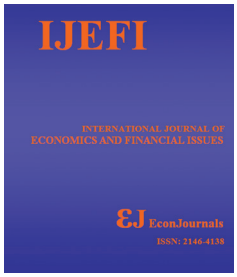

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Data Envelopment Analysis and Tobit Analysis for Firm Efficiency in Perspective of Working Capital Management in Manufacturing Sector of Pakistan

Muhammad Fawad Ahmad[1], Muhammad Ishtiaq[2], Kashif Hamid[3]*, Muhammad Usman Khurram[4], Ali Nawaz[5]

[1]Department of Business Administration, G.C University, Faisalabad, Pakistan, [2]Department of Business Administration, G.C University, Faisalabad, Pakistan, [3]Institute of Business Management Sciences, University of Agriculture, Faisalabad, Pakistan, [4]LSCS, University of Agriculture, Faisalabad, Pakistan, [5]Department of Business Administration, G.C University, Faisalabad, Pakistan. *Email: kashif.boparai@hotmail.com

ABSTRACT

This research is performed for dealing with some of the important working capital management policies and efficiency regarding to manufacturing sector of Pakistan. For this purpose data from 37 firms have been taken for the period 2009-2014. Data envelopment analysis (DEA) and Tobit regression analysis has been performed to achieve the objective of this study. DEA results indicate that only fifteen companies require increase in inputs to attain better output whereas six companies require decrease in the input. However sixteen companies have to consistent with their existing proportionate of inputs to sustain the output maximization. Tobit regression analysis concludes that average collection period has significant negative impact on efficiency and current ratio, gross working capital turnover ratio and financial leverage ratio have positive significant impact on efficiency.

Keywords: Working Capital Management, Efficiency, Data Envelope Analysis, Tobit Analysis, Manufacturing Sector
JEL Classifications: C8, G3

1. INTRODUCTION

Inefficient and ineffective financial management harm business profitability and value of the firm. In order to raise shareholder value, corporate strategy should include efficient management of working capital management (Nazir and Afza, 2009) as well. Moreover, efficient management of working capital contributes to improve operational performance of the business and helps the business to meet its short term liabilities effectively (Paramasivan and Subramanian, 2009). Therefore, business tries to attain an optimum level of working capital that increases business value. Effective management of working capital is the most important for the business because it directly affects the profitability and liquidity of a business (Deloof, 2003). In current scenario, competition between firms is forcing them to utilize their diverse methods in order to enhance their productivity and to reduce their expenses in order to make them competitive and to maintain their sustainability in competition.

In recent years, performance has been optimized by many of the manufacturing firms and that's why cost pressure has increased. In enhancing the performance of firms, the most important issue to be considered is to determine the reasons of precedence and debility. Analysis and comparison of firms and to determine precedence and debility is the biggest challenge for the firm managers (Tseng, 2009). Imply, working capital management doesn't mean only financial performance improvement in today's broke and changeable economy, but also means to ask for day to day operations of the firm. So it is important to understand the impact of working capital management on firm efficiency. Also; many researchers have done a lot of work on finding the connection and impact of working capital management on performance of firm using different techniques and methods, but no work is done for the impact of working capital management on firm efficiency for listed manufacturing companies in emerging economy of Pakistan using the technique of data envelopment analysis (DEA) and Tobit analysis up to the best of journals survey. This limited

evidence along with working capital management invite for research on impact of working capital management on firm performance in Pakistani context.

This study focused on working capital management and non-financial enterprises in Pakistan profitability kind of impact. Existing literature and references on working capital management of different sectors lacks the empirical evidence and DEA and Tobit analysis is used for a sample of Pakistani listed companies. The objective of managing working capital is just to assure the relationship that is carried out, is because of the consequence of firm's efficiency on working capital management.

The results of this study may implicate other companies who are attempting to take some positive decision concerning working capital management. A simple conceptual framework will render some guidelines for managers, directors, investors, accountants and professionals of manufacturing firms. Study findings will further help examine the effectiveness of management of working capital in the considered manufacturing firms for program valuation.

