Sector-wise Performance of Working Capital Management Measures and Profitability Using Ratio Analysis

Abdul Raheman

(Corresponding Author)

Asst. Professor, University Institute of Management Sciences, PMAS-Arid Agri. University Rawalpindi & PhD Scholar, Department of Management Sciences, COMSATS Institute of Information Technology, Islamabad, Pakistan.

Dr. Abdul Qayyum

Professor / Registrar, Pakistan Institute of Development Economics, Islamabad, Pakistan.

Dr. Talat Afza

Professor , Faculty of Management Sciences, COMSATS Institute of Information Technology, Lahore, Pakistan

Abstract

Working capital management efficiency plays a very significant and vital role in the performance of a manufacturing firm, where a major part of assets is composed of current assets. Therefore, the level of Working Capital must be properly determined and allocated to various segments, effectively controlled and regularly reviewed in order to have adequate and efficient flow of working capital. In this perspective, this paper analyzes working capital management performance of manufacturing sectors by using different working capital management measures which include Cash Conversion Cycle (CCC), Net Trade Cycle (NTC), Receivable Turnover in Days (RTD), Inventory Turnover in Days (ITID), Payable Turnover in Days (PTD) and Return on Total Assets (ROTA). It also compares the ranking of sectors/industries based on working capital management performance in order to identify the prominent and laggard sectors. This study covers a period of 10 years from 1998 to 2007 for 204 manufacturing and trading firms listed at Karachi Stock Exchange and classified in 24 sectors. In general the sectors which are leading on the basis of overall average results are also among the leading sectors throughout the study period. There is divergence among sectors over 1998-2007 in terms of working capital measures and corporate profitability. Sector-wise working capital management performance reveals that CCC and NTC, both comprehensive measures provide almost similar results. Oil & Gas Exploration and Refinery, Cement, Fertilizer and Oil and Gas Marketing sectors are on top based on both measures of working capital management. Above sectors are also among the leading sectors according to inventory turnover measure of working capital management performance. Similarly sectors which are laggard in terms of CCC and NTC are mainly due to inefficiency in ITID and RTD. Therefore, the laggard sectors must review their inventory and collection policy in order to be efficient in working capital management. There are few sectors which are although among the efficient sectors in terms of working capital but still among the laggard in terms of profitability such as Cement, Sugar and Vanaspati & Allied sectors. All Textile sectors are among the laggard sectors in terms of working capital management measures and ROTA. The cable and electric goods, Engineering and Pharmaceutical sectors are the laggard in terms of CCC because of problems and inefficiency with their inventory and collection policy. Dominant and laggard sectors in terms of working capital performance are mainly attributed to their inventory turnover in days. In most cases, the CCC and NTC is driven by the inventory turnover of the firm.

Keywords: Cash Conversion Cycle, Receivable Turnover in Days, Inventory Turnover in Days, Payable Turnover in Days, Net Trade Cycle, Karachi Stock Exchange

1. Introduction

The working capital management has become a very important part of a firm's financial management because its management not only affects the survival of firm but the performance of firm is also dependant on how effectively and efficiently working capital is utilized in the firm's operations. Therefore, it is vitally important to see that how working capital management policies affect the corporate performance. Traditionally, the primary objective of Working Capital management was considered to maintain sufficient cash to meet the claims of current maturity of creditors. However, the concept of working capital management has changed and now a

days it also includes management of all current assets including cash, marketable securities, accounts receivable, inventory as well as the current liabilities. Therefore, the level of Working Capital must be properly determined and allocated to various segments, effectively controlled and regularly reviewed in order to have adequate and efficient flow of working capital. Maintaining liquidity was one of the prime goals of the firms for number of years and they strive to maintain higher liquidity to safeguard against risk of default. This focus was mainly due to the reason that, at that time the financial viability of firms was associated with their liquidity.

Eventually, it was felt that maintaining high liquidity affects the profitability of firm in an adverse manner mainly due to the reason that most of the assets of the firm were retained in the current form i.e. cash, marketable securities, receivables and inventory which could be used for investment in long term assets to generate revenue . The profitability and liquidity, both are important goals for any firm and to forego one goal at the cost of other can create severe problems for the firm. Profitability is a long term goal for any firm because it is required for the survival of the firm while liquidity is relatively short term goal which needs to be addressed to protect the firm from bankruptcy (Seereiter, 1981).

Working capital management efficiency and its significance has been highlighted by a number of researchers such as (Uyar, 2009; Samiloglu and Demirgunes, 2008; Vishnani and Shah, 2007; Teruel and Solano, 2007, Lazaridis & Tryfonidis, 2006; Padachi, 2006; Deloof, 2003; Wang, 2002; Shin and Soenen, 1998; Smith et al., 1997; and Jose, Lancaster and Stevens, 1996).

The lack of empirical evidence with reference to manufacturing sector of Pakistan provides a strong motivation for examining Working capital management performance on industry/sectoral basis. The current study is a new one on working capital management which uses financial data of firms listed on Karachi stock exchange. The study is expected to make the following significant contributions to the existing literature.

Firstly, this study is the first one where sector-wise working capital management performance in terms of collection policy, inventory policy, payment policy, Cash Conversion Cycle, Net Trade Cycle, liquidity and profitability is compared using financial data for firms listed on Karachi Stock Exchange. The working capital component wise comparison is also presented in this research. Furthermore, no other empirical investigation with reference to working capital management performance efficiency has included such a large sample and time span of ten years as covered in this research.

Therefore, the main objectives of the current study are: to analyze working capital management performance of manufacturing sectors by using different working capital management measures which include Cash Conversion Cycle, Net Trade Cycle, Receivable Turnover in Days, Inventory Turnover in Days, Payable Turnover in Days and Return on Total Assets and to compare the ranking of sectors based on working capital management performance in order to sort out the similarities and differences.

In the next section important studies related to this issue in Pakistan and outside countries are reviewed followed by the methodology for analyzing performance efficiency of working capital management measures including data, sample and variable constructions. Fourth section discusses the results related to sector-wise working capital management performance efficiency during period 1998 to 2007 for twenty four manufacturing sector. The comparison is presented in terms of Cash Conversion Cycle, Net Trade Cycle, Receivable Turnover in Days, Inventory Turnover in Days, Payable Turnover in Days and Return on Total Assets. The ranking of sectors based on their working capital management performance is also a part of this section. Finally the Conclusion is presented in the fifth section.

2. Literature Review

The corporate financial management literature conventionally focused on the study of long term financial resources where a number of studies have analyzed the topics related to capital structure, investments, dividends and firm valuation. However, the short term investments of a firm with maturity less than a year in the form of current assets also represent a major share of total assets on the Balance sheet of the manufacturing firms.

Importance of one of the comprehensive measure of working capital management called as, “Cash Conversion Cycle” was highlighted by Verlyn and Laughlin (1980). They explained that although working capital management received less attention in the literature than longer-term investment and financing decisions, it occupied the major portion of a financial manager's time and attention. An examination of conventional, static balance sheet liquidity ratios indicated the inherent potential for misinterpreting a firm's relative liquidity position. The extension of this traditional analysis to include flows embodied in the operating cycle concept through receivable and inventory turnover measured directs attention only to the timing of a firm's cash inflows

and excludes from consideration the time element of its cash outflow requirements. Since cash outflows are not synchronized with inflows for the typical firm, such an omission is a serious deficiency in liquidity analysis. Adopting a payables turnover concept extends the operating cycle analysis to incorporate both the relevant outflow and inflow components.

It has been generally established that the performance / profitability of a firm largely depends upon the manner of its working capital management. If a firm is inefficient in managing working capital, it will not only reduce profitability but may also lead to financial crisis. Both inadequate and excessive working capital is detrimental for a business concern. The excessive working capital can result in idle funds which could be used for earning profit while the inadequate working capital will interrupt the operations and will also impairs profitability (Chowdhury and Amin, 2007).

The impact of overall working capital policies on the profitability of Pharmaceutical firms listed at Dhaka Stock Exchange was investigated by Chowdhury and Amin (2007). The primary and secondary data was used for the period 2000 to 2004 to analyze the working capital management policies. The results indicated that for the overall performance of the Pharmaceutical industry, working capital management played a vital role and there existed a positive relationship between current assets management and performance of firms. On the other side the questionnaire data used for the study highlighted that firms in this industry have been efficient in managing their cash, accounts receivables and accounts payable. Further this industry maintained large volume of inventories but maintaining large inventories didn't reflect inefficient management for this industry.

Another important study on the relationship between liquidity management and operating performance was conducted by Wang (2002). His study also examined the relationship between liquidity management and corporate value for firms in Taiwan and Japan. He found negative relationship between Cash Conversion Cycle, return on assets and return on equity which was also sensitive to industry factors. The results of the study indicated that although there were differences in financial system and structural characteristics of both countries, still aggressive liquidity management increased the performance which also leads to increase in the corporate value for Japanese and Taiwanese firms.

