$$\Delta Size = \text{Assets/Mkt. Value}_t - \text{Assets/Mkt. Value}_{t-1}$$

$$\Delta Sales = \text{Sales/Mkt. Value}_t - \text{Sales/Mkt. Value}_{t-1}$$

$$\Delta Cashflow = \text{Cashflow/Mkt. Value}_t - \text{Cashflow/Mkt. Value}_{t-1}$$

$$\Delta Borrowings = \text{Borrowings/Mkt. Value}_t - \text{Borrowings/Mkt. Value}_{t-1}$$

α represents intercept, β represents coefficient of independent variable ε represents residual error. Panel data fixed effect model was applied and the results are shown in Table 6.9.

Table 6.9: Regression results for relation between excess market returns, change in cash and change in excess cash using equation

Dependent Variable: $Excess\ Market\ Returns$				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\Delta Excess\ Cash$	-0.180	0.029	-6.266	0.000
$\Delta Cash$	0.109	0.032	3.461	0.001
$\Delta Size$	0.037	0.007	5.510	0.000
$\Delta Cashflow$	0.010	0.007	1.524	0.128
$\Delta Borrowings$	-0.022	0.008	-2.836	0.005
$\Delta Sales$	0.074	0.004	18.409	0.000
C	0.124	0.007	17.563	0.000
Adjusted R-squared	0.068			

It is clear from Table 6.9 that both Δ*Excess Cash* and Δ*Cash* are significant at 5% significance level. The signs of their coefficients are however, opposite. The positive coefficient of Δ*Cash* signifies that an increase in cash holding is generally preferred by the market and thus excess market returns increase with an increase in cash levels. However, the negative sign attached to the coefficient of Δ*Excess Cash* signifies that an increase in excess cash is not considered good by the market and therefore there is a drop in excess returns. In other words, any increase in deviations from target cash is not appreciated by investors and results in lower stock returns. Overall, these results show that although growth in cash accruals is appreciated and rewarded by the market, but if the cash holding level of a firm is already exceeding the optimal level, then a further increase in accruals is considered bad and penalized by the market. Overall the graphical and statistical analysis suggests that cash accruals are positively related to the market value of the firm. The results also revealed that cash holdings are positively related to ratio of

market value to book value and the effect is significant. However, the negative coefficient of squared cash holdings signifies that the relationship is not linear in nature. The positive relationship holds only up to a certain level of cash holdings and an increase in cash beyond this level makes the relationship negative. This was in concurrence with the trade-off theory according to which there are costs and benefits of holding cash and if the accruals are increased beyond a limit, the costs will exceed the benefits. Further, the results pointed out that a positive change in cash accrual did have a positive effect on stock returns earned in excess of the benchmark return. Moreover, it was also found that an increase in excess cash (in comparison to target level) had a negative effect on the returns earned by investors. This indicated that though the market reacts positively to an increase in cash holding, yet any increase past a level is not appreciated by investors.

Though a number of studies have examined corporate cash holdings, none of them have comprehensively covered all aspects of cash dynamics in an emerging economy like India. The results of this study will help managers of both Indian firms and also foreign firms planning to invest in the Indian manufacturing sector by acquainting them with the prevalent cash management practices and helping them understand how these practices are different from the developed countries.

This chapter examines various aspects of cash holdings (ranging from determinants to implications) by firms. It gives evidence that though the trade-off theory is instrumental in explaining most of the dynamics of cash accruals, the behaviour of some aspects of cash holdings were consistent with the pecking order theory. It was further found that a significant portion of the changes made by firms in their cash levels are done in order to achieve a target/optimal level of cash. The target level of cash is expected to balance the costs and benefits of holding cash, which is consistent with the views of trade-off theory. Findings also reveal that firms continuously adjust their holdings and display a mean reversion property in order to achieve the target level. The study also shows that an increase in cash holdings is viewed as a positive sign and consequently stock returns and market value of firms improve. This relationship however, holds only up to a certain level of cash accruals and any increase beyond this may harm shareholder wealth.

CHAPTER 7

SUMMARY, CONCLUSION AND IMPLICATIONS

Preview

This chapter presents the summary of the study along with major findings and their implications. It also presents the limitations of the study and discusses the possible areas of future research.

CHAPTER 7
SUMMARY, CONCLUSION AND IMPLICATIONS

7.1 Introduction

This chapter presents a summary of the entire study and discusses implications of the research for various stakeholders. This study conducted an empirical analysis of the working capital management efficiency in Indian manufacturing sector during the period 2004 to 2013. It explores number of critical issues related to working capital management and addresses the following research objectives:

- To analyse the current measures of working capital management efficiency and suggest an improved measure for robust and effective analysis of working capital management.
- To analyse the working capital management efficiency and its trend in Indian manufacturing sector firms in current scenario.
- To explore the various factors that affect the efficiency of working capital management in firms and analyse how these firm specific and macroeconomic variables influence the WCM efficiency.
- To examine the structure/nature of WCM efficiency change (productivity) in the Indian manufacturing firms during the period 2004 to 2013.
- To analyse the relationship between WCM efficiency and performance of firm.
- To examine the pattern of corporate cash holdings, their optimal levels and effect on firms' value.

With the exploration of these research issues, this study carries out comprehensive empirical analysis of working capital management of the Indian manufacturing industry and focuses on enhancing the literature and understanding of WCM efficiency. The study examines all the major aspects of working capital management including cash holdings in order to carry out a robust analysis of the subject in the context of an emerging economy.

This study followed a systematic approach to achieve its objectives and the analysis was divided into six main chapters. Chapter one introduced the topic and basic concepts of the research area along with goals of the study. Chapter two presented a comprehensive review of

literature on various aspects of working capital management, cash holdings and efficiency analysis. Chapter three discussed the research design of the study with description of the major models adopted along with the tools and techniques used in the study. Chapter four presented the empirical analysis of the first three objectives of the study. Here the study adopts Data Envelopment Analysis (DEA) to estimate efficiency of working capital management of firms and discusses the various advantages of the new measure over the traditional ones. It examined the WCM efficiency scores and also analysed the trend in WCM efficiency over the ten year period (2004-2013). Moreover, this chapter examined the influence of various firm-specific characteristics and macroeconomic variables on the WCM efficiency of firms. Chapter five dealt with the objective number four and five of the study. Here Malmquist Productivity index and it components pure efficiency, scale efficiency and technology change were used to examine the change in WCM efficiency. Further, the chapter explored the relationship between WCM efficiency and performance of firm. Chapter six dealt with a different aspect of working capital management and analysed the dynamics of cash holding in Indian manufacturing firms. Here the pattern of cash holding, its optimal level, deviations from optimal level and its effect on firm was analysed.

The study analysed the data from Indian manufacturing firms during the period 2004 to 2013 which includes pre, during and post financial crisis period. Since norms and requirements differ across industries therefore the entire sample of 1244 firms was divided into 11 major industries for bias free analysis.

7.2 Findings

This section briefly discusses the findings from various sections of the study.

7.2.1 Analysis of WCM Efficiency:

The traditional measures of WCM efficiency have been criticised by a few previous studies due to reasons like mathematical fallacy, equal weightage to components, not consideration of investment amount and only measuring the duration of working capital investment etc. Based on previous studies on efficiency measurement using data envelopment analysis, the present study proposes a new measure based on data envelopment analysis to assess the WCM efficiency of firms.

- The new measure was based on NTC measure and used inventory, receivables and modified sundry creditors as inputs and net sales and cash flow as outputs. Bootstrapped BCC DEA model is applied for measurement of WCM efficiency.

- The new measure is found to be an improvement over the traditional measures because of its benefits of having no mathematical fallacy, higher scale of measurement, capability of benchmarking analysis and ability to be flexibility and modifiable. This new measure can aid in more effective measurement of WCM efficiency which would be useful to all stakeholders of firm in assessing the quality of short term fund management.
- The efficiency scores obtained using the new technique indicated that the average WCM efficiency of Indian manufacturing sector is around 40%, and that there is a vast difference between maximum and minimum efficiencies in each industry. In each industry there were firms that had efficiency scores which was a small fraction of the efficiency scores of industry leaders. This indicates that in all industries, there are firms which are extremely inefficient in managing working capital a lot of effort is required to bring such firms at par with the leaders. Overall the WCM efficiency of Indian manufacturing firms seems to be on the lower side because of a low average value of 40% and skewed nature of the efficiency scores.
- Graphical and statistical analysis was carried out to examine the trend in WCM efficiency. Here both traditional and the proposed new measure was employed. The results indicated that different efficiency measures indicate different trends but it is clear that the efficiency level of working capital management of firms does vary with time and this might be the result of several microeconomic and macroeconomic factors. The trend also indicated that there has been dip in efficiency during the financial crisis period. Results also suggest that though each industry has its own accepted norms for working capital management levels and maintains its position relative to other industries but still the efficiency level varies across the years. The results stress the need for examination of factors that might impact the WCM efficiency of firms.

7.2.2 Determinants of WCM Efficiency:

From the results of previous section it was clear that the WCM efficiency of firms do vary with time. Though a large percentage of this change may be due to change in management policy and management effectives, however previous studies have indicated that various other factors might also have impact on the WCM efficiency scores. This section examines a set of such probable factors foe their influence on WCM efficiency and found that most of the firm-specific factors have significant influence whereas the macroeconomic factors were found to have inconsistent effect.