2. LITERATURE REVIEW

Relative efficiency of the companies is the primary focus to be calculated and for which the technique of DEA is used and the benchmarked base is the manufacturing companies (Yue, 1992; Ayadi et al., 1998; Casu and Molyneux, 2003). The scores of benchmarked base always stays in between 1 and 0 (Das and Ghosh, 2006; Banker et al., 2010). If the score is 1, it shows that the company is fully efficient and if the score is 0, it shows that the company is working on its worst efficiency (Miller and Noulas, 1996). DEA uses two types of preferences; input and output of the company (Yue, 1992; Grigorian and Manole, 2002; Coelli et al., 2005; Kao et al., 2011; Fernando and Nimal, 2014). The DEA model which is input oriented focuses on decrease in input with the use of given output. Whereas DEA model which is output oriented, focuses only on increase in output with the use of given input (Coelli et al., 2005). In order to carry out the DEA, two kinds of assumption are made; constant return to scale (CRS) and variable return to scale (VRS) (Avkiran, 1999; Coelli et al., 2005). Charnes et al. (1978) firstly used this input oriented DEA model and evaluated the efficiency of decision making units (DMUs) using constant return to sales assumption. Production function has a feature, names as CRS and is demonstrated when a positive variation in input causes the same positive variation in output. Nevertheless, DMUs have increasing or decreasing value of return to scale in VRS. Afterwards, Banker et al. (1984) presented BCC model and calculated efficiency with the use of VRS. This BCC model gives greater efficiency or equal efficiency values as compared to the CRS both CRS and VRS models are given bellow with detail.

Abokaresh and Kamaruddin (2011) evaluated efficiency effect of Libyan manufacturing firms before and after their privatization from the year 2000 to 2008. In their study, technical efficiency calculated from the data. Average value of efficiency before privatization was 49.5% of all the firms, where, it becomes 62.3% after their privatization, which showed only 15.3% change after their privatization. It showed no any significant change.

Zhou et al. (2011) considered the same technology on large sized and medium sized firms, taken from thirty provinces, using CRS and VRS both, for the period from 2006 to 2008. They found a decreasing trend in three years; they also found that year 2006 was the most efficient with 23.3% efficient companies. Actually it was observed that the data had decreasing return to scale throughout the whole years.

Whereas (Hsiao et al., 2010; Kao et al., 2011; Barth et al., 2013; Jha et al., 2013; Lee and Chih, 2013) used TOBIT analysis to analyze the efficiency of the determinants of the working capital management.

2.1. Research Hypothesis

H1: Inputs are major determinants of firm efficiency.

H2: Efficiency of outputs is based upon efficiency of the inputs.

H3: ACP has negative impact on firm efficiency.

H4: Current ratio (CR) has negative impact on the firm efficiency.

H5: Gross working capital turnover ratio (GWCTR) has positive impact on the firm efficiency.

H6: Sales growth (SG) has positive impact on firm efficiency.

H7: Financial leverage ratio (FLR) has positive impact on firm efficiency.

3. DATA AND METHOD

3.1. Sample Data

Our sample contains 37 manufacturing companies working in Pakistan. Panel data is taken for the period 2009-2014.

3.2. Variable Proxies

As stated above, dependent variable (efficiency) and independent variables (proxies of working capital management) are calculated by the available financial statement's data published by the State Bank of Pakistan. For this purpose, following ratios and particulars are used: (1) Total sales of firms, (2) total profit after taxes, (3) total assets, (4) cost of sales and (5) total selling and administration expenses and cost, (6) average collection period (ACP), (7) GWCTR, (8) SG, (9) credit ratio and (10) financial debt ratio.

Now all the ratios and particulars of balance sheets mentioned above are given in detail along with the calculation methods and formulas.

Variables	Computation
Assets turnover ratio	(Net sales/total assets)
Average collection period	(Net sales/account receivables)×360
Gross working to capital turnover ratio	(Sales/average working capital)
Sales growth	(Current month's sales−Previous year's sales)/previous year's sales
Current ratio	Current assets/current liabilities
Financial debt ratio	Total liabilities/total assets