The importance of working capital management efficiency for value creation of shareholders was presented by Shin and Soenen (1998). They empirically investigated, whether short Net Trading Cycle (NTC) is beneficial for the company's profitability. They found a strong negative relationship between lengths of the firm's net-trading Cycle and profitability. Furthermore, they found that the shorter Net Trade Cycles are associated with higher risk adjusted stock returns.

Another study on the relationship between Cash Conversion Cycle and corporate profitability was performed by Soenen (1993) at the industry level. Soenen employed return on total assets as an index of financial profitability. Although return on equity might be of greater interest to investors, return on total assets was not influenced by the financial leverage of the firm. The Net Trade Cycle and the return on total assets were calculated for all firms in each industry for every single year from 1970 to 1989 to find out the inverse relationship between Net Trade Cycle and return on total assets. The results showed that although there was some influence of the Net Trade Cycle on corporate profitability, the trade cycle did not influence profitability very much. The "right" associations of a short Net Trade Cycle with high profitability and the combination of a long Net Trade Cycle with low profitability was found in 18 of the 20 industries. However, using the Chi-square test, the negative relationship between the Net Trade Cycle and corporate profitability was statistically significant for eight industries. The results demonstrated that shorter Net Trade Cycles were most commonly associated with higher profitability while the reverse was also true. Analysis at the specific industry level indicated that the inverse association between the Net Trade Cycle and the firm's profitability was very different, depending on the type of industry. The results showed that, in most firms in these industries, managing the corporate cash cycle efficiently has a direct impact on corporate profitability.

The impact of working capital management on profitability is also estimated in few studies with reference to Pakistan. There are few studies on working capital investment and financing policies as well. The review of these studies also helps us to understand that this neglected area of working capital management needs more attention by the researchers.

Efficient utilization of working capital has a direct bearing on the corporate profitability. It also augments the productivity of investment in fixed assets of a firm. If adequate working capital is not available on time for the firms, their survival can be at stake. Therefore, it is very essential to maintain an adequate supply of working capital for healthy growth of an enterprise (Jain, 2004). Lack of empirical evidence on the working capital management and its impact on the firm performance in case of manufacturing sector of Pakistan is main motivating force to study the subject in more detail. There are few studies with reference to working capital

management in Pakistan like Raheman et.al. (2010a) analyzed the impact of working capital management on performance of manufacturing sector in Pakistan. Furthermore, Raheman et. al. (2010b) in another study analyzed the impact of working capital management on firm performance for nine groups of sectors. Afza and Nazir (2008) investigated the factors determining the working capital requirements for a sample of 204 firms in sixteen manufacturing sub sectors during 1998-2006. The results of their study indicate that working capital management plays significant role in firm's profit, risk and it value creation. Further, it also requires day to day supervision and maintaining proper level of its components like cash, receivable, payables and inventory. Another study by Afza and Nazir (2007) investigated the relationship between aggressive and conservative working capital policies for a sample of 205 firms in 17 sectors listed on Karachi Stock Exchange during 1998-2005. They found a negative relationship between the profitability measures of firms and degree of aggressiveness of working capital investment and financing policies.

Raheman and Nasr (2007) studied the relationship between working capital management and corporate profitability for 94 firms listed on Karachi Stock Exchange using ordinary least square method. They have used the static measure of liquidity and ongoing operating measure of working capital management during 1999-2004. The findings of study suggested that there exist a negative relation between working capital management measures and profitability. Furthermore, liquidity and leverage has a negative relation with profitability while size has positive relation with profitability.

The above studies highlights that if firms are efficient in their working capital management, they will be more profitable. The above analysis of different studies identifies that there are no reported studies on sector-wise performance efficiency of working capital management measures with reference to manufacturing sector of Pakistan. Therefore, this study compares the performance efficiency of working capital management measures across 24 manufacturing sectors using ratio analysis.

3. Methodology

This section explains the methodology used for analyzing working capital management performance efficiency for the overall manufacturing sector and for individual sectors using different working capital measures during period 1998 to 2007. The working capital measures include Receivable Turnover in Days (RTD), Inventory Turnover in Days (ITID), Payable Turnover in Days (PTD), Cash Conversion Cycle (CCC) and Net Trade Cycle (NTC). Return on Total Assets (ROTA) represents the performance of firms. Cash Conversion Cycle is calculated on the basis of three components RTD, ITID and PTD. These components of CCC help us to analyze the collection, inventory conversion and payment policy on sectoral basis. Net Trade Cycle (NTC) is also used as a measure of working capital management performance. The comparison of sectoral performance is also based on these working capital measures which help us to identify the prominent and laggard sectors in terms of their ranking.

3.1: *Measurement of Variables.*

The following variables are used in this paper to analyze the performance efficiency of working capital management measures and profitability.

3.1.1: Receivable Turnover in Days (RTD)

In working capital management, the receivables are a very important component of current assets and RTD is the average length of time required to convert the firm's receivables into cash. The managerial efficiency in granting and controlling credit could be ascertained on the basis of RTD. It would indicate the pattern of debtors on the basis of which liquidity of debtors could be ascertained. If the firm takes more time in collecting receivables, the profitability of the firm declines. The Receivable Turnover in Days is calculated by using following formula:

$$\mathrm{Re}ceivableTurnoverinDays = \frac{Accountsreceivables}{NetSales} * 365$$

3.1.2: Inventory Turnover in Days (ITID)

ITID is another important component of working capital management which is also called as inventory conversion period. It is the average time required to convert materials into finished goods and then to sell those goods. This variable helps in evaluating the efficiency in inventory management policy of the firm. If the firms take more time in selling inventory which means inventories are not getting convert into sales, will decrease the profitability of firm. Inventory Turnover in Days is calculated using following Formula:

$$InventoryTurnoverInDays = \frac{Inventory}{CostofGoodsSold} * 365$$

3.1.3: Payable Turnover in Days (PTD)

Payable Turnover in Days is the average length of time between the purchase of material and labor and the payment of cash for them. As the firm takes more time in making payment to payables, it will have positive impact on firm's profitability because firm takes time to utilize funds for a longer period. However negative association of PTD with ROTA means that the less profitable firms wait longer to pay their bills. Moreover, Speeding up the payments to suppliers may increase the profitability because sometime a substantial discount is offered from suppliers for prompt payment. PTD is calculated using following formula:

$$PayableTurnoverinDays = \frac{Accountspayables}{NetPurchases} * 365$$

3.1.4: Cash Conversion Cycle (CCC)

Cash Conversion Cycle starts by purchasing raw material when payment is not made immediately. The delay in paying the payables against purchases results in the payable period. Than the firm uses raw material in the production and convert it into finished goods which will be converted to sales. This time period between the initial investment and inventories and the sale date is the inventory period. All of the customer not pay in cash but will pay later which results in receivable period. If a firm's balance sheet is prepared at the start of the process, cash is reflected as current asset. If there is a little delay, cash has been replaced first with inventories of raw material and then by inventories of finished goods; also a current asset. When the goods are sold, inventories give way to the accounts receivable (another current asset) and finally when the customers pay their bill, the firm takes out its profit and replenishes the cash balance. Sound working capital policy is designed to minimize the time between cash expenditure on material and the collection of cash on sales.

CCC is used as a comprehensive measure of working capital management. If the firm is able to reduce this cycle, this step will enhance its profitability. Therefore efforts must be made to keep at minimum level. If the payment period is longer than the sum of inventory and receivable period, it results in a negative CCC. But the chances of its occurrence are rare. The CCC is calculated by the following Formula:

$$CashConversionCycle = \mathrm{Re}ceivableTurnoverinDays + InventoryTurnoverinDays - PaybaleTurnoverinDays$$

3.1.5: Net Trading Cycle (NTC)

Net Trading Cycle is an alternative measure of evaluating Working Capital Management Efficiency. It has been used in many Papers to evaluate the working capital management like Shin and Soenen (1998). The profitability of firm increases with decrease in the Net Trading Cycle. Therefore efforts must be made to decrease this time period. The formula for this variable is as follow:

$$NetTradingCycle = \left[\frac{Account\,Receivables}{NetSales} * 365\right] + \left[\frac{Inventory}{NetSales} * 365\right] - \left[\frac{AccountsPayable}{NetSales} * 365\right]$$

3.1.6: Return on Total Assets (ROTA)

Return on Total Assets is used as a measure of firm performance and shows operating income related to total assets. The depreciation is added to the operating income because it is a non cash expense which was deducted only to follow the matching principle to reach the true value of accounting operating profit. We are using profitability with specific reference to working capital management although it depends on many other factors like leverage, size and growth which are included in the model as control variables.

$$Return on Total Assets = \frac{Operating Income + Depreciation}{Total Assets}$$

3.2: Data and Sample

The present research covers a period of 10 years from 1998 to 2007 for manufacturing and trading firms listed at Karachi Stock Exchange (KSE). All firms listed on Karachi Stock Exchange are classified into 35 sectors as per KSE classification of sectors based on their activities. This research covers 24 manufacturing and trading sectors of Karachi Stock Exchange including major sectors like Textile, Cement, Sugar, Fertilizers, Power Generation, Automobile, Oil & Gas, Glass and Ceramics, Paper & Board, Food & Personal care products, Chemicals & Pharmaceuticals, Engineering etc. We have excluded the financial sector firms because their working capital management is totally different from non financial sector firms. Excluded firms in financial sectors include banking and finance, insurance, leasing, modarabas, business services, renting and other services. There are 765 firms listed on the stock exchange which include 448 manufacturing and trading firms.