- Age of firm has positive association with WCM efficiency suggesting that experience and reputation in market allow firms to handle liquidity more efficiently. As the age of firms increase they become more established in market and thus gain expertise in handling working capital. Their established reputation with the suppliers to help them in improving WCM efficiency.
- Cash holding positively affects WCM efficiency indicating that cash acts as alternative to other liquid assets. Since cash is the most liquid asset, therefore a firm holding more cash requires lesser investments in other liquid assets and thus can manage with lower working capital, which in turn increases its WCM efficiency.
- Leverage has negative affect on WCM efficiency, suggesting that risk of financial distress forces firms to invest more in current assets. Firms with higher debt, face more risk of financial distress. Such firms may thus want to have enough liquidity to reduce the liquidity risk. This would require larger investments in working capital, which in turn may reduce WCM efficiency.
- Increase in size of firm tends to reduce its WCM efficiency suggesting that larger firms become less aggressive in managing working capital. It was found that as firms become larger, their focus is more on gaining market share and less on aggressive fund management. Therefore larger firms keep larger liquidity and grant more credit to buyers. This may cause reduction in WCM efficiency.
- Increased investments in fixed assets tend to make firms more efficient in WCM indicating that higher investments in fixed assets cause investments in liquid assets to be reduced. Limited availability of funds requires the firms to choose between long term and short term investments. Therefore firms choosing to make larger investments in fixed assets may reduce the investments in liquid assets. This would improve their WCM efficiency.
- Return on assets and sales growth have positive effect on the efficiency of WCM. This suggests that improvement in sales and returns improves the firm's reputation among the suppliers and encourages the firm to become more aggressive in managing working capital. Since ROA measures the efficiency of asset utilisation, therefore increase in ROA may also indicate improvement in utilisation of short term assets and hence have impact positive impact on WCM efficiency.
- The macroeconomic variables had inconsistent effect on WCM efficiency and thus their influence remains inconclusive. It was observed that most of the macroeconomic variables test impacted different industries in different manners. In addition their impact

was significant in only small number if industries. Hence it can be concluded that macroeconomic conditions impact different industries in different ways and thus the direction and significance of their influence remains inconclusive.

- The results suggested that a variety of factors influence the WCM efficiency of firms. While few of these can be directly controlled by the management, the others can be tweaked in indirect manner to improve the WCM efficiency of firm.

7.2.3 Analysis of Efficiency Change (Productivity):

In this section, WCM efficiency change (also called productivity) was analysed using Malmquist Productivity index (MPI) along with its constituents pure and scale efficiency change and technology change.

- The results indicated that the WCM efficiency has improved over the last 10 years and it was found that the cumulative efficiency change has increased to almost 4 times of its level 10 years back. It was found that most of this change has been due to change in technology and not due to improvement in technical and scale efficiency of firm.
- The analysis indicated that during the study period pure efficiency has almost doubled and scale efficiency has improved to almost 1.3 times. This suggested that the improvement in internal processes and improvement in scale of operations have caused a small improvement in WCM efficiency over the ten years of study.
- The determinants of MPI exhibited relationships almost similar to those obtained in previous section (determinants of WCM efficiency) and thus confirmed the earlier results. Changes in values of variables in successive years were used as independent variables. It was found that change in cash and change in net fixed asset has positive influence on overall change in WCM efficiency. Change in ROA and change in sales growth also exhibited a positive relation with WCM efficiency change whereas change in debt and change in size were found to have negative effect.
- Not all the variables test were found to be equally significant in PE and SE. Change in cash, proportion of fixed assets and sales growth were found to be positively related to PE. In contrast, change in debt and change in size exhibited negative relationship. Change in ROA was not found to be statistically significant (at 95%). The variables that were significant in the model exhibited same direction of relationship as in case of MPI.
- Only four variables were significant in case of SE. Change in ROA and Change in sales growth exhibited positive relationship whereas change in debt and change in size had

negative relationship. Others like change in cash, change in proportion of fixed assets etc. were found to be insignificant.

- Overall the results indicate that firms are able to increase their WCM efficiency due to various reasons. While some improve the technical efficiency, others improve the scale of operations. The results also suggest that no all the determinants of WCM efficiency have significant impact on both pure and scale efficiency.

7.2.4 WCM Efficiency and Firm Performance:

In this section the study explored the linkages between firm's performance and WCM efficiency to examine whether improvement in WCM efficiency, would lead to improved performance of firm. It was observed that:

- Most of the performance measures are positively related to WCM efficiency which suggested that improvement in the liquidity management improves the financial performance of firms.
- Return on sales which is the most commonly used performance measure was positively related to WCM efficiency and all the measures of efficiency showed consistency in the relationship.
- Similarly market performance/valuation measure Tobin's Q was found to be positively related with the WCM efficiency measures. This suggested that increase in WCM efficiency is valued by the investors and they assign more value to such firms.
- Another performance measure MVA (market value added) which is an indicator of wealth creation showed positive relationship with WCM efficiency measures. This suggested that improvement in the efficiency of working capital management improves the overall functioning of firms and hence it leads to creation of value/wealth and higher valuation by investors.
- However some other performance measures like return on assets and price to earnings ratios exhibited inconclusive results as they were found to be significant only in few industries..
- The results were consistent with the previous studies and indicated that both accounting and market performance is positively influenced by WCM efficiency. It thus essential for management to focus on liquidity management and strive of efficient handling of liquid assets.

- Overall it can be inferred that an increase in the WCM efficiency is an essential ingredient for improvement in the performance of firm and for achieving shareholder wealth maximisation.

7.2.5 Cash Holdings Analysis:

The nature of cash is much different from other liquid assets and thus required separate analysis to understand its behaviour and pattern. Hence this section carried out a comprehensive analysis of corporate cash holdings and its dynamics in the context of Indian manufacturing firms. The analysis examined cash holdings levels, their mean reversion nature, optimal lvels and their impact on firm. The analysis exhibited interesting results.

- It was found that the mean cash holding level was around 4% which was much lower than the values reported in developed countries by previous studies. This might be due to the competitive environment and interest rates prevailing in India, which might be much different than those in developed economies.
- It was observed that cash holdings have mean reversion property i.e. the firms try to achieve a target or optimal level of holdings and as the cash holdings deviate from the level, firms try to reverse the change and bring it back to the desired target level.
- It was observed that firms do not excessively exceed the target cash level but can fall significantly short of the optimal level. This suggests that exceeding the target cash holding may be more costly than falling short of the target.
- The cash holding pattern of Indian manufacturing firms were found to be more or less in agreement with the principles of trade-off theory which suggests that firms try to balance the costs and benefits of holding cash.
- The study modelled optimal cash holdings level using various firm-specific variables and analysed the deviations from this optimal level.
- It was found that for an average firm, the deviation from the target in any year is around 50% of its value in the previous year, indicating that firms move towards the target and reduce the gap (between actual cash holding and optimal cash holdings) in subsequent years.
- The results further indicated that a positive change in cash holdings do has a positive effect on excess stock returns earned i.e. the investors attach more value to a firm that has more cash. However, it was also found that beyond a level, any increase in cash holdings (increase in excess cash) is considered unnecessary hoarding and the value of the firm starts declining.

- Overall the study reconfirms the importance of optimal cash holdings and it effective management for the success of firm.

7.3 Implications of the Study

This study examines the WCM efficiency of Indian manufacturing firms in an entirely new perspective. This study performs an empirical evaluation of working capital management in manufacturing firms with focus on its efficiency, productivity changes, determining factors, and linkage with the performance. It brings forth a number of interesting results and novel insights into the operations of manufacturing sector.

The study proposes a new measure to gauge the efficiency of working capital management. This new measure is not only able to remove the problems of traditional measures but also offers additional benefits. In addition, the measure is flexible enough to accommodate for various returns to scale and allows putting conditions on inputs/outputs. This new measure will aid in effective measurement of WCM efficiency which will be useful to all stakeholders of firms in assessing the short term fund management of firm.

Valuable insights and analysis opportunities are given by the proposed new measure which will aid financial managers to assess and benchmark their WCM performance within the industry in a better way. This will also help the managers in understanding the areas of weakness and strengths in liquidity management and how much extra effort is required in order to become as efficient as their competitors. The new measure being flexible can be suitable modified for any particular situation or industry for measuring WCM efficiency in a desired manner. This would aid the managers and analysts in more effective assessment of management efficiency under different business conditions.

The study contributes to the existing literature by giving a new direction to the research on analysis of WCM. The new DEA based measure opens up further opportunities to improve the measurement of WCM efficiency since the study provides a new base model on which future researchers can build upon and develop a universally applicable model for effective measurement of WCM efficiency.

The study is able to provide important insights on the overall WCM efficiency of manufacturing sector along with analysis of each industry. This would aid the regulators and government in getting a better understanding of sector’s capability in managing liquidity and would thus aid in framing of appropriate policies for the development of sector. The results

give information about the efficiency level of each industry, enabling the regulator to assess the relative strength of industries and frame policies accordingly.

The study gives valuable information about the trend in efficiency of the manufacturing sector and the exogenous factors influencing it. The results give insights to managers regarding the factors that influence WCM efficiency and what decisions should be taken to improve it. The results suggest that some factors are outside of firm's control and thus cannot be managed; however others like investment in fixed assets, cash holdings, leverage etc. are within management's control and thus can be suitably tweaked for improvement of WCM efficiency.

The results also indicate that macroeconomic factors affect each industry differently and thus management must consider the economic conditions before making liquidity related decisions. The determinant analysis will also aid the government in making better incentive policies for the development of the manufacturing sector as a whole and for each industry separately.

Results from productivity analysis using MPI suggest that WCM efficiency of industries may change due to one or more of the following reasons: process improvement, improvement in scale of operations or change in overall technology. The trend and causes of change in pure and scale efficiency is examined and the results provide useful insights into WCM productivity. Thus the study provides better understanding of the efficiency change in various industries and this can be utilised by analysts, managers and regulators in examining the cause of WCM efficiency change and the extent of change in each industry/firm.

The study offers evidence that increase in WCM efficiency leads to improvement in performance. It was found that not only the accounting performance but even the market performance and wealth creation of the firm shows improvement when there is positive change in WCM efficiency. The results of the study indicate that return on assets, Tobin's Q and Market Value Added show significant improvement when WCM efficiency moves in positive direction.