3.3. DEA

3.3.1. CRS model

Considering the investigation of Coelli et al. (2005), an assumption is made with reference to the input oriented DEA model that there are B companies, from which each has P inputs which are producing Q outputs. Input matrix is denoted by X for all companies selected and it is calculated by Q x C in the same way, output matrix is denoted by Y and it can be calculated by Q x C. For n^{th} company, X_n shows the input column vector of n^{th} company. Similarly, Y_n shows the output column vector of n^{th} company. In accordance with Charnes et al. (1978), n^{th} company efficiency is calculated with maximizing the proportion of weighted output and weighted input like U′Yn/V′Xn. Where U shows Q*1 output weighted vector and V shows P*1 input weighted vector and U′ shows the output weighted transpose and V′ shows input weighted transpose considering the situation that the companies have ratios equals to 1 or less than 1. Optimum weights can be calculated by the following formula for n^{th} companies:

$$\text{Max}_{u,v}\,(U'Y_n/V'X_n) \quad (1)$$

Where,
$(U'Y_s/V'X_s) \leq 1$ s = 1, 2, 3,…, C
U, V ≥ 0

Objective of the mentioned linear programming technique is to evaluate the efficiency of n^{th} companies by calculating U and V values with an assumption that the companies have equal or <1 value of efficiency. The issue with the ratio formation is that U and V has been provided n^{th} vales. In order to solve this problem, the V′Xn = 1 is applied, which gives:

$$\text{Max}_{u,v}\,(U'Y_n) \quad (2)$$

Where,
V′Xn = 1 s = 1, 2, 3., C
U′Ys−V′Xs ≤ 0
U, V ≥ 0

The mentioned problem is DEA multiplier. Same variables are considered for this multiplier which is used in earlier model (1).

The problem, which is input oriented, is evaluated with the application of duality theorem in the context of linear programming.

$$\text{Min}_{\lambda,\theta}\,(\theta) \quad (3)$$

Where,
Yλ ≥ Y_n
θX_n −Xλ ≥ 0
λ ≥ 0

In the above mentioned equation, λ is the column matrix which has an order B*1 and it has only the constant vector. This type is more recommended because it has less constraints as compared to the original model. For the purpose of evaluating the value of efficiency of each company, the above mentioned problem is figured out B times.

DEA which is output oriented can be derived as:

$$\text{Max}_{\lambda,\phi}(\phi) \quad (4)$$

Where,
Yλ ≥ ϕY_n
X_n −Xλ ≥ 0
λ ≥ 0

The sign of ϕ denotes scalar and shows efficiency vale of n^{th} companies. Remaining variables will remain same as those were explained in previous problem (3).

3.4. Tobit Regression Analysis

In this study, Tobit regression analysis is also being used to measure the relationship between the working capital management and firm efficiency of the listed manufacturing companies of Pakistan, since we have mentioned in earlier chapter that we are using Tobit Regression Analysis instead of OLS Regression because of censored dependent variable of Efficiency of firms (Hsiao et al., 2010; Kao et al., 2011; Barth et al., 2013; Jha et al., 2013; Lee and Chih, 2013a; 2013b). Tobit Regression model, which is used to measure the relationship of working capital management and firm efficiency, is mentioned below.

$$\text{Firm EFF}_{nt} = \beta_0+\beta_1\,\text{ACP}_{nt}+\beta_2\,\text{GWCTR}_{nt}+\beta_3\,\text{SG}_{nt} +\beta_4\,\text{CR}_{nt}+\beta_5\,\text{FDR}_{nt}+e_{nt} \quad (5)$$

Where,
Firm_EFFnt = Efficiency of n^{th} firm at time t
β_0 = Constant
ACPnt = Average collection period of n^{th} firm at time t
GWCTRnt = Gross working capital turnover ratio of n^{th} firm at time t
SGnt = Sale growth of n^{th} firm at time t
CRnt = Current ratio of n^{th} firm at time t
FDRnt = Financial debt ratio of n^{th} firm at time t
e_{nt} = Error term of n^{th} firm at time t

β_1, β_2, β_3, β_4 and β_5 are the coefficients which are measured by the use of Tobit regression Analysis. Firstly, the efficiency of the companies is calculated which is the dependent variable. This efficiency is basically having a range of values and the range is 1 and 0. The value of efficiency always lies in between 1 and 0 (Das and Ghosh, 2006; Banker et al., 2010). For n^{th} companies, Tobit analysis can be explained with following mathematical expressions:

$$Y_n^* = \beta X_n+\mu_