Secondary data is used for analyzing the performance efficiency of working capital management measures. The data are collected for those firms which were listed in KSE before 1998 and remained listed during 1998 to 2007, and also performed operations during this time period. Therefore, finally 204 firms are included in the sectoral analysis listed on Karachi Stock Exchange.

The data of 204 selected firms is extracted from their annual reports. Most of The annual reports for ten years are collected from Lahore Stock Exchange, Islamabad Stock Exchanges and firms in the form of hard copies. Some of the annual reports are collected from the websites of KHI Stocks (http://www.khistocks.com.pk/), Business Recorder (http://www.brecorder.com/), Pak search Database Company (http://www.paksearch.com/) and firms.

4. Sector-wise Performance of Working Capital Management Measures and Profitability

This section analyzes the Cash Conversion Cycle, Net Trade Cycle, collection, inventory conversion, payment and Profitability efficiencies of overall manufacturing sector and also for 24 sub sectors during 1998 to 2007. Sector-wise yearly performance and ranking of these working capital measures is also a part of the discussion.

4.1: Performance Analysis of Working Capital Management Measures and Profitability.

The overall performance of working capital measures and profitability for 24 manufacturing sectors is presented in table 4.1. As can be seen from the table, manufacturing sector in general has an overall average Cash Conversion Cycle of 80 days while the average Net Trade Cycle is 72 days during period 1998 to 2007. The components of Cash Conversion Cycle consisting of the collection policy, inventory policy and payment policy for the manufacturing sector reflects that the average time for the manufacturing sector during which receivables remain outstanding is 35 days while on average it takes 27 days to pay their bills in the form of payables. The

inventory for the manufacturing sector relatively takes more time to be converted into sales which is on average 72 days. The average Return on Total Assets for manufacturing sector is 15.73%.

Table 4.1
Sector-wise Working Capital Management Performance (1998-2007)

S. No	Sector	CCC	NTC	RTD	ITID	PTD	ROTA
1	Automobile Assembler	62	56	8	68	14	0.1795
2	Automobile Parts and Accessories	122	105	34	100	11	0.1796
3	Cable and Electric Goods	167	152	96	107	37	0.1296
4	Cement	12	12	12	25	25	0.0996
5	Chemical	59	54	26	74	42	0.1378
6	Engineering	144	127	50	118	23	0.1089
7	Fertilizer	16	17	17	23	24	0.2342
8	Food and Personal care Product	69	52	8	71	10	0.3139
9	Glass and Ceramics	131	113	57	103	29	0.1581
10	Jute	98	90	26	89	16	0.1668
11	Leather and Tanneries	140	123	65	134	60	0.1205
12	Oil and Gas Exploration &Refinery	-1	4	49	29	79	0.1601
13	Oil and Gas Marketing	14	18	39	21	46	0.1499
14	Paper and Board	101	88	41	69	9	0.1665
15	Pharmaceutical	134	97	28	124	18	0.2144
16	Synthetic and Rayon	80	73	19	120	59	0.1188
17	Textile Composite	102	94	44	79	21	0.1166
18	Textile Spinning	77	73	31	67	20	0.1176
19	Textile Weaving	68	64	34	48	14	0.1112
20	Tobacco	44	38	2	52	10	0.2781
21	Vanaspati and Allied	57	53	21	51	14	0.0598
22	Power Generation & Distribution	84	78	70	30	16	0.1656
23	Sugar and Allied	56	51	10	71	25	0.1141
24	Miscellaneous	93	86	62	54	23	0.1733
	Overall Manufacturing Sector (Avg)	**80**	**72**	**35**	**72**	**27**	**0.1573**

Note: *Calculations are based on formula presented in Variables section at 3.1, data extracted from Annual Reports of the firms*

The sectoral performance of different working capital measures reveal that the Cash Conversion Cycle, a comprehensive measure of working capital management efficiency, is at its lowest for Oil and Gas sector. It is on average negative for the Oil and Gas Exploration and Refinery sector which reflect that the Payable Turnover in Days exceeds the operating cycle. According to Gitman (1991), the chances of negative CCC are rare but non-manufacturing firms are more likely to have negative CCC than manufacturing firms since firms in these sectors carry small and fast selling inventories and often sell for cash.

Oil and Gas exp. & Refinery, Cement and Oil and Gas Marketing sectors are on the top in ranking in terms of Cash Conversion Cycle. These sectors have CCC of -1, 12 and 14 days respectively. The other alternate

measure of working capital management performance, Net Trade Cycle (NTC), also reflects the similar results as of Cash Conversion Cycle. The average results indicate that the laggard sectors in terms of CCC including Cable and Electric Goods, Engineering, Leather, Glass & Ceramics, Pharmaceutical and Automobile parts sectors need to concentrate on their working capital management policy. Another interesting finding is that these above sectors with higher CCC are facing this problem mainly due to their slower inventory turnover in days. These sectors are taking more time in selling their inventory which lengthens their Cash Conversion Cycle. Moreover, cable and electric goods, Engineering and Pharmaceutical are also inefficient in their collection policy as their Receivable Turnover in Days is also the highest in comparison to the other sectors. Another important aspect of analysis is that the sectors with shorter Cash Conversion Cycle are also performing better in terms of profitability. For example, Fertilizer sector with average CCC of 16 days, Tobacco with 44days, chemical with 59 days, Automobile assembler with 62 days and Food and Personal care product with 69 days are also better in terms of average cash conversion efficiency relative to other sectors and are the best performer in terms of profitability with average profitability of 24%, 28%, 14%, 18% and 32% respectively. Food & Personal care product, Tobacco and Fertilizer sectors are also among the highest in terms of average profitability. This indicates that efficiency in working capital management is associated with better performance in terms of profitability.

The detailed analysis of individual measures of Working capital management performance for all sectors during 1998 to 2007 is presented in the following to make the intra-sector efficiency comparison.

4.1.1: Cash Conversion Cycle Efficiency

The yearly Cash Conversion Cycle for all manufacturing sectors during the years 1998 to 2007 are presented in Table 4.2 at the end of paper.

Average Cash Conversion Cycle in days for the overall manufacturing sector shows that it is the highest in year 1999 at 90 days and is the lowest at 74 days in 2000. However, there is a gradual increase after year 2000 in Cash Conversion Cycle and it reached to average 85 days in year 2004 and 2005 and declined to 77 days during 2006. The Cash Conversion Cycle for individual sectors during period 1998 to 2007 shows that the sectors which are top in ranking based on the average results of last ten years has consistently performed better and remained top for the whole window period. The Oil and Gas Exploration and Refinery sector is the only exceptions where the average Cash Conversion Cycle is in negative. This trend of negative Cash Conversion Cycle was present throughout this ten years time period except for years 2002 to 2004, where it is positive but still very minimum relative to other sectors. The Oil and Gas Marketing sector is also among the efficient sectors in terms of CCC. The reason for their top performance is perhaps due to their nature of business as these sectors are among the non-manufacturing sector where the operating cycle is short. Cement and Fertilizer sectors are the best performers among the manufacturing sectors with shorter average Cash Conversion Cycle of 12 and 14 days respectively. These two sectors are also among the best performer sectors throughout study period.

In general, if we compare the Cash Conversion Cycle for different sectors for year 1998 being the first year of analysis and year 2007, the last year of analysis. Automobile Parts and Accessories, Cable and Electric Goods, Cement, Chemical, Food and Personal care Product, Glass and Ceramics, Oil and Gas Exploration &Refinery, Oil and Gas Marketing, and Textile Weaving improved their cash conversion efficiency during study period. Other sectors lost their efficiency in terms of reducing Cash Conversion Cycle during this time period. Power Generation & Distribution, Automobile assembler and Tobacco sectors relatively remained stable in terms of Cash Conversion Cycle. Furthermore, many sectors including Cement, Fertilizer, cable and electric goods, Leather and Tanneries, Paper and Board, and Synthetic and Rayon in which the cash conversion efficiency was affected in the last year of analysis i.e. 2007. This performance in the last year might be attributed to political and judiciary crisis as well as the law and order situation in the country.