The results strengthen the earlier belief that there is positive relation between the WCM efficiency and firm performance and provide evidence for the same in an emerging economy. Earlier studies had indicated that India ranks among bottom in WCM efficiency since managers in India do not consider WCM to be a critical issue. It is expected that the results will motivate managers to pay more attention towards effective management of WC. The study will encourage the management of firms to focus more on liquidity management as it would result in performance improvement which in turn would result in increase of shareholder's wealth.

The study provides important insights into the behaviour and subtleties related to cash holdings of manufacturing firms in a developing economy like India. The results of the study will help managers of foreign firms planning to invest in the Indian manufacturing sector by acquainting them with the cash management practices prevalent here and helping them understand how these practices are different from the ones in developed economies.

The study will aid managers in understanding the factors that affect the cash holding pattern. The results indicates that firms try to achieve a target level of cash holdings and deviations from this level are generally eliminated in two years. It was also found that excess cash holdings do not result in excess market returns. The study suggests that holding too less and too much of cash is harmful for the firm's market value. The results thus stress the importance of having an optimal level of cash holdings in order to improve the valuation of firm. The findings will aid the practitioners in achieving the target of maximizing shareholder wealth through proper cash management.

This study provides new evidences for a better understanding of the short term financial behaviour of firms in developing economies like India. This study complements the existing empirical research on working capital and adds to the growing literature on liquidity management by modern firms.

7.4 Limitations of the Study

This study has certain limitations which arise mainly due to its scope, methodology and tools applied in the analysis. Broad limitations of the study are as follows:

- The study considered balanced panel data only and therefore, an equal number of firms are included in each year of analysis. This balancing excluded a) several new firms from the study which started their operations in the later years of the study period and b) many old firms which ceased to exist during the analysis period.
- The study included firms which were operating throughout the analysis period. This limitation restricted the number of firms to be included in the study and therefore the sample size was limited and smaller than the population.
- There is a possibility of having survivor bias in the sample as the only firms which were operating in all the years were considered. Moreover, since small firms have higher chance of failures therefore, the sample may be biased towards large firms.

- Sectors other than manufacturing have not been considered in the study due to lower importance of working capital in these sectors. However, excluding them may have resulted in biased results.
- Since the study is limited to public limited companies therefore private companies have been excluded from the analysis. This may have introduced biased results of the analysis since there is a large number of private firms in India and they may operate much differently than public firms.
- The major limitation of the DEA based measure is that it cannot be calculated on a standalone basis. That is, in order to know a firm's WCM efficiency, information about all its peers is needed and this may be a difficult job.
- The study suffers from the limitation of DEA that it is only possible to estimate relative efficiency and it's not possible to get an idea of the maximum possible level of performance.
- Since the DEA measure is relative in nature, therefore, in spite of using bootstrapping the results may be somewhat sample sensitive. This means that it is possible that a different sample could produce different results.
- The study is limited to ten years i.e. 2004-2013. Although the analysis period is long enough to include most economic and business conditions (pre, during and post financial crisis period), however still there may be some bias due to the limited period of the study.
- The macroeconomic variables do not take into consideration ethe ffect of public governance and transparency in the country. These have changed over the years and have important effect on business (Chipalkatti et al., 2007).
- The study may suffer from the limitations inherent in the statistical tools like panel data, regression analysis etc..
- The analysis of non-cash current assets and cash holdings are carried out separately and not in an integrated manner.
- The generalisations of results are very much restricted to Indian scenario and thus cannot be generalised for other countries.

Many of the limitation of the study can be overcome and can form the agenda for future research.

7.5 Future Research

This study focuses on efficient management of working capital in Indian manufacturing firms which includes effective management of both cash and non-cash assets. Considering the scope and limitations of this study, future research can be extended in the following ways:

- Since working capital management is most important for manufacturing sector therefore this study has considered only public ltd manufacturing firms for analysis. Future research may include data from sectors other than manufacturing and may also include both private and public ltd companies to carry out a more exhaustive analysis of working capital management practices in Indian firms.
- This study considers a reasonably long period of 10 years (2004-2013) for analysis, however future research may consider a larger time period for more robust analysis and may also include firms which operated for only for partial duration of the study, in order to remove any chance of survivor bias.
- This study analyses the working capital management efficiency of Indian firms only. The study can be replicated with data from other countries and the efficiency results can be compared with our results to examine the differences in working capital management efficiency across countries. Reasons for difference in WCM efficiency across different countries can also be examined.
- This study focuses on a limited number of input and output variables to examine the determinants of WCM efficiency. Future work may include including more input and output variables to determine DEA based WCM efficiency and may incorporate more firm-specific and macroeconomic factors in second stage. More types of economy indicators may be incorporated in the study.
- Enterprise resource planning (ERP) systems helps in automating and connecting the various processes of a firm (Gupta, 2000). It is possible that implementation of ERP systems in a firm may also have influence on its WCM policies and performance. Future research can explore the effect of ERP systems implementation on WCM efficiency.
- This study relies totally on secondary data analysis. Future research may include opinions of managers (primary data study) of efficient firms to understand and highlight their practices which make their firms efficient in working capital management. Such

study may also contrast the practices of efficient and less efficient firms for better understanding of the difference.

- This study introduced DEA for measuring WCM efficiency. Future research may use other modern techniques (other than DEA) to measure WCM efficiency and compare the results with this study's results. Other frontier analysis technique like stochastic frontier analysis (SFA) may also be tested. Similarly other measures of WCM like core working capital concept given by Bhattacharya (2007) may also be empirically tested. This would further confirm the state of efficiency in WCM of Indian firms.

- This study analysed cash and non-cash components of working capital separately. Future research may try to analyse both in an integrated manner in order to get a consolidated picture of liquidity management in firms. This will aid in better benchmarking and identification of firms which manage both cash and non-cash components of working capital efficiently.

- This study has used a number of financial performance measures to analyse the impact of WCM efficiency. Future research may also analyse the impact of WCM efficiency on reputation of firms from the point of view of customers, suppliers and other stake holders.

Thus this study opens a number of avenues for researchers and provides new directions for further research in the vital area of working capital management.

ANNEXURE I

INDUSTRY WISE LIST OF FIRMS

Food and Agro Products		
A D F Foods Ltd.	India Sugars & Refineries Ltd.	Riga Sugar Co. Ltd.
A V T Natural Products Ltd.	J V L Agro Inds. Ltd.	Rossell India Ltd.
Adani Wilmar Ltd.	Jagatjit Industries Ltd.	Ruchi Infrastructure Ltd.
Agro Dutch Inds. Ltd.	Jay Shree Tea & Inds. Ltd.	Ruchi Soya Inds. Ltd.
Agro Tech Foods Ltd.	Jayant Agro-Organics Ltd.	S B E C Sugar Ltd.
Ajanta Soya Ltd.	Joonktollee Tea & Inds. Ltd.	Sabmiller India Ltd.
Andrew Yule & Co. Ltd.	K C P Sugar & Inds. Co.. Ltd.	Sakthi Sugars Ltd.
Anik Industries Ltd.	K L R F Ltd.	Sayaji Industries Ltd.
Anil Ltd.	K M Sugar Mills Ltd.	Scottish Assam (India) Ltd.
Avanti Feeds Ltd.	K R B L Ltd.	Shree Renuka Sugars Ltd.
B & A Ltd.	K S E Ltd.	Simbhaoli Sugars Ltd.
B C L Ind. Ltd.	K S Oils Ltd.	Simran Farms Ltd.
Bajaj Hindusthan Ltd.	Kanoria Sugar& Mfg. Co.Ltd.	Sir Shadi Lal Enterprises Ltd.
Balrampur Chini Mills Ltd.	Kesar Enterprises Ltd.	Sri Chamundeswari Sugars Ltd.
Bambino Agro Inds. Ltd.	Khaitan (India) Ltd.	Srinivasa Hatcheries Ltd.
Bannari Amman Sugars Ltd.	Kohinoor Foods Ltd.	Sukhjit Starch & Chemicals Ltd.
Blossom Industries Ltd.	Kothari Ferment & Biochem Ltd.	Super Bakers (India) Ltd.
Britannia Industries Ltd.	Kothari Sugars & Chemicals Ltd.	Tasty Bite Eatables Ltd.
C C L Products (India) Ltd.	Kwality Ltd.	Tata Coffee Ltd.
Cadbury India Ltd.	Lakshmi Energy & Foods Ltd.	Tata Global Beverages Ltd.
Chordia Food Products Ltd.	Manjushree Plantations Ltd.	Terai Tea Co. Ltd.
D F M Foods Ltd.	Marico Ltd.	Thiru Arooran Sugars Ltd.
Dalmia Bharat Sugar & Inds.	Mawana Sugars Ltd.	Tilaknagar Industries Ltd.
Devon Plant. & Inds. Ltd.	Milkfood Ltd.	Tirupati Starch & Chemicals Ltd.
Dhampur Sugar Mills Ltd.	Modi Naturals Ltd.	Triveni Engineering & Inds. Ltd.
Dharani Sugars & Chem Ltd.	Mohan Meakin Ltd.	Ugar Sugar Works Ltd.
Diana Tea Co. Ltd.	Monsanto India Ltd.	Umang Dairies Ltd.
Divya Jyoti Inds. Ltd.	Mount Ever Mineral Water Ltd.	United Breweries Ltd.
Dwarikesh Sugar Inds. Ltd.	Mount Shivalik Inds. Ltd.	United Nilgiri Tea Est Co. Ltd.
E I D-Parry (India) Ltd.	N T C Industries Ltd.	United Provinces Sugar Co. Ltd.
Flex Foods Ltd.	Neelamalai Agro Inds. Ltd.	United Spirits Ltd.
Foods & Inns Ltd.	Nelliampathy Tea & Prod Ltd.	Universal Starch-Chem All. Ltd.
Freshtrop Fruits Ltd.	Nestle India Ltd.	Upper Ganges Sugar & Inds. Ltd.
G M Breweries Ltd.	Norben Tea & Exports Ltd.	Uttam Sugar Mills Ltd.
Gayatri Bioorganics Ltd.	Oudh Sugar Mills Ltd.	V S T Industries Ltd.
Gayatri Sugars Ltd.	Parrys Sugar Industries Ltd.	Vadilal Industries Ltd.
Glaxosmithkline C.H. Ltd.	Peria Karamalai Tea&Prod Ltd.	Venky'S (India) Ltd.
Gobind Sugar Mills Ltd.	Piccadily Agro Inds. Ltd.	Vijay Solvex Ltd.
Godfrey Phillips India Ltd.	Ponni Sugars (Erode) Ltd.	Vikas Granaries Ltd.
Godrej Agrovet Ltd.	Prima Agro Ltd.	Vikas W S P Ltd.
Golden Tobacco Ltd.	Prima Industries Ltd.	Vimal Oil & Foods Ltd.
Goodricke Group Ltd.	Radico Khaitan Ltd.	Vishnu Sugar Mills Ltd.
Gujarat Ambuja Exports Ltd.	Rajshree Sugars & Chem Ltd.	Zydus Wellness Ltd.
Harrisons Malayalam Ltd.	Rana Sugars Ltd.	
Hatsun Agro Products Ltd.	Rasoi Ltd.	
Heritage Foods Ltd.	Rasoya Proteins Ltd.	
I F B Agro Inds. Ltd.	Ravalgaon Sugar Farm Ltd.	
I T C Ltd.	Rei Agro Ltd.	