Net Trade Cycle, another measure of overall working capital management efficiency and an alternate measure of CCC also presents the similar trend for all the sectors included in the analysis. Shin and Soenen (1998) and many others have used this measure of analysis in their respective studies. The results of average Net Trade Cycle during 1998 to 2007 are presented in Table 4.3 at the end of paper. Average Net Trading Cycle for the overall manufacturing sector is 72 days during period 1998 to 2007. The Oil and Gas Exploration and Refinery sector is also on the top according to this measure of working capital management similar to Cash Conversion Cycle measure. Other leading sectors include Cement, Fertilizer and Oil & Gas Marketing. Average Net Trade Cycle is longer for Cable & Electric Goods, Engineering, Leather & Tanneries and Automobile parts & accessories. The longest Net Trading Cycle during the study period is for cable and electric goods during year

1999 where the length of average NTC is 217 days. Twelve sectors which are about 50% of the sectors have improved their Net Trade Cycle during the study period.

The analysis of different components of Cash Conversion Cycle is also needed to see that which of the component has a major impact on the overall Cash Conversion Cycle and also to analyze the collection, payment and inventory policy for different sectors. Sector-wise Receivable Turnover in Days, Inventory Turnover in Days and Payable Turnover in Days is presented in the following pages.

4.1.2: Collection Efficiency

Sector-wise Receivable Turnover in Days during period 1998 to 2007 is presented in the Table 4.4 towards the end of paper, which examines the collection efficiency of different sectors. RTD is the first major component of Cash Conversion Cycle which indicates the collection efficiency of different sectors of Karachi Stock Exchange. Receivable Turnover in Days for the overall manufacturing sector fluctuated between 30 to 44 days during the study period. RTD is the highest in year 1999 and minimum in year 2006. It is showing a mix less volatile downward trend for the manufacturing sector during 1998 to 2007. Tobacco, Automobile Assembler, Food & Personal Care Products and Sugar sectors are among the leading sectors in terms of collecting their receivables. The Cable and Electric goods, Power Generation and Distribution, Leather and Tanneries, Cable and Electric goods, Glass and Ceramics and Engineering sectors are taking more time to collect their receivables. Twelve sectors have improved their Receivable Turnover in Days while the collection period for ten sectors increased during this time period while, two sectors remain stable. The analysis of RTD for different sectors during 1998 to 2007 also reveals that there are no major fluctuations and in general, it shows a stable pattern of sectoral performance in terms of collection efficiency. The sectors which are leading on the basis of average results are also among the leading sectors throughout the years under analysis.

4.1.3: Inventory Conversion Efficiency

The second major component of the Cash Conversion Cycle is the Inventory Turnover in Days which indicates the average length of time period taken by firms to convert the inventory into sales. Table 4.5 at the end of paper shows sector-wise Inventory Turnover in Days during period 1998 to 2007. Inventory Turnover in Days for the manufacturing sector shows that on average it takes 72 days for inventory to be converted into sales. The ITID for the individual years during 1998 to 2007 shows an upward moving trend where average ITID is lowest with 65 days during 2001 while the same is highest during year 2004 and 2005. Sector-wise results shows that the Leather & Tanneries sector which is the least efficient sector in terms of inventory conversion remained least efficient throughout period 1998 to 2007 because it is taking on average maximum time period for conversion of inventory into sales. Other laggard sectors in terms of ITID are Pharmaceutical, Synthetic and Rayon, Engineering and Cable & Electric Goods. Efficient sectors on the basis of average ITID include Oil and Gas Marketing sector with average of 21 days followed by Fertilizer, Cement and Oil & Gas Exploration and Refinery with average ITID of 23, 25 and 29 days respectively. The average inventory conversion period increased for seventeen sectors during study period which has increased inventory conversion period for the manufacturing sector and also showing an upward trend.

4.1.4: Payment Efficiency

Payable Turnover in Days being the third component of Cash Conversion Cycle, indicates that on average, manufacturing firms belonging to different sectors takes how many days to make payments for payables. Table 4.6 at the end of the paper presents Payable Turnover in Days for 24 manufacturing sectors. The Payable Turnover in Days for the overall manufacturing sector is twenty seven days during period 1998 to 2007. It varies between average 32 days to 23 days showing relatively stable payment policy for the manufacturing sector during study period. The sector-wise Payable Turnover in Days reveals that Oil & Gas Exploration and Refinery, Leather and Tanneries and Synthetic and Rayon sectors are taking longer time period to make payments for their bills, with an average of 79 days, 60 days and 59 days respectively. As a financial manager, one should try to accelerate cash collections and slowdown the cash disbursements. This slowing down procedure must not be at the cost of goodwill of the firm. Therefore efficiency in terms of payment policy is related with the delay in paying payables. A sector is considered to be an efficient sector if it slow downs its payments. This also makes economic sense because it will help the firms to utilize the funds for a longer period of time which increases profitability. The sectors where quick payments are made on average basis include

Paper and Board, Food and Personal care products, Tobacco and Automobile Parts with average 9 days, 10 days, 10 days and 11 days respectively. The payment period increased for eleven sectors which improves the efficiency of these sectors in terms of payment.

4.1.5: Performance Efficiency in Terms of Profitability

Return on Total Assets is used as a measure of performance for the manufacturing firms and sectors with higher percentage of ROTA are considered as better performers and with low percentage of ROTA as low performers. Sector wise Return on Total Assets during 1998 to 2007 is presented in Table 4.7 towards the end of the paper. In general, the manufacturing sector has an average Return on Total Assets of 15.7% and this average profitability for the manufacturing sector increased over the study period except the years 2001, 2004 and 2007. The sharp decline was in year 2007 where, average profitability declined by 1.5% for the overall manufacturing sector. In year 1998, first year of analysis, the average profitability is 13% which is the lowest while in year 2006; the average profitability is the highest at 17.3%. During period 1998 to 2006, there is a gradual increase in the average profitability of the manufacturing sector. On average, Food & Personal care product, Tobacco and Fertilizer sectors are on the top in terms of profit efficiency. These sectors are also the best performers throughout study period. Fertilizer sector is the best performer during first two years of analysis followed by Food and Personal Care Product. During 2000 to 2003, Food sector is the best performer while Tobacco sector is highest in ranking during the last four years of analysis with Food sector as second best performer. It should also be noted that these three sectors are also among the efficient sectors in terms of working capital management. Both Oil and Gas sectors are the most efficient sectors with reference to working capital management and showed better performance and consistency in terms of profit efficiency during study period. Sector wise comparative efficiency in terms of Return on Total Assets also reveals that a few sectors with relatively higher Cash Conversion Cycle also performed better in terms of profitability. These sectors include Pharmaceutical, Automobile parts, Power Generation and Distribution, Cable and electric goods, Jute and Leather and Tanneries. Perhaps it might be possible that higher Cash Conversion Cycle has led to higher sales, which may have resulted in increased profitability.

The above discussion of working capital management performance summarizes that Cash Conversion Cycle and Net Trade Cycle, both provides similar results. Oil and Gas exp. & Refinery, Cement and Oil and Gas Marketing sectors are on the top in ranking in terms of Cash Conversion Cycle. It is in negative only for the Oil and Gas Exploration and Refinery sector which reflects that the Payable Turnover in Days exceeds the operating cycle. These sectors are among the non-manufacturing sectors where the operating cycle is short. Cement and Fertilizer sectors are the best performers among the manufacturing sectors with shorter Cash Conversion Cycle. The cable and electric goods, Engineering and Pharmaceutical sectors are the laggard in terms of CCC due to the inefficient inventory and collection policies. The Fertilizer, Tobacco, chemical, Automobile Assembler and Food & Personal care product sectors, with shorter Cash Conversion Cycle, are also performing better in terms of profitability. Power Generation & Distribution, Automobile assembler and Tobacco sectors remain relatively stable in terms of Cash Conversion Cycle.

Component-wise analysis of Cash Conversion Cycle shows that, in general, there is a stable pattern of sectoral performance in terms of collection efficiency. The sectors which are efficient in terms of average results of RTD also remained efficient throughout the years under analysis. Overall inventory conversion period for the manufacturing sector increased during the period under study due to the lengthening of inventory conversion period for seventeen sectors. With regards to efficiency in terms of payment policy, the payment period increased for eleven sectors out of twenty four which improves the efficiency of these sectors in terms of payment. The sectors which take lesser time in paying bills include Paper and Board, Food and Personal care products, Tobacco and Automobile parts. On average, Food & Personal care product, Tobacco and Fertilizer sectors are on the top in terms of profit efficiency. These three sectors are also the best performer throughout period under analysis. Pharmaceutical, Automobile parts, Power Generation and Distribution, Cable and electric goods, Jute and Leather and Tanneries sectors have relatively higher Cash Conversion Cycle but still performed better in terms of profitability.

4.2: Ranking of Sectors

Based on the above discussion and analysis of working capital management performance for different sectors, the sectoral ranking is presented in Table 4.8.

Table 4.8

Ranking of Sectors based on Working Capital Measures and Profitability

		RANKING					
S. No	**Sector**	**CCC**	**NTC**	**RTD**	**ITID**	**PTD**	**ROTA**
1	Oil & Gas Exploration and Refinery	1	1	18	4	1	11
2	Cement	2	2	5	3	9	23
3	Oil & Gas Marketing	3	4	15	1	4	13
4	Fertilizer	4	3	6	2	10	3
5	Tobacco	5	5	1	8	23	2
6	Sugar and Allied	6	6	4	14	8	20
7	Vanaspati& Allied	7	8	8	7	20	24
8	Chemical	8	9	10	15	5	14
9	Auto. Assembler	9	10	2	18	21	6
10	Textile Weaving	10	11	14	6	18	21
11	Food & Personal care Product	11	7	3	13	22	1
12	Textile Spinning	12	13	12	10	14	18
13	Synthetic and Rayon	13	12	7	22	3	17
14	Power Gen. & Dist	14	14	23	5	16	10
15	Miscellaneous	15	15	21	9	12	7
16	Jute	16	17	9	17	17	8
17	Paper and Board	17	16	16	12	24	9
18	Textile Composite	18	18	17	16	13	19
19	Auto. Parts & Access.	19	20	13	11	19	5
20	Glass and Ceramics	20	21	20	19	7	12
21	Pharmaceutical	21	19	11	23	15	4
22	Leather & Tanneries	22	22	22	24	2	16
23	Engineering	23	23	19	21	11	22
24	Cable & Electric Goods	24	24	24	20	6	15

Note: Number 1 in ranking indicates the highest rank while 24 is the lowest rank.

The ranking of sectors shows that Oil & Gas Exploration and Refinery, Cement, Fertilizer and Oil and Gas Marketing sectors are on the top based on Cash Conversion Cycle and Net Trade Cycle. These sectors are also among the leading sectors according to inventory turnover measure of working capital management performance. Both the Oil sectors are among the leading sectors in terms of Payable Turnover in Days. Fertilizer and Cement sectors are among leading sectors based on Receivable Turnover in Days, whereas, Food & Personal Care Product, Tobacco, Fertilizer and Automobile sectors are among the leading sectors in terms of profitability as well as Receivable Turnover in Days. The Cement sector which is among the top sectors in terms of CCC, NTC, RTD and ITID has relatively lower profitability compared to other sectors. Power Generation sector which is at 10^{th} number in raking according to profitability is among the laggard sectors in terms of working capital management except for inventory turnover measure. All of the Textile sectors are among the laggard sectors in terms of working capital management measures and operating profitability.

5: Conclusions

Working Capital Management efficiency comparison between different manufacturing sectors is conducted which has helped us to identify the leading and laggard sectors. Working capital management performance of different manufacturing sectors reveals that Cash Conversion Cycle and Net Trade Cycle, both are comprehensive measures of working capital management performance provides similar results. In general there is a stable pattern of sectoral performance in terms of collection efficiency. The sectors which are leading on the

basis of overall average results are also among the leading sectors throughout the study period but there is divergence among sectors over 1998-2007 in terms of working capital measures and corporate profitability.

The main findings of the study are:

- Oil and Gas Exploration & Refinery and Oil and Gas Marketing sectors have the shortest Cash Conversion Cycle and Net Trade Cycle. These sector do not manufacture goods therefore, they have shorter days in inventory and also make cash sales and credit sales for short maturity. Further, Most of the firms in the Oil sector are also among the listed 100 Index companies of Karachi Stock Exchange throughout the study period. Furthermore, Cement and Fertilizer sectors from the manufacturing sectors have the shorter Cash Conversion Cycle and NTC.
- All Textile sectors are among the laggard sectors in terms of working capital management measures and operating profitability while Power Generation sector which is at 10^{th} number in raking according to profitability is among the laggard sectors in terms of working capital management except for inventory turnover measure.
- The cable and electric goods, Engineering and Pharmaceutical sectors are the laggard in terms of CCC because of problems and inefficiency with their inventory and collection policy.
- Dominant and laggard sectors in terms of working capital performance are mainly attributed to their inventory turnover in days. In most cases, the Cash Conversion Cycle and Net Trade Cycle are driven by the inventory turnover of the firm.
- Pharmaceutical, Automobile parts, Cable and electric goods and Jute and Leather sectors have positive relation between Cash Conversion Cycle and profitability because longer Cash Conversion Cycle leads to higher sales which increases profitability.
- There are few sectors which are although among the efficient sectors in terms of working capital but still among the laggard in terms of profitability such as Cement, Sugar and Vanaspati & Allied sectors.
- Based on the above findings, some important implications are:
- Working capital management should be the concern of all the manufacturing sectors and need to be given due care however, the Cable & Electric Goods, Engineering, Leather & Tanneries, Pharmaceutical, Glass and Ceramics sectors need to pay more attention to all aspects of working capital management issues, especially the inventory conversion period and collection period. Because proper management of inventory and collection from receivables by the firms in these sectors can convert these laggard sectors into better performer. Sectors which are dominating in terms of working capital management are mainly due to proper inventory management.
- Textile sector, being the largest sector in terms of size needs special attention by the policy formulators. The Textile Composite and Textile Spinning sectors need to formulate policies for all areas of working capital management which include collection, inventory and payment policies however Textile Weaving sector firms needs more attention in the collection and payment policies. Power generation sector, where no inventory or goods are manufactured needs to emphasize on the collection and payment policies.
- The findings of the study implicate that firm managers can create value for the shareholders by reducing the number of days in inventories, Cash Conversion Cycle and Net Trade Cycle to a reasonable minimum and it should be a major concern of financial executives. This is only possible if the components of Cash Conversion Cycle and Net Trade Cycle(RTD, ITID and PTD) may be dealt individually and policy is formulated for these components

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Annexure

Table 4.2
Sector-wise Cash Conversion Cycle (1998 to 2007)

S. No	Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg.
1	Automobile Assembler	52	82	73	60	59	52	59	58	65	58	**62**
2	Automobile Parts and Accessories	122	116	122	125	115	130	123	133	121	115	**122**
3	Cable and Electric Goods	181	241	221	173	168	169	141	119	116	137	**167**
4	Cement	25	14	13	15	11	11	10	1	2	17	**12**
5	Chemical	91	67	83	55	54	50	55	48	40	45	**59**
6	Engineering	105	149	150	161	127	166	185	139	127	132	**144**
7	Fertilizer	7	8	3	13	15	28	16	13	22	38	**16**
8	Food and Personal care Product	74	88	76	67	63	69	67	58	60	63	**69**
9	Glass and Ceramics	167	133	120	126	119	141	151	136	117	100	**131**
10	Jute	56	72	56	32	120	100	148	137	148	111	**98**
11	Leather and Tanneries	142	148	119	143	152	146	147	136	117	149	**140**
12	Oil and Gas Exploration &Refinery	36	-15	-26	-14	16	15	7	-10	-5	-12	**-1**
13	Oil and Gas Marketing	10	26	17	14	23	10	12	14	10	8	**14**
14	Paper and Board	94	95	89	85	103	95	104	101	111	127	**101**
15	Pharmaceutical	121	201	150	126	130	113	109	132	126	131	**134**
16	Synthetic and Rayon	63	84	65	62	87	70	71	101	92	108	**80**
17	Textile Composite	90	96	91	93	79	90	109	146	116	114	**102**
18	Textile Spinning	50	76	60	51	55	62	77	134	110	97	**77**
19	Textile Weaving	108	70	63	58	46	57	55	95	64	61	**68**
20	Tobacco	42	46	40	49	42	44	37	45	48	48	**44**
21	Vanaspati and Allied	16	50	61	62	40	70	53	67	70	82	**57**
22	Power Generation & Distribution	68	177	50	106	92	73	85	83	44	68	**84**
23	Sugar and Allied	52	47	20	79	66	62	53	56	56	69	**56**
24	Miscellaneous	40	84	67	115	97	99	160	91	75	101	**93**
	Manufacturing Sector (Avg)	**76**	**90**	**74**	**77**	**78**	**80**	**85**	**85**	**77**	**82**	**80**

Note: *Calculations are based on formula presented in section 3.1, data extracted from Annual Reports of the firms*

Table 4.3
Sector-wise Net Trading Cycle (1998 to 2007)