Textiles		
A I Champdany Inds. Ltd.	Indian Acrylics Ltd.	Priyadarsini Ltd.
A P M Industries Ltd.	Indian Card Clothing Co. Ltd.	Pushpsons Industries Ltd.
Aarvee Denims & Exports Ltd.	Indo Count Inds. Ltd.	R S W M Ltd.
Acknit Industries Ltd.	Indo Rama Synthetics Ltd.	Raghuvir Synthetics Ltd.
Ambika Cotton Mills Ltd.	J B F Industries Ltd.	RSRM Spg. & Wvg. Mills Ltd.
Anjani Synthetics Ltd.	J J Exporters Ltd.	Rainbow Denim Ltd.
Arora Fibres Ltd.	JRi Spg. & Wvg. Mills Co. Ltd.	Rajapalayam Mills Ltd.
Arvind Ltd.	Jasch Industries Ltd.	Raymond Ltd.
Ashima Ltd.	K G Denim Ltd.	Reliance Chemotex Inds. Ltd.
Aunde India Ltd.	K G Petrochem Ltd.	Rishi Techtex Ltd.
B S L Ltd.	K S L & Industries Ltd.	Rupa & Co. Ltd.
Banswara Syntex Ltd.	K-Lifestyle & Industries Ltd.	S N S Textiles Ltd.
Bengal Tea & Fabrics Ltd.	Kamadgiri Fashion Ltd.	S P L Industries Ltd. (Delhi)
Bhandari Hosiery Exports Ltd.	Kanco Enterprises Ltd.	S R F Ltd.
Binayak Tex Processors Ltd.	Kewal Kiran Clothing Ltd.	S T I India Ltd.
Blue Blends (India) Ltd.	Khator Fibre & Fabrics Ltd.	S T L Global Ltd.
Bombay Dyeing & Mfg. Co. Ltd.	Kitex Garments Ltd.	Salona Cotspin Ltd.
Celebrity Fashions Ltd.	Lakshmi Mills Co. Ltd.	Sambandam Spinning Mills Ltd.
Century Enka Ltd.	Lambodhara Textiles Ltd.	Sangam (India) Ltd.
Cheslind Textiles Ltd.	Loyal Textile Mills Ltd.	Santaram Spinners Ltd.
Cheviot Co. Ltd.	Mafatlal Industries Ltd.	Santosh Fine-Fab Ltd.
D C M Ltd.	Mahalaxmi Rubtech Ltd.	Sarla Performance Fibres Ltd.
Damodar Industries Ltd.	Maharaja Shree U. Mills Ltd.	Seasons Textiles Ltd.
Deepak Spinners Ltd.	Malwa Cotton Spg. Mills Ltd.	Shalimar Wires Industries Ltd.
Dhanlaxmi Fabrics Ltd.	Mangalam Ventures Ltd.	Shiva Texyarn Ltd.
Digjam Ltd.	Maral Overseas Ltd.	Shree Rajasthan Syntex Ltd.
Eskay K'N'It (India) Ltd.	Maxwell Industries Ltd.	Shri Dinesh Mills Ltd.
Eurotex Ind. & Exports Ltd.	Mayur Uniquoters Ltd.	Shri Jagdamba Polymers Ltd.
Fairdeal Filaments Ltd.	Minaxi Textiles Ltd.	Siyaram Silk Mills Ltd.
Filatex India Ltd.	Modern Threads (India) Ltd.	Soma Textiles & Inds. Ltd.
Flora Textiles Ltd.	Mohit Industries Ltd.	Spenta International Ltd.
G T N Industries Ltd.	Nahar Industrial Enterprises Ltd.	Spentex Industries Ltd.
Ganesha Ecosphere Ltd.	Nahar Spinning Mills Ltd.	Spice Islands Apparels Ltd.
Ganges Manufacturing Co. Ltd.	Naihati Jute Mills Co. Ltd.	Sri Ganapathy Mills Co. Ltd.
Gangotri Textiles Ltd.	Orbit Exports Ltd.	Sri Lakshmi Saraswathi T. Ltd.
Garden Silk Mills Ltd.	Oswal Spin. & Wvg. Mills Ltd.	Sri Nachammai Cotton Mills Ltd.
Garware Marine Inds. Ltd.	P B M Polytex Ltd.	Sri Ramakrishna Mills Ltd.
Garware-Wall Ropes Ltd.	Page Industries Ltd.	Sumeet Industries Ltd.
Gini Silk Mills Ltd.	Pasupati Acrylon Ltd.	Super Sales India Ltd.
Ginni Filaments Ltd.	Pasupati Spin. & Wvg. Mills Ltd.	Super Spinning Mills Ltd.
Gloster Ltd.	Patspin India Ltd.	Supertex Industries Ltd.
Grasim Industries Ltd.	Pioneer Embroideries Ltd.	Supreme Tex Mart Ltd.
Gravity (India) Ltd.	Prakash Woollen Mills Ltd.	Surat Textile Mills Ltd.
Gujarat Raffia Inds. Ltd.	Pranavaditya Spinning Mills Ltd.	Suryajyoti Spinning Mills Ltd.
H P Cotton Textile Mills Ltd.	Prashant India Ltd.	Suryalakshmi Cotton Mills Ltd.
Himatsingka Seide Ltd.	Precot Meridian Ltd.	Suryalata Spinning Mills Ltd.
Hind Syntex Ltd.	Premco Global Ltd.	Suryavanshi Spinning Mills Ltd.
Hindoostan Mills Ltd.	Premier Synthetics Ltd.	T T Ltd.

Thanjavur Spinning Mill Ltd.	Vardhman Polytex Ltd.	Winsome Textile Inds. Ltd.
Trident Ltd.	Vardhman Textiles Ltd.	Wires & Fabriks (S.A.) Ltd.
Uniroyal Industries Ltd.	Virat Industries Ltd.	Zenith Exports Ltd.
V M T Spinning Co. Ltd.	Vogue Textiles Ltd.	Zenith Fibres Ltd.
V T X Industries Ltd.	Voith Paper Fabrics India Ltd.	Zodiac Clothing Co. Ltd.
Valson Industries Ltd.	Welspun India Ltd.	
Vardhman Acrylics Ltd.	Welspun Syntex Ltd.	
Drugs		
Aarti Drugs Ltd.	Hiran Orgochem Ltd.	Samrat Pharmachem Ltd.
Abbott India Ltd.	Ind-Swift Laboratories Ltd.	Sanjivani Paranteral Ltd.
Advik Laboratories Ltd.	Ind-Swift Ltd.	Sanofi India Ltd.
Ahlcon Parenterals (India) Ltd.	Indoco Remedies Ltd.	Shasun Pharmaceuticals Ltd.
Ajanta Pharma Ltd.	Ipca Laboratories Ltd.	Shilpa Medicare Ltd.
Albert David Ltd.	J B Chems & Pharmas Ltd.	Smruthi Organics Ltd.
Alembic Ltd.	Jagsonpal Pharmaceuticals Ltd.	Span Diagnostics Ltd.
Ambalal Sarabhai Ent. Ltd.	Jenburkt Pharmaceuticals Ltd.	Strides Arcolab Ltd.
Amrutanjan Health Care Ltd.	Kamron Laboratories Ltd.	Sun Pharmaceutical Inds. Ltd.
Anglo-French Drugs & Inds. Ltd.	Kerala Ayurveda Ltd.	Surya Pharmaceutical Ltd.
Anuh Pharma Ltd.	Kilitch Drugs (India) Ltd.	Suven Life Sciences Ltd.
Arvind Remedies Ltd.	Kopran Ltd.	Syncom Formulations Ltd.
Astrazeneca Pharma India Ltd.	Lupin Ltd.	T T K Healthcare Ltd.
Aurobindo Pharma Ltd.	Lyka Labs Ltd.	Themis Medicare Ltd.
B D H Industries Ltd.	Makers Laboratories Ltd.	Torrent Pharmaceuticals Ltd.
Bal Pharma Ltd.	Mangalam Drugs & Organic Ltd.	Unichem Laboratories Ltd.
Biocon Ltd.	Marksans Pharma Ltd.	Unjha Formulations Ltd.
Cadila Healthcare Ltd.	Medi-Caps Ltd.	Venus Remedies Ltd.
Caplin Point Laboratories Ltd.	Medicamen Biotech Ltd.	Vikram Thermo (India) Ltd.
Cipla Ltd.	Merck Ltd.	Vimta Labs Ltd.
Claris Lifesciences Ltd.	Morepen Laboratories Ltd.	Vista Pharmaceuticals Ltd.
Colinz Laboratories Ltd.	Mylan Laboratories Ltd.	Wanbury Ltd.
Diamines & Chemicals Ltd.	N G L Fine-Chem Ltd.	Wintac Ltd.
Divi'S Laboratories Ltd.	Natco Pharma Ltd.	Wockhardt Ltd.
Dr. Reddy'S Laboratories Ltd.	Natural Capsules Ltd.	Wyeth Ltd.
East India Pharma Works Ltd.	Nectar Lifesciences Ltd.	Zenotech Laboratories Ltd.
Emami Ltd.	Neuland Laboratories Ltd.	
Emmessar Biotech & Nut Ltd.	Novartis India Ltd.	
Everest Organics Ltd.	Nutraplus India Ltd.	
F D C Ltd.	Ortin Laboratories Ltd.	
Fermenta Biotech Ltd.	Panacea Biotec Ltd.	
Gennex Laboratories Ltd.	Parenteral Drugs (India) Ltd.	
Glaxosmithkline Pharmas Ltd.	Pfizer Ltd.	
Glenmark Pharmaceuticals Ltd.	Piramal Enterprises Ltd.	
Godavari Drugs Ltd.	Plethico Pharmaceuticals Ltd.	
Granules India Ltd.	Ranbaxy Laboratories Ltd.	
Gufic Biosciences Ltd.	Resonance Specialties Ltd.	
Gujarat Themis Biosyn Ltd.	Roopa Industries Ltd.	
Hester Biosciences Ltd.	S M S Pharmaceuticals Ltd.	