S. No	Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg.
1	Automobile Assembler	48	75	68	55	53	45	53	53	59	53	**56**
2	Automobile Parts and Accessories	105	99	103	109	101	110	104	114	105	102	**105**
3	Cable and Electric Goods	161	217	202	157	150	152	127	113	113	131	**152**
4	Cement	25	14	12	15	11	12	10	4	5	16	**12**
5	Chemical	88	64	72	51	50	45	49	43	37	43	**54**
6	Engineering	94	131	137	148	109	145	159	124	112	117	**127**
7	Fertilizer	8	11	9	16	18	27	17	12	19	33	**17**
8	Food and Personal care Product	60	68	59	52	47	51	49	42	43	45	**52**
9	Glass and Ceramics	145	113	102	108	106	121	128	118	102	88	**113**
10	Jute	48	64	52	75	108	82	128	121	128	97	**90**
11	Leather and Tanneries	125	133	111	132	134	129	130	120	99	119	**123**
12	Oil and Gas Exploration &Refinery	53	-8	-22	-10	17	17	9	-3	-2	-9	**4**
13	Oil and Gas Marketing	22	33	20	16	24	11	13	15	11	9	**18**
14	Paper and Board	86	84	80	77	89	80	88	88	98	115	**88**
15	Pharmaceutical	97	147	112	96	95	80	76	89	89	93	**97**
16	Synthetic and Rayon	57	73	56	54	77	65	66	95	86	102	**73**
17	Textile Composite	85	90	82	86	71	83	101	130	104	104	**94**
18	Textile Spinning	49	72	55	48	53	59	73	124	102	92	**73**
19	Textile Weaving	103	66	58	54	43	54	53	92	60	58	**64**
20	Tobacco	39	42	35	44	37	37	31	38	39	38	**38**
21	Vanaspati and Allied	16	47	54	57	38	66	50	63	65	77	**53**
22	Power Generation & Distribution	64	172	55	103	82	59	70	67	43	69	**78**
23	Sugar and Allied	47	42	19	72	60	58	48	50	50	64	**51**
24	Miscellaneous	41	79	67	107	89	89	145	86	71	91	**86**
	Manufacturing Sector (Avg)	**69**	**80**	**67**	**72**	**69**	**70**	**74**	**75**	**68**	**73**	**72**

Note: *Calculations are based on formula presented at section 3.1, data extracted from Annual Reports of firms*

Table 4.4
Sector-wise Receivable Turnover in Days (1998 to 2007)

S. No	Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg.
1	Automobile Assembler	4	15	15	7	8	8	4	4	4	6	**8**
2	Automobile Parts and Accessories	29	32	34	43	38	36	35	31	28	29	**34**
3	Cable and Electric Goods	74	142	141	96	88	82	65	82	93	100	**96**
4	Cement	18	12	9	12	13	13	11	10	9	13	**12**
5	Chemical	36	22	29	27	28	21	20	22	22	34	**26**
6	Engineering	40	60	70	76	51	47	41	36	38	38	**50**
7	Fertilizer	10	16	17	21	23	25	19	9	11	20	**17**
8	Food and Personal care Product	7	10	10	9	8	9	5	7	6	8	**8**
9	Glass and Ceramics	65	55	54	55	60	62	59	58	54	47	**57**
10	Jute	14	22	22	24	22	20	29	40	37	25	**26**
11	Leather and Tanneries	50	77	83	93	70	66	70	63	44	37	**65**
12	Oil and Gas Exploration &Refinery	104	69	43	46	53	41	34	40	29	34	**49**
13	Oil and Gas Marketing	91	65	39	34	34	24	25	27	26	28	**39**
14	Paper and Board	48	42	45	46	40	34	35	37	36	43	**41**
15	Pharmaceutical	32	35	41	29	27	23	21	22	27	28	**28**
16	Synthetic and Rayon	12	13	17	13	20	21	21	24	23	30	**19**
17	Textile Composite	56	48	49	50	30	37	44	46	41	42	**44**
18	Textile Spinning	32	35	32	28	26	24	24	32	31	40	**31**
19	Textile Weaving	78	41	30	25	15	28	31	43	25	25	**34**
20	Tobacco	1	2	2	2	2	2	0	6	1	1	**2**
21	Vanaspati and Allied	13	10	12	15	26	33	20	23	25	29	**21**
22	Power Generation & Distribution	61	167	63	95	71	41	53	43	41	69	**70**
23	Sugar and Allied	10	13	11	6	13	9	11	11	8	9	**10**
24	Miscellaneous	44	60	65	85	66	60	70	59	53	53	**62**
	Manufacturing Sector (Avg)	**39**	**44**	**39**	**39**	**35**	**32**	**31**	**32**	**30**	**33**	**35**

Note: *Calculations are based on formula presented at section 3.1, data extracted from Annual Reports of firms*

Table 4.5
Sector-wise Inventory Turnover in Days (1998 to 2007)

S. No	Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg.
1	Automobile Assembler	72	84	73	69	68	58	66	65	71	60	**68**
2	Automobile Parts and Accessories	105	94	97	92	87	102	96	109	117	103	**100**
3	Cable and Electric Goods	142	129	106	108	110	120	112	84	79	81	**107**
4	Cement	29	19	25	24	27	24	26	18	26	28	**25**
5	Chemical	101	84	108	82	60	58	77	60	61	52	**74**
6	Engineering	103	118	102	106	120	129	161	115	107	118	**118**
7	Fertilizer	14	23	18	31	29	18	11	29	21	39	**23**
8	Food and Personal care Product	76	86	75	67	63	69	73	64	66	70	**71**
9	Glass and Ceramics	133	104	100	103	90	102	114	100	96	90	**103**
10	Jute	62	75	55	10	114	103	136	114	124	95	**89**
11	Leather and Tanneries	148	140	104	127	148	142	131	127	124	154	**134**
12	Oil and Gas Exploration &Refinery	28	31	30	28	32	23	31	29	26	29	**29**
13	Oil and Gas Marketing	19	26	22	16	20	14	23	25	26	23	**21**
14	Paper and Board	55	61	55	45	71	69	76	71	87	97	**69**
15	Pharmaceutical	113	191	127	113	118	107	106	127	115	122	**124**
16	Synthetic and Rayon	103	114	163	106	118	96	105	147	120	127	**120**
17	Textile Composite	50	67	59	64	69	75	87	128	100	92	**79**
18	Textile Spinning	34	61	50	44	59	62	68	124	92	72	**67**
19	Textile Weaving	38	38	40	40	43	48	50	71	53	58	**48**
20	Tobacco	51	53	51	57	51	55	46	46	54	54	**52**
21	Vanaspati and Allied	43	47	55	52	31	43	40	61	55	80	**51**
22	Power Generation & Distribution	19	23	11	25	35	39	60	41	27	23	**30**
23	Sugar and Allied	63	52	28	91	80	87	67	77	73	93	**71**
24	Miscellaneous	49	55	41	51	47	58	107	45	32	59	**54**
	Manufacturing Sector (Avg)	**69**	**74**	**66**	**65**	**70**	**71**	**78**	**78**	**73**	**76**	**72**

Note: *Calculations are based on formula presented at section 3.1, data extracted from Annual Reports of firms*

Table 4.6
Sector-wise Payable Turnover in Days (1998 to 2007)

S. No	Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg.
1	Automobile Assembler	24	18	15	15	16	14	11	11	10	9	**14**
2	Automobile Parts and Accessories	11	10	9	10	10	9	7	7	24	18	**11**
3	Cable and Electric Goods	35	30	26	32	30	32	37	47	55	43	**37**
4	Cement	22	17	22	21	29	26	27	27	32	24	**25**
5	Chemical	45	39	54	55	34	29	42	34	44	41	**42**
6	Engineering	38	30	22	21	44	10	17	11	18	23	**23**
7	Fertilizer	17	32	32	38	37	15	15	25	10	21	**24**
8	Food and Personal care Product	10	9	8	9	7	8	10	13	13	15	**10**
9	Glass and Ceramics	32	26	33	32	31	24	21	21	33	38	**29**
10	Jute	20	25	20	2	16	23	17	18	13	9	**16**
11	Leather and Tanneries	56	68	68	78	66	62	53	54	51	43	**60**
12	Oil and Gas Exploration &Refinery	96	115	99	88	70	49	58	78	60	76	**79**
13	Oil and Gas Marketing	99	64	43	35	32	28	37	38	42	44	**46**
14	Paper and Board	8	8	11	6	7	8	8	7	11	13	**9**
15	Pharmaceutical	24	26	18	16	15	16	18	17	16	18	**18**
16	Synthetic and Rayon	52	42	115	57	51	47	55	71	50	49	**59**
17	Textile Composite	16	19	18	21	20	21	22	28	25	19	**21**
18	Textile Spinning	15	20	22	21	30	24	16	22	13	14	**20**
19	Textile Weaving	8	9	7	8	12	18	26	19	14	22	**14**
20	Tobacco	9	9	13	10	10	13	10	7	7	7	**10**
21	Vanaspati and Allied	40	6	6	4	16	6	7	16	11	27	**14**
22	Power Generation & Distribution	13	13	25	14	13	7	29	2	25	23	**16**
23	Sugar and Allied	21	18	19	18	26	34	25	32	25	33	**25**
24	Miscellaneous	52	31	39	22	15	20	17	13	10	11	**23**
	Manufacturing Sector (Avg)	**32**	**29**	**31**	**26**	**27**	**23**	**24**	**26**	**26**	**27**	**27**

Note: *Calculations are based on formula presented at section 3.1, data extracted from Annual Reports of firms*

Table 4.7
Sector-wise Return on Total Assets (1998 to 2007)

S. No	Sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg.
1	Automobile Assembler	0.131	0.139	0.121	0.165	0.186	0.236	0.203	0.165	0.231	0.219	**0.179**
2	Automobile Parts & Access.	0.146	0.2	0.206	0.178	0.162	0.207	0.245	0.188	0.145	0.121	**0.18**
3	Cable and Electric Goods	0.097	0.113	0.133	0.123	0.144	0.137	0.134	0.138	0.14	0.136	**0.13**
4	Cement	0.033	0.072	0.128	0.074	0.098	0.067	0.153	0.145	0.155	0.071	**0.1**
5	Chemical	0.037	0.059	0.11	0.09	0.119	0.151	0.199	0.216	0.198	0.199	**0.138**
6	Engineering	0.091	0.035	0.069	0.079	0.111	0.12	0.122	0.153	0.158	0.153	**0.109**
7	Fertilizer	0.34	0.287	0.254	0.271	0.219	0.211	0.193	0.215	0.206	0.146	**0.234**
8	Food & Personal care Prod.	0.251	0.286	0.346	0.337	0.386	0.35	0.305	0.283	0.304	0.292	**0.314**
9	Glass and Ceramics	0.097	0.162	0.196	0.182	0.136	0.161	0.156	0.18	0.174	0.138	**0.158**
10	Jute	0.152	0.129	0.099	0.052	0.077	0.249	0.223	0.232	0.229	0.226	**0.167**
11	Leather and Tanneries	0.057	0.104	0.109	0.117	0.109	0.095	0.102	0.117	0.159	0.236	**0.12**
12	Oil and Gas Expl.& Refinery	0.103	0.144	0.116	0.129	0.16	0.198	0.174	0.251	0.166	0.16	**0.16**
13	Oil and Gas Marketing	0.125	0.161	0.162	0.146	0.155	0.172	0.155	0.165	0.154	0.105	**0.15**
14	Paper and Board	0.135	0.167	0.171	0.177	0.191	0.213	0.205	0.144	0.158	0.104	**0.167**
15	Pharmaceutical	0.112	0.177	0.224	0.183	0.153	0.243	0.286	0.283	0.256	0.228	**0.214**
16	Synthetic and Rayon	0.136	0.142	0.111	0.164	0.15	0.133	0.111	0.073	0.092	0.076	**0.119**
17	Textile Composite	0.132	0.114	0.169	0.129	0.14	0.111	0.093	0.084	0.091	0.103	**0.117**
18	Textile Spinning	0.108	0.029	0.243	0.175	0.127	0.103	0.096	0.086	0.115	0.093	**0.118**
19	Textile Weaving	0.189	0.156	0.144	0.096	0.11	0.079	0.055	0.051	0.134	0.099	**0.111**
20	Tobacco	0.104	0.153	0.183	0.186	0.251	0.261	0.325	0.428	0.43	0.46	**0.278**
21	Vanaspati and Allied	0.056	0.058	0.149	0.055	0.125	0.068	0.022	0.009	0.04	0.016	**0.06**
22	Power Gen. & Distribution	0.253	0.182	-0.003	0.234	0.188	0.181	0.178	0.183	0.135	0.126	**0.166**
23	Sugar and Allied	0.107	0.158	0.171	0.094	0.11	0.08	0.105	0.114	0.101	0.102	**0.114**
24	Miscellaneous	0.13	0.173	0.201	0.192	0.229	0.222	0.087	0.128	0.187	0.185	**0.173**
	Manufacturing Sector (Avg)	**0.13**	**0.142**	**0.159**	**0.151**	**0.16**	**0.169**	**0.164**	**0.168**	**0.173**	**0.158**	**0.157**

Note: *Calculations are based on formula presented at section 3.1, data extracted from Annual Reports of firms.*

CO2 emissions, energy use and green GNP in Iran

Rahman Khoshakhlagh
Professor, Department of Economic, University of Esfahan
Masumeh Ghasemi
Postgraduate Student, Department of Economic, University of Esfahan

Abstract
Production is function of labor, capital and energy. At the same time production involves using environmental quality or increasing pollution as here in this paper is represented by CO_2. as result, after evaluating deprecation of environmental quality it is subtracted from the value of production to come up with what is called green GNP. So Green GNP changes due to factors of production as well as pollution entered. Also this paper examined the relationships between green GNP, factors of production (energy, capital, and labor force) and CO2 emission for Iran. The study employed annual time series data (1981 -2008), ARDL model have been applied to the data, due to the general thought which says to be isomorphic to integrated data, and the modeling of co integration processes, some time series are unable to have the advantages of ARDL models, which has on ability to capture both long and short term dynamic in equation model,. Then ARDL model (2, 1, 0, 2, 0) is employed to determine the long and short- term, the results show while the effects of energy use and capital are positive and the effects of CO2 emission and labor force are negative, it is also find that the speed of adjustment in the estimated model by 0.915 and it seems relatively high and significant.
Keywords: Adjusted economic growth, Green GNP, Factors of production, Autoregressive distributed lags (ARDL) models.
JEL Classification Codes: Q56, Q54, and P28.

Introduction:

Global warming and climate change have been one of the most important environmental problems in the last two decades. The ever increasing amount of carbon dioxide (CO2) emissions (hereafter carbon emissions), the dominant contributor to the greenhouse effect, seems to be aggravating this problem . Among the greenhouse gases, carbon dioxide is responsible for more than 60% of the greenhouse effect. Thus, the impacts of global warming and climate change on the world economy have been assessed intensively by academics and practitioners. In addition, worldwide organizations, such as the United Nations, have been attempting to reduce the adverse impacts of global warming and climate changes through intergovernmental and binding agreements, such as the Kyoto Protocol . The Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC), aimed at combating global warming. The UNFCCC is an international environmental treaty with the goal of achieving ‘‘stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system’’. The Protocol was initially adopted on 11 December 1997 in Kyoto, Japan and entered into force on 16 February 2005. As of November 2009, 187 states have signed and ratified the protocol. Although Iran signed Kyoto Protocol in 2009, it will not be obligated to reduce its emissions until 2012. There seems to be basically three research strands in literature on the relationship between economic growth, energy consumption and utilization and environmental pollutants. The first strand focuses on the environmental pollutants and economic growth nexus.

The second strand of the research is related to energy consumption and output nexus. This nexus suggests that economic development and output may be jointly determined, because

economic growth is closely related to energy consumption as higher economic development requires more energy consumption. Following the study of Kraft and Kraft, an extensive number of empirical works have assessed the empirical evidence employing Granger causality and co integration model. The earlier studies mostly apply a bi variate model and fail to get consensus results. However, the multivariate studies also produce conflicting results. Ozturk provides an extensive review survey of the studies on the empirical results from causality tests between energy consumption and economic growth.

The third strand is a combined approach of these two methods which is implied to investigate validity of both nexuses in the same framework. This approach investigates the dynamic relationships between economic growth, environmental pollutants and energy consumption altogether with environmental consideration for economic growth and calculation green GNP.

Green GNP:

Environmental economists have argued that pollution is one of the factors which make GNP an inappropriate measure of economic welfare. Recently they have tried to construct a measure of gross national product net of environmental costs. That is, they collect data on how much damage has been done to the environment due to production and consumption activities and try to transform the damages into money value. By subtracting the costs from GNP, they are trying to construct the so-called Green GNP. However, although the analysis is restricted by the pollution data we have used, we can illustrate that Green GNP may be calculated more easily and directly from the estimates we have got in the previous section.

Removing the pollution produced during the production and consumption process is equivalent to removing the direct taste effect of pollution.

If environmental depreciation be denoted by CEM, then sustainable income can be denned as (NNP-CEM).

Green GNP (ENP) = NNP-CEM (1)

Methodology and data:

Most of the earlier empirical causality studies on energy – growth and environmental pollutants – economic growth nexuses were using only two variables. In other words, they were employed bivariate models which cause an omitted variable problem. Thus, to avoid this problem, we employed a multivariate model in this study. To investigate the long-run relationship between carbon dioxide emissions, energy use, ENP, labor force and capital. We employed the following equation:

$$ENP_t = \alpha + \beta EC_t + \theta CO2_t + \phi K_t + \gamma L_t + \varepsilon_t \quad (2)$$

Where ENP_t is green GNP, EC is energy use (barrel of oil equivalent), CO_2 is carbon dioxide emissions (per ton), K is fixed capital and L is total labor force.