Plastics and Polymers		
A P T Packaging Ltd.	M I L Industries Ltd.	
Acrysil Ltd.	Machino Plastics Ltd.	
Apcotex Industries Ltd.	Mahindra Composites Ltd.	
Arcee Industries Ltd.	Mangalore Ref. & Petroche Ltd.	
Arrow Coated Products Ltd.	Manjushree Technopack Ltd.	
Bajaj Steel Inds. Ltd.	Marvel Vinyls Ltd.	
Balmer Lawrie-Van Leer Ltd.	National Plastic Inds. Ltd.	
Bhansali Eng Polymers Ltd.	National Plastic Tech Ltd.	
Bharat Petroleum Corpn. Ltd.	Nilkamal Ltd.	
Bilcare Ltd.	Numaligarh Refinery Ltd.	
Bloom Dekor Ltd.	O K Play India Ltd.	
Bright Brothers Ltd.	Pankaj Polymers Ltd.	
Caprihans India Ltd.	Peacock Industries Ltd.	
Chemplast Sanmar Ltd.	Pearl Polymers Ltd.	
Chennai Petroleum Corpn. Ltd.	Poly Medicure Ltd.	
Cosmo Films Ltd.	Polycon International Ltd.	
Deccan Polypacks Ltd.	Polylink Polymers (India) Ltd.	
Deco-Mica Ltd.	Polyplex Corporation Ltd.	
Dhunseri Petrochem & Tea Ltd.	Polyspin Exports Ltd.	
Dutron Polymers Ltd.	Premier Polyfilm Ltd.	
E P C Industrie Ltd.	Prima Plastics Ltd.	
Ecoplast Ltd.	Raj Packaging Inds. Ltd.	
Essel Propack Ltd.	Reliance Industries Ltd.	
Ester Industries Ltd.	Resins & Plastics Ltd.	
Fenoplast Ltd.	Rubber Products Ltd.	
Finolex Industries Ltd.	Safari Industries (India) Ltd.	
G R P Ltd.	Shaily Engineering Plastics Ltd.	
Garware Polyester Ltd.	Sharp Industries Ltd.	
Graphite India Ltd.	Shree Rama Multi-Tech Ltd.	
Gujarat Craft Inds. Ltd.	Sintex Industries Ltd.	
Gujarat Petrosynthese Ltd.	Sonal Adhesives Ltd.	
Hindustan Fluorocarbons Ltd.	Stylam Industries Ltd.	
Hindustan Petroleum Corpn. Ltd.	Styrolution A B S (India) Ltd.	
Hitech Plast Ltd.	Supreme Industries Ltd.	
Hydro S & S Inds. Ltd.	Supreme Petrochem Ltd.	
Indian Oil Corpn. Ltd.	T P L Plastech Ltd.	
Infra Industries Ltd.	Tokyo Plast International Ltd.	
International Conveyors Ltd.	Uflex Ltd.	
Iykot Hitech Toolroom Ltd.	V I P Industries Ltd.	
Jai Corp Ltd.	Vinyoflex Ltd.	
Jain Irrigation Systems Ltd.	Wim Plast Ltd.	
Jalpac India Ltd.	Xpro India Ltd.	
Jindal Poly Films Ltd.		
Jumbo Bag Ltd.		
Kalpena Industries Ltd.		
Kanpur Plastipack Ltd.		
Kemrock Ind & Exports Ltd.		
Kriti Industries (India) Ltd.		

Other Chemicals		
Aarti Industries Ltd.	Gujarat Organics Ltd.	Premier Explosives Ltd.
Adi Finechem Ltd.	Gujarat State Fert. & Chem Ltd.	Punjab Alkalies & Chem. Ltd.
Aditya Birla Chemicals Ltd.	Gulf Oil Corpn. Ltd.	Punjab Chem & Crop Pro. Ltd.
Aimco Pesticides Ltd.	Gulshan Polyols Ltd.	Rallis India Ltd.
Aksharchem (India) Ltd.	Haryana Leather Chemicals Ltd.	Rama Phosphates Ltd.
Alkyl Amines Chemicals Ltd.	Hikal Ltd.	Rashtriya Chemicals & Fert Ltd.
Amines & Plasticizers Ltd.	Hindustan Organic Chem. Ltd.	Refnol Resins & Chemicals Ltd.
Andhra Petrochemicals Ltd.	I G Petrochemicals Ltd.	Rhodia Specialty Chem Ltd.
Andhra Sugars Ltd.	I O L Chem & Pharma. Ltd.	Ritesh International Ltd.
Atul Ltd.	I V P Ltd.	Sabero Organics Gujarat Ltd.
Avon Organics Ltd.	India Carbon Ltd.	Sah Petroleums Ltd.
Bagadia Colourchem Ltd.	India Gelatine & Chem. Ltd.	Savita Oil Technologies Ltd.
Balaji Amines Ltd.	Indian Farmers Fert. Co-Op. Ltd.	Shiva Global Agro Inds. Ltd.
Basant Agro Tech (India) Ltd.	Indian Toners & Developers Ltd.	Southern Gas Ltd.
Bayer Cropscience Ltd.	Indo Borax & Chemicals Ltd.	Sree Rayalaseema Chem Ltd.
Bhagiradha Chem. & Inds. Ltd.	Inox Air Products Ltd.	Sree Rayalaseema Hi-S H. Ltd.
Bharat Rasayan Ltd.	Jayshree Chemicals Ltd.	Sterling Biotech Ltd.
Bodal Chemicals Ltd.	Jubilant Life Sciences Ltd.	Sudarshan Chemical Inds. Ltd.
Bombay Oxygen Corpn. Ltd.	Kanoria Chemicals & Inds. Ltd.	Sunshield Chemicals Ltd.
Borax Morarji Ltd.	Keltech Energies Ltd.	Syngenta India Ltd.
C J Gelatine Products Ltd.	Khaitan Chem. & Fert. Ltd.	Tamilnadu Petroproducts Ltd.
Camphor & Allied Products Ltd.	Kilpest India Ltd.	Tanfac Industries Ltd.
Castrol India Ltd.	Kothari Industrial Corpn. Ltd.	Tata Chemicals Ltd.
Chambal Fertilisers & Chem Ltd.	Liberty Phosphate Ltd.	Teesta Agro Inds. Ltd.
Chembond Chemicals Ltd.	Lime Chemicals Ltd.	Thirumalai Chemicals Ltd.
Chemfab Alkalis Ltd.	Link Pharma Chem Ltd.	Tide Water Oil Co. (India) Ltd.
Continental Petroleums Ltd.	Madras Fertilizers Ltd.	Transpek Industry Ltd.
Coromandel International Ltd.	Manali Petrochemicals Ltd.	Tuticorin Alkali Ch. & Fert Ltd.
D I C India Ltd.	Mangalore Chem & Fert. Ltd.	U P L Ltd.
Dai-Ichi Karkaria Ltd.	Mysore Petro Chemicals Ltd.	Ultramarine & Pigments Ltd.
Deepak Fert.& Petroch Co. Ltd.	Narmada Gelatines Ltd.	Venlon Enterprises Ltd.
Deepak Nitrite Ltd.	National Fertilizers Ltd.	Vidhi Dyestuffs Manuf. Ltd.
Dhanuka Agritech Ltd.	National Oxygen Ltd.	Vinati Organics Ltd.
Dharamsi Morarji Chem Co. Ltd.	National Peroxide Ltd.	Vivid Global Inds. Ltd.
Dynamic Industries Ltd.	Navin Fluorine Intl. Ltd.	
Excel Crop Care Ltd.	Nikhil Adhesives Ltd.	
Excel Industries Ltd.	Nirma Ltd.	
Fert. & Chem Travancore Ltd.	Nitta Gelatin India Ltd.	
Fischer Chemic Ltd.	Organic Coatings Ltd.	
Foseco India Ltd.	P I Industries Ltd.	
G H C L Ltd.	Panama Petrochem Ltd.	
Goa Carbon Ltd.	Phillips Carbon Black Ltd.	
Godrej Industries Ltd.	Phyto Chem (India) Ltd.	
Govind Poy Oxygen Ltd.	Pidilite Industries Ltd.	
Grauer & Weil (India) Ltd.	Pioneer Distilleries Ltd.	
Gujarat Alkalies & Chem. Ltd.	Plastiblends India Ltd.	
Gujarat Fluorochemicals Ltd.	Poddar Pigments Ltd.	
Gujarat Narmada Val. F&C Ltd.	Pondy Oxides & Chemicals Ltd.	

Consumer Goods		
Aplab Ltd.	Moser Baer India Ltd.	
Aquamall Water Solutions Ltd.	Mro-Tek Ltd.	
Archies Ltd.	Navneet Education Ltd.	
Asian Electronics Ltd.	Opto Circuits (India) Ltd.	
Asian Star Co. Ltd.	Panasonic Energy India Co. Ltd.	
Astra Microwave Products Ltd.	Pee Cee Cosma Sope Ltd.	
Avantel Ltd.	Philips Electronics India Ltd.	
B P L Ltd.	Pond'S Exports Ltd.	
Bajaj Electricals Ltd.	P&G Hygiene&Health Care Ltd.	
Bata India Ltd.	Relaxo Footwears Ltd.	
Bharat Electronics Ltd.	Repro India Ltd.	
Bhartiya International Ltd.	Rexnord Elect & Controls Ltd.	
Butterfly Gandhimathi Appl. Ltd.	Ruttonsha Intl Rectifier Ltd.	
Centenial Surgical Suture Ltd.	S P E L Semiconductor Ltd.	
Centum Electronics Ltd.	S R Industries Ltd.	
Colgate-Palmolive (India) Ltd.	Sambhaav Media Ltd.	
Continental Controls Ltd.	Sandesh Ltd.	
Cosmo Ferrites Ltd.	Schneider El. President Sys Ltd.	
Cyber Media (India) Ltd.	Shantivijay Jewels Ltd.	
Dabur India Ltd.	Shree Pacetronix Ltd.	
Daikaffil Chemicals India Ltd.	Shrenuj & Co. Ltd.	
Eveready Industries (India) Ltd.	Smartlink Network Systems Ltd.	
F C I Oen Connectors Ltd.	Sovereign Diamonds Ltd.	
Fine-Line Circuits Ltd.	Starlite Components Ltd.	
Godrej Consumer Products Ltd.	Suashish Diamonds Ltd.	
Goldiam International Ltd.	Super Tannery Ltd.	
Golkunda Diamond & Jewel Ltd.	Superhouse Ltd.	
Gujarat Poly-Avx Elect. Ltd.	Swelect Energy Systems Ltd.	
H T Media Ltd.	Symphony Ltd.	
Hawkins Cookers Ltd.	T C P L Packaging Ltd.	
Hind Rectifiers Ltd.	T V S Electronics Ltd.	
Hindustan Unilever Ltd.	Titan Company Ltd.	
Hipolin Ltd.	Trend Electronics Ltd.	
Hitachi Home & Life Sol. Ltd.	V X L Instruments Ltd.	
Honeywell Autom. India Ltd.	Vaibhav Global Ltd.	
I F B Industries Ltd.	Valiant Communications Ltd.	
Incap Ltd.	Value Industries Ltd.	
Indo- National Ltd.	Whirlpool Of India Ltd.	
Jagran Prakashan Ltd.	Worldwide Leather Exports Ltd.	
Jocil Ltd.		
Kaycee Industries Ltd.		
Krypton Industries Ltd.		
Lakshmi Elect. Control Sys. Ltd.		
Liberty Shoes Ltd.		
Lloyd Electric & Engg. Ltd.		
M P S Ltd.		
Mirc Electronics Ltd.		
Mirza International Ltd.		

Construction & Infrastructure Equipment		
A C C Ltd.	N C L Industries Ltd.	
Aksh Optifibre Ltd.	O C L India Ltd.	
Akzo Nobel India Ltd.	Orient Abrasives Ltd.	
Ambuja Cements Ltd.	Orient Bell Ltd.	
Anjani Portland Cement Ltd.	Panyam Cem & Mineral Ins. Ltd.	
Apar Industries Ltd.	Paramount Communications Ltd.	
Aro Granite Inds. Ltd.	Pokarna Ltd.	
Asian Paints Ltd.	Polycab Wires Pvt. Ltd.	
Berger Paints India Ltd.	Precision Wires India Ltd.	
Bheema Cements Ltd.	Raasi Refractories Ltd.	
Birla Corporation Ltd.	Ram Ratna Wires Ltd.	
Birla Ericsson Optical Ltd.	Ramco Cements Ltd.	
Cable Corpn. Of India Ltd.	Ramco Industries Ltd.	
Carborundum Universal Ltd.	Regency Ceramics Ltd.	
Century Plyboards (India) Ltd.	Restile Ceramics Ltd.	
Century Textiles & Inds. Ltd.	Sagar Cements Ltd.	
Cera Sanitaryware Ltd.	Sanghi Industries Ltd.	
Chettinad Cement Corpn. Ltd.	Sarda Plywood Inds. Ltd.	
Deccan Cements Ltd.	Saurashtra Cement Ltd.	
Diamond Power Infra Ltd.	Schablona India Ltd.	
Divyashakti Granites Ltd.	Shalimar Paints Ltd.	
Ecoboard Industries Ltd.	Shiva Cement Ltd.	
Elantas Beck India Ltd.	Shree Cement Ltd.	
Everest Industries Ltd.	Shri Keshav Cement & Infra Ltd.	
Finolex Cables Ltd.	Shri Nataraj Cer&Chem Ind. Ltd.	
Galada Power & Tele Ltd.	Somany Ceramics Ltd.	
Greenply Industries Ltd.	Sterlite Technologies Ltd.	
Grindwell Norton Ltd.	Surana Telecom & Power Ltd.	
Gujarat Sidhee Cement Ltd.	T R L Krosaki Refractories Ltd.	
H E G Ltd.	U M Cables Ltd.	
H I L Ltd.	Universal Cables Ltd.	
Heidelberg Cement India Ltd.	Vesuvius India Ltd.	
Himadri Chemicals & Inds. Ltd.	Vinay Cements Ltd.	
I F G L Refractories Ltd.	Vindhya Telelinks Ltd.	
India Cements Ltd.	Visaka Industries Ltd.	
J K Lakshmi Cement Ltd.	Western India Plywoods Ltd.	
Jenson & Nicholson (India) Ltd.		
Jolly Board Ltd.		
K C P Ltd.		
Kajaria Ceramics Ltd.		
Kalyanpur Cements Ltd.		
Kansai Nerolac Paints Ltd.		
Keerthi Industries Ltd.		
Kei Industries Ltd.		
Madhav Marbles & Granites Ltd.		
Mangalam Cement Ltd.		
Mangalam Timber Products Ltd.		
Morganite Crucible (India) Ltd.		

Metal Products		
A P L Apollo Tubes Ltd.	J S W Steel Ltd.	Ratnamani Metals & Tubes Ltd.
Aditya Ispat Ltd.	Jai Balaji Inds. Ltd.	Real Strips Ltd.
Ahmednagar Forgings Ltd.	Jayaswal Neco Inds. Ltd.	Remi Edelstahl Tubulars Ltd.
Alicon Castalloy Ltd.	Jindal Saw Ltd.	Sacheta Metals Ltd.
Alumeco India Extrusion Ltd.	Jindal Stainless Ltd.	Salzer Electronics Ltd.
Amtek India Ltd.	Jindal Steel & Power Ltd.	Sarda Energy & Minerals Ltd.
Anil Special Steel Inds. Ltd.	Jyoti Structures Ltd.	Shah Alloys Ltd.
Balasore Alloys Ltd.	Kaira Can Co. Ltd.	Shivalik Bimetal Controls Ltd.
Bhagwati Autocast Ltd.	Kalpataru Power Trans. Ltd.	Shri Bajrang Alloys Ltd.
Bhagyanagar India Ltd.	Kalyani Steels Ltd.	Simplex Castings Ltd.
Bhoruka Aluminium Ltd.	Kanishk Steel Inds. Ltd.	Skipper Ltd.
Bhushan Power & Steel Ltd.	Kirloskar Ferrous Inds. Ltd.	Southern Ispat & Energy Ltd.
Bhushan Steel Ltd.	L G Balakrishnan & Bros. Ltd.	Steel Authority Of India Ltd.
Bihar Sponge Iron Ltd.	Lakshmi Precision Screws Ltd.	Steelcast Ltd.
Carnation Industries Ltd.	Lamina Foundries Ltd.	Steelco Gujarat Ltd.
Century Extrusions Ltd.	Lanco Industries Ltd.	Sterling Tools Ltd.
Cubex Tubings Ltd.	Lloyds Metals & Energy Ltd.	Sudal Industries Ltd.
E L Forge Ltd.	M M Forgings Ltd.	Sujana Metal Products Ltd.
Electrosteel Castings Ltd.	Magna Electro Castings Ltd.	Sundaram-Clayton Ltd.
Electrotherm (India) Ltd.	Maharashtra Seamless Ltd.	Sunflag Iron & Steel Co. Ltd.
Essar Steel India Ltd.	Mahindra Hinoday Inds. Ltd.	Super Forgings & Steels Ltd.
Everest Kanto Cylinder Ltd.	Mahindra Intertrade Ltd.	Suraj Ltd.
Ferro Alloys Corpn. Ltd.	Mahindra Ugine Steel Co. Ltd.	Suraj Products Ltd.
Fluidomat Ltd.	Maithan Alloys Ltd.	Surana Industries Ltd.
G K W Ltd.	Man Industries (India) Ltd.	Surya Roshni Ltd.
Gandhi Special Tubes Ltd.	Manaksia Ltd.	Swiss Glascoat Equipments Ltd.
Garg Furnace Ltd.	Modern Steels Ltd.	T T K Prestige Ltd.
Gillette India Ltd.	Monnet Ispat & Energy Ltd.	Tamilnadu Steel Tubes Ltd.
Godawari Power & Ispat Ltd.	Mukand Ltd.	Tata Metaliks Ltd.
Gontermann-Peipers (India) Ltd.	Multimetals Ltd.	Tata Sponge Iron Ltd.
Good Luck Steel Tubes Ltd.	National Aluminium Co. Ltd.	Tata Steel Ltd.
Gujarat Foils Ltd.	National Fittings Ltd.	Tayo Rolls Ltd.
Gujarat Intrux Ltd.	Nile Ltd.	Tinplate Co. Of India Ltd.
Gujarat Wedge Wire Scr. Ltd.	Nitin Alloys Global Ltd.	Tube Investments Of India Ltd.
Hind Aluminium Inds. Ltd.	Nova Iron & Steel Ltd.	Tulsyan N E C Ltd.
Hindalco Industries Ltd.	Oil Country Tubular Ltd.	Uni Abex Alloy Products Ltd.
Hinduja Foundries Ltd.	Orissa Sponge Iron & Steel Ltd.	Usha Martin Ltd.
Hindustan Copper Ltd.	Panchmahal Steel Ltd.	Uttam Galva Steels Ltd.
Hindustan Everest Tools Ltd.	Pradeep Metals Ltd.	V B C Ferro Alloys Ltd.
Hindustan Zinc Ltd.	Prakash Industries Ltd.	Vallabh Steels Ltd.
Hisar Metal Inds. Ltd.	Proseal Closures Ltd.	Vardhman Industries Ltd.
I S M T Ltd.	R M G Alloy Steel Ltd.	Vishal Malleables Ltd.
India Steel Works Ltd.	Rajasthan Tube Mfg. Co. Ltd.	Welcast Steels Ltd.
Indian Metals & Ferro A. Ltd.	Rajkumar Forge Ltd.	Welspun Corp Ltd.
Indian Steel & Wire Prod. Ltd.	Rajratan Global Wire Ltd.	Western India Shipyard Ltd.
Indsil Hydro Power & Man. Ltd.	Ramkrishna Forgings Ltd.	Zenith Birla (India) Ltd.
Investment & Precision Cast Ltd.	Rapicut Carbides Ltd.	
J S W Ispat Steel Ltd. [Merged]	Rathi Steel & Power Ltd.	