In this paper total labor force and fixed capital are taken for 1980- 2008 from the central bank's balance sheet. The data were compared with data from the World Bank and Statistical Center of Iran. Data on energy use and CO_2 emissions are taken from World Development Indicators and International Agency Energy. Data relating to adjusted Economic growth is ENP or green GNP, ENP has been calculated with using central bank data.

The long run and short runs relationships between ENP, energy use, CO_2 emissions, capital and labor force in Iran will be performed in two steps. Firstly, we will test the long-run relationships among the variables by using the ARDL bounds testing approach of co integration. Secondly, we test short- run relationships by using the error-correction models.

2.1. Autoregressive distributed lag (ARDL) co integration analysis:

The ARDL bounds testing approach of co integration is developed by Pesaran and Shin and Pesaran et al. The ARDL co integration approach has numerous advantages in comparison with other co integration methods such as Engle and Granger, Johansen, and Johansen and Juselius procedures: (i) no need for all the variables in the system be of equal order of integration, (ii) it is efficient estimator even if samples are small and some of the regressors are endogenous, (iii) it allows that the variables may have different optimal lags, and (iv) it employs a single reduced form equation. Basically, this approach involves two steps for estimating long run relationship. The first step is to investigate the existence of long-run relationship among all variables in the equation. The ARDL model for the standard log-linear functional specification of long-run relationship between ENP, energy use, CO_2 emissions, capital and labor force may follows as:

$$\Delta ENP_t = \alpha_1 + \sum_{i=1}^{a1} \varphi_{1i}\Delta ENP_{t-i} + \sum_{j=0}^{b1} \beta_{1j}\Delta EC_{t-j} + \sum_{p=0}^{c1} \theta_{1p}\Delta CO_{2t-p} + \sum_{q=0}^{d1} \emptyset_{1q}\Delta K_{t-q} + \sum_{v=0}^{e_1} \gamma_{1v}\Delta L_{t-v} + \delta_1 ENP_{t-1} + \delta_2 EC_{t-1} + \delta_3 CO_{2t-1} + \delta_4 K_{t-1} + \delta_5 L_{t-1} + \varepsilon_{1t}$$

…… (3)

Where ε_{1t} and Δ are the white noise term and the first difference operator, respectively. An appropriate lag selection based on a criterion such as Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC). The bounds testing procedure is based on the joint F-statistic or Wald statistic that is tested the null of no co integration,

H_0: $\delta_r = 0$, against the alternative of H_1 : $\delta_r \neq 0$ $r = 1,$ 2, 3, 4, 5.

Two sets of critical values that are reported in Pesaran et al. provide critical value bounds for all classifications of the regressors into purely I(1), purely I(0) or mutually co integrated. If the calculated F-statistics lies above the upper level of the band, the null is rejected, indicating co integration. If the calculated F-statistics is below the upper critical value, we cannot reject the null hypothesis of no co integration. Finally, if it lies between the bounds, a conclusive inference cannot be made without knowing the order of integration of the underlying regressors. The second step is to estimate the following long-run and short-run models that are represented in Esq. (4) and (5) if there is evidence of long-run relationships (co integration) between these variables.

$$ENP_t = \alpha_2 + \sum_{i=1}^{a1} \varphi_{2i} gdp_{t-i} + \sum_{j=0}^{b1}{}' \beta_{2j} EC_{t-j} + \sum_{p=0}^{c1}{}' \theta_{2p} CO_{2t-p} + \sum_{q=0}^{d1}{}' \emptyset_{2q} K_{t-q} + \sum_{v=0}^{e1} \gamma_{2v} L_{t-v} + \varepsilon_{2t}$$

……(4)

$$\Delta ENP_t = \alpha_3 + \sum_{i=1}^{a1} \varphi_{3i}\Delta ENP_{t-i} + \varepsilon_{3t} + \sum_{j=0}^{b1} \beta_{3j}\Delta EC_{t-j} + \sum_{p=0}^{c1} \theta_{3p}\Delta CO_{2t-p} + \sum_{q=0}^{d1} \emptyset_{3q}\Delta K_{t-q} + \sum_{v=0}^{e1} \gamma_{3v} L_{t-v} + \Psi ECT_{t-1}$$

…… (5)

Where Ψ is the coefficient of error correction term (hereafter ECT). ECT, defined as:

$$ECT_t = ENP_t - \alpha_2 - \sum_{i=1}^{a1} \varphi_{2i} ENP_{t-i} - \sum_{j=0}^{b1} \beta_{2j} EC_{t-j} - \sum_{p=0}^{c1} \theta_{2p} CO_{2t-p} - \sum_{q=0}^{d1} \varpi_{2q} K_{t-q} - \sum_{v=0}^{e1} \gamma_{2v} L_{t-v}$$

……(6)

It shows how quickly variables converge to equilibrium and it should have a statistically significant coefficient with a negative sign.

Empirical results:

Table 1: The estimated long run coefficients results Model: ARDL (2, 1, 0, 2, 0) Dependent variable: ENP_t

Regressor	Coefficients	t-ratio	Prop level
EC	121.4222	1.9059	.076
CO2	-167.0376	-4.9573	.000
K	41.8318	2.7910	.014
L	-291.2416	-2.2931	.037
Constant	19.6997	3.8967	.001
Time Trend	-.68794	-3.8744	.001

The results shows that in the long–run a 1 percent of changes increased of energy use leads to ENP increased with 121.422, the EC in the model is not significant statistically at 5% significance level, alternatively , CO2 emission has a significant effect on ENP and 1percent changes increase in the variable leads to 167 decreases in ENP. Respectively to table, if the changes in capital with one percent increase, the effect of ENP increased by 41.83, and it is significant statistically. In addition labor force increased with one percent the ENP decreased by 291.24 percent exactly

Table 2 : Estimated short-run Error Correction Model ECM- ARDL ARDL (2, 1, 0, 2, 0) Dependent variable: dENP

Regressor	Coefficients	t-ratio	Prop level
dENP1	.38801	3.4319	.003
dEC	229.4522	5.8169	.000
dCO2	-152.9688	-6.3518	.000
dK	65.8915	6.8463	.000
dK1	-59.7381	-5.1145	.000
dL	-266.7116	-2.4141	.027
dC	18.0405	3.3890	.003
dT	-.63000	-3.0215	.008
ecm(-1)	-.91577	-6.0777	.000
R^2	.94613	F(8,17) = 56.1353	.000

The error correction term indicates the speed of adjustment which indicates equilibrium in the dynamic models, the ECM coefficients shows how quickly variables return to equilibrium and shows that are significant with a negative sign, also ECM holds highly significant error correction term is further proof of the existence of a stable long –term relationship, and shows

an expected a negative sign of the ECM and highly significant in the model, the long –term growth rate in ENP deviation is corrected by 0. 91 over time , it means that adjustment is relatively high , all variables are highly significant statistically in the model , this give us an evidence that the estimated coefficients presents the actual estimated of model parameters , and this model is fit to analysis the data to capture the short–run and long–run term equilibrium.

Table (3) present the estimated of autoregressive distributed lag ARDL (2, 1, 0, 2, 0), based on SBC all coefficient has appositive sign and has significant statistically.

Table 3 : The estimated autoregressive distributed lag model
Model: ARDL (2, 1, 0, 2, 0) based on: SBC dependent variable: ENP

Regressor	Coefficients	t-ratio	Prop level
ENP(-1)	.47223	4.4093	.001
ENP(-2)	-.38801	-3.4319	.004
EC	229.4522	5.8169	.000
EC(-1)	-118.2568	-3.9994	.001
CO2	-152.9688	-6.3518	.000
K	65.8915	6.8463	.000
K(-1)	-87.3212	-6.4886	.000
K(-2)	59.7381	5.1145	.000
L	-266.7116	-2.4141	.029
Constant	18.0405	3.3890	.004
Time Trend	-.63000	-3.0215	.009
R^2	.93304		

Conclusion

The main objective of this study was to determine the major driver of adjusted economic growth in Iran, in this study we first used the annual time series data (1981 -2008) , the variables which used in this study are ENP (Environmental National Production), factors of production (energy use, capital and labor force) and CO2 emission.

We have applied the ARDL technique , this approach provides new co integration technique , in the application of ARDL models two models are estimated , model (1) is (2,1,0,2,0) include energy use , CO2 emission , capital , labor force as a major determinant of ENP , second model is similar to model (1) but with a first difference applying ECM version of the ARDL, the model shows that error correction coefficients which determine speed of adjustment , has an expect and highly significant negative sign .

The results of estimations show in the long term effects of energy use aren't significant at 5% significance level but are positive. The effects of other variables are significant, but the effects of CO2 emission and labor force are negative and capital effect is positive. In the short term effects of all variables are significant and effects of CO2 emissions and the labor force are negative and effects of energy use and capital are positive.

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