Machinery		
A B B India Ltd.	Hittco Tools Ltd.	T I L Ltd.
A B C Bearings Ltd.	Honda Siel Power Products Ltd.	T R F Ltd.
Acrow India Ltd.	I M P Powers Ltd.	Thermax Ltd.
Adarsh Plant Protect Ltd.	I T L Industries Ltd.	Timken India Ltd.
Ador Fontech Ltd.	Ingersoll-Rand (India) Ltd.	U T Ltd.
Ador Welding Ltd.	International Combustion Ltd.	V S T Tillers Tractors Ltd.
Akar Tools Ltd.	Ion Exchange (India) Ltd.	Veejay Lakshmi Engg. W. Ltd.
Alfa Transformers Ltd.	J S L Industries Ltd.	Voltamp Transformers Ltd.
Anup Engineering Ltd.	Jainex Aamcol Ltd.	W P I L Ltd.
Atlas Copco (India) Ltd.	Jost'S Engineering Co. Ltd.	Walchandnagar Industries Ltd.
Austin Engineering Co. Ltd.	K S B Pumps Ltd.	Wendt (India) Ltd.
B E M L Ltd.	Kennametal India Ltd.	Windsor Machines Ltd.
Batliboi Ltd.	Kilburn Engineering Ltd.	Yuken India Ltd.
Bemco Hydraulics Ltd.	Kirloskar Brothers Ltd.	
Bharat Bijlee Ltd.	Kirloskar Electric Co. Ltd.	
Bharat Heavy Electricals Ltd.	Kirloskar Pneumatic Co. Ltd.	
Birla Precision Tech. Ltd.	Kulkarni Power Tools Ltd.	
Blue Star Ltd.	L & T Valves Ltd.	
Brady & Morris Engg. Co. Ltd.	Manugraph India Ltd.	
C T R Manufacturing Inds. Ltd.	Marsons Ltd.	
Calcom Vision Ltd.	Mather & Platt Pumps Ltd.	
Cenlub Industries Ltd.	Mazda Ltd.	
Crompton Greaves Ltd.	Mcnally Bharat Engg. Co. Ltd.	
Cummins India Ltd.	Mcnally Sayaji Engg. Ltd.	
D & H India Ltd.	Miven Machine Tools Ltd.	
D H P India Ltd.	Modison Metals Ltd.	
Delta Magnets Ltd.	N R B Bearings Ltd.	
E C E Industries Ltd.	Orient Paper & Inds. Ltd.	
Easun Reyrolle Ltd.	Panasonic Carbon India Co. Ltd.	
Eimco Elecon (India) Ltd.	Pitti Laminations Ltd.	
Elecon Engineering Co. Ltd.	Polymechplast Machines Ltd.	
Elgi Equipments Ltd.	Praj Industries Ltd.	
Ema India Ltd.	Premier Ltd.	
Emco Ltd.	Rajoo Engineers Ltd.	
Envair Electrodyne Ltd.	Rasi Electrodes Ltd.	
Esab India Ltd.	Remi Process Plant & Mach. Ltd.	
F A G Bearings India Ltd.	Revathi Equipment Ltd.	
Fairfield Atlas Ltd.	S M Energy Teknik & Elec. Ltd.	
Forbes & Co. Ltd.	S N L Bearings Ltd.	
Frick India Ltd.	Shakti Pumps (India) Ltd.	
G E E Ltd.	Shanthi Gears Ltd.	
G G D. Machine Works Ltd.	Shilchar Tech. Ltd.	
G M M Pfaudler Ltd.	Shilp Gravures Ltd.	
Goldstone Infratech Ltd.	Siemens Ltd.	
Greaves Cotton Ltd.	Solitaire Machine Tools Ltd.	
Gujarat Apollo Inds. Ltd.	Stovec Industries Ltd.	
Havells India Ltd.	Suzlon Energy Ltd.	
Hercules Hoists Ltd.	Swaraj Engines Ltd.	

Transport Equipment		
A B G Shipyard Ltd.	Indag Rubber Ltd.	T V S Motor Co. Ltd.
A N G Industries Ltd.	India Nippon Electricals Ltd.	T V S Srichakra Ltd.
Amalgamations Repco Ltd.	J K Tyre & Inds. Ltd.	Talbros Auto. Components Ltd.
Amara Raja Batteries Ltd.	J M T Auto Ltd.	Talbros Engineering Ltd.
Amtek Auto Ltd.	Jamna Auto Inds. Ltd.	Taneja Aero. & Aviation Ltd.
Apollo Tyres Ltd.	Jay Bharat Maruti Ltd.	Tata Motors Ltd.
Ashok Leyland Ltd.	Jay Ushin Ltd.	Triton Valves Ltd.
Atlas Cycles (Haryana) Ltd.	K A R Mobiles Ltd.	Ucal Fuel Systems Ltd.
Atul Auto Ltd.	Kalyani Forge Ltd.	Victor Gaskets India Ltd.
Autolite (India) Ltd.	Kesoram Industries Ltd.	Wheels India Ltd.
Automobile Corpn. Of Goa Ltd.	Kinetic Engineering Ltd.	Z F Steering Gear (India) Ltd.
Automotive Axles Ltd.	L M L Ltd.	
Automotive Stamp. & Ass. Ltd.	Lumax Industries Ltd.	
Axles India Ltd.	M R F Ltd.	
Balkrishna Industries Ltd.	Mahindra Gujarat Tractor Ltd.	
Banco Products (India) Ltd.	Majestic Auto Ltd.	
Bharat Forge Ltd.	Maruti Suzuki India Ltd.	
Bharat Gears Ltd.	Menon Bearings Ltd.	
Bharat Seats Ltd.	Menon Pistons Ltd.	
Bharati Shipyard Ltd.	Minda Industries Ltd.	
Bimetal Bearings Ltd.	Motherson Sumi Systems Ltd.	
Bosch Ltd.	Munjal Auto Inds. Ltd.	
Ceat Ltd.	Munjal Showa Ltd.	
Delphi-T V S Diesel Sys. Ltd.	Omax Autos Ltd.	
Denso India Ltd.	Perfect Circle India Ltd.	
Dynamatic Technologies Ltd.	Precision Pipes & Pro. Co. Ltd.	
Eastern Treads Ltd.	Pricol Ltd.	
Eicher Motors Ltd.	Rasandik Engg Inds. India Ltd.	
Eimco-K C P Ltd.	Raunaq Auto Components Ltd.	
Escorts Ltd.	Reil Electricals India Ltd.	
Exide Industries Ltd.	Remsons Industries Ltd.	
Falcon Tyres Ltd.	Rico Auto Inds. Ltd.	
Federal-Mogul Goetze Ltd.	Roto Pumps Ltd.	
Force Motors Ltd.	S M L Isuzu Ltd.	
Gabriel India Ltd.	San Engg & Loco. Co. Ltd.	
Goodyear India Ltd.	Schrader Duncan Ltd.	
Govind Rubber Ltd.	Scooters India Ltd.	
Gujarat Automotive Gears Ltd.	Setco Automotive Ltd.	
H B L Power Systems Ltd.	Sharda Motor Inds. Ltd.	
H M T Ltd.	Shriram Pistons & Rings Ltd.	
Harita Seating Systems Ltd.	Sibar Auto Parts Ltd.	
Hero Motocorp Ltd.	Simmonds Marshall Ltd.	
Hi-Tech Gears Ltd.	Sona Koyo Steering Sys. Ltd.	
High Energy Batteries Ltd.	Steel Strips Wheels Ltd.	
Hindustan Composites Ltd.	Subros Ltd.	
Hindustan Hardy Spicer Ltd.	Sundaram Brake Linings Ltd.	
Hindustan Motors Ltd.	Sundram Fasteners Ltd.	
I P Rings Ltd.	Suprajit Engineering Ltd.	

Miscellaneous Manufacturing		
Aditya Birla Nuvo Ltd.	National Steel & Agro Inds. Ltd.	
Agio Paper & Inds. Ltd.	Orient Press Ltd.	
Alstom T & D India Ltd.	Paper Products Ltd.	
Andhra Pradesh Paper Mills Ltd.	Perfectpac Ltd.	
Asahi India Glass Ltd.	Permanent Magnets Ltd.	
B & A Packaging India Ltd.	Phoenix Lamps Ltd.	
B A S F India Ltd.	Photoquip (India) Ltd.	
B P Ergo Ltd.	Poona Dal & Oil Inds. Ltd.	
Ballarpur Industries Ltd.	Pudumjee Industries Ltd.	
Balmer Lawrie & Co. Ltd.	Pudumjee P & P Mills Ltd.	
Beardsell Ltd.	Rainbow Papers Ltd.	
Bombay Burmah Trdg. Co. Ltd.	Rama Pulp & Papers Ltd.	
Borosil Glass Works Ltd.	Ray Ban Sun Optics India Ltd.	
Ceeta Industries Ltd.	S I Group-India Ltd.	
Clariant Chemicals (India) Ltd.	Saint-Gobain Sekurit India Ltd.	
Coral Newsprints Ltd.	Seshasayee Paper & Boards Ltd.	
Cosboard Industries Ltd.	Shree Ajit Pulp & Paper Ltd.	
D C M Shriram Consolid. Ltd.	Shree Bhawani Paper Mills Ltd.	
D C M Shriram Inds. Ltd.	Shree Krishna P. Mill & Ind Ltd.	
D C W Ltd.	Shree Rama Newsprint Ltd.	
De Nora India Ltd.	Shreyans Industries Ltd.	
Emami Paper Mills Ltd.	Sirpur Paper Mills Ltd.	
G K B Ophthalmics Ltd.	South India Paper Mills Ltd.	
Genus Power Infrastructures Ltd.	Standard Industries Ltd.	
Gillanders Arbuthnot & Co. Ltd.	Star Paper Mills Ltd.	
Goa Glass Fibre Ltd.	Sundaram Multi Pap Ltd.	
Gujarat Borosil Ltd.	T A L Manuf. Solutions Ltd.	
H S I L Ltd.	Tamil Nadu N. & Papers Ltd.	
Haldyn Glass Ltd.	Technocraft Ind. (India) Ltd.	
Hindustan National G & Ind Ltd	Techtran Polylenses Ltd.	
I S T Ltd.	Texplast Industries Ltd.	
Impex Ferro Tech Ltd.	Timex Group India Ltd.	
India Glycols Ltd.	Today'S Writing Instruments Ltd.	
Integra Engineering India Ltd.	U P Twiga Fiberglass Ltd.	
J K Paper Ltd.	Uttam Value Steels Ltd.	
Jaiprakash Associates Ltd.	Varun Industries Ltd.	
Jyothy Laboratories Ltd.	Visa Steel Ltd.	
K D D L Ltd.	West Coast Paper Mills Ltd.	
Kakatiya Cement Sugar & Inds. Ltd.	Wimco Ltd.	
Kalptaru Papers Ltd.	Yash Papers Ltd.	
Kokuyo Camlin Ltd.	Yokogawa India Ltd.	
La Opala R G Ltd.		
Lakshmi Automatic Loom Works Ltd.		
Linc Pen & Plastics Ltd.		
Magnum Ventures Ltd.		
Mahindra & Mahindra Ltd.		
Murli Industries Ltd.		
N R Agarwal Inds. Ltd.		

ANNEXURE II

	DEA		NWC		NTC	
	Adjusted R Squared	Durbin Watson Statistics	Adjusted R Squared	Durbin Watson Statistics	Adjusted R Squared	Durbin Watson Statistics
Food & Agro Products	0.750	1.576	0.736	1.528	0.735	1.525
	0.741	1.606	0.762	1.565	0.737	1.564
	0.818	1.195	0.773	1.178	0.769	1.151
	0.535	1.959	0.524	1.993	0.532	1.982
	0.691	1.296	0.666	1.281	0.659	1.250
	0.198	1.986	0.202	1.962	0.183	1.975
Textiles	0.551	1.803	0.539	1.824	0.536	1.810
	0.589	1.735	0.593	1.729	0.587	1.727
	0.966	1.422	0.965	1.421	0.965	1.424
	0.088	2.067	0.106	2.017	0.069	2.051
	0.906	1.444	0.900	1.403	0.900	1.401
	0.068	2.081	0.060	2.073	0.068	2.122
Drug & Pharma	0.689	1.599	0.685	1.608	0.691	1.622
	0.566	1.697	0.561	1.663	0.581	1.683
	0.742	1.526	0.746	1.531	0.745	1.527
	0.585	1.767	0.592	1.789	0.580	1.799
	0.763	1.490	0.767	1.491	0.766	1.487
	0.624	1.648	0.625	1.675	0.602	1.702
Plastic & Polymer	0.508	1.762	0.535	1.797	0.549	1.790
	0.528	1.762	0.609	1.794	0.609	1.791
	0.922	1.542	0.927	1.541	0.927	1.532
	0.325	1.913	0.284	1.904	0.323	1.902
	0.863	1.534	0.865	1.571	0.861	1.567
	0.411	1.732	0.428	1.748	0.428	1.746
Other Chemical	0.673	1.619	0.687	1.616	0.691	1.624
	0.645	1.607	0.645	1.629	0.638	1.598
	0.885	1.579	0.895	1.575	0.894	1.580
	0.445	1.836	0.485	1.837	0.493	1.843
	0.739	1.482	0.743	1.490	0.754	1.490
	-0.013	2.105	-0.014	2.159	-0.008	2.151
Consumer Products	0.717	1.351	0.730	1.368	0.728	1.371
	0.684	1.424	0.684	1.432	0.687	1.427
	0.767	1.481	0.756	1.445	0.756	1.441
	0.587	1.878	0.591	1.876	0.590	1.876
	0.761	1.458	0.759	1.466	0.758	1.464
	0.574	1.515	0.582	1.488	0.572	1.459
Construction & Infra Equipment	0.674	1.507	0.676	1.501	0.678	1.503
	0.505	1.619	0.583	1.664	0.496	1.632
	0.743	1.501	0.744	1.513	0.749	1.511
	0.296	2.025	0.370	1.966	0.362	1.962
	0.574	1.335	0.572	1.330	0.577	1.347
	0.308	1.960	0.357	1.851	0.399	1.994
Metal Products	0.616	1.555	0.636	1.537	0.616	1.562
	0.688	1.509	0.693	1.503	0.693	1.499

	0.880	1.653	0.724	1.680	0.737	1.673
	0.226	1.938	0.306	1.913	0.283	1.929
	0.696	1.545	0.676	1.595	0.669	1.579
	0.313	1.722	0.378	1.701	0.272	1.768
Machinery	0.687	1.509	0.660	1.464	0.663	1.479
	0.699	1.491	0.727	1.528	0.703	1.543
	0.568	1.453	0.586	1.479	0.585	1.495
	0.359	1.940	0.366	1.930	0.362	1.915
	0.583	1.384	0.610	1.427	0.615	1.460
	0.451	1.426	0.507	1.429	0.500	1.441
Transport Equipment	0.701	1.550	0.698	1.547	0.697	1.546
	0.689	1.572	0.690	1.568	0.694	1.564
	0.662	1.439	0.660	1.433	0.663	1.442
	0.053	2.121	0.136	2.107	0.138	2.112
	0.633	1.440	0.629	1.440	0.630	1.443
	0.267	1.706	0.268	1.707	0.266	1.702
Misc. Manufacturing	0.532	1.654	0.527	1.630	0.525	1.610
	0.133	1.902	0.296	1.744	0.141	1.847
	0.753	1.518	0.768	1.505	0.769	1.527
	0.304	2.005	0.335	1.980	0.334	1.986
	0.613	1.568	0.644	1.558	0.637	1.581
	0.116	1.903	0.288	2.011	0.116	1.924

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List of Publications

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1. "Working Capital Management Efficiency: A Two-stage DEA Approach", *International Journal of Business Excellence,* Inderscience Publications (Forthcoming) (ABDC listed & Scopus indexed journal)
2. "Analysing Efficiency Change in Working Capital Management using Malmquist Productivity Index", *Journal of Information and Optimization Sciences*, Taylor & Francis Publications, (Accepted for publication)
3. "Working Capital Management Efficiency in Indian Manufacturing Sector: Trends and Determinants", *International Journal of Economics and Business Research*, Inderscience Publications , Vol. 10, No.1, 2015 (ABDC listed journal)
4. "A DEA Approach to Working Capital Management Efficiency", *Indore Management Journal*, IIM-Indore, Vol. 6, No.1, 2015.
5. "Impact of Corporate Governance Practices on Working Capital Management Efficiency", *Indian Journal of Finance*, Vol. 9, No. 1, 2015 (Scopus indexed journal)

Papers presented and published in Conference Proceedings

1. "Operating Liquidity and Financial Leverage: Evidences from Indian Machinery Industry", XVIII Annual International Conference of SOM Opportunities, IIT Roorkee, December 12-14, 2014. (Published in Procedia Social and Behavioral Sciences, Elsevier, Vol. 189, 2015**)**
2. "Exploring Alternate Measures of Working Capital Management Efficiency", Global Conference on Managing in Recovering Markets, MDI Gurgaon, March 11 – 13, 2015 (Published)
3. "Analysing the Characteristics of Working Capital Management in Indian Manufacturing Sector", International Conference on Advances in Management and Technology: Mapping Strengths with Opportunities, MNNIT, Allahabad January 29-31, 2015 (proceedings published by McGraw Hill) (**Best paper award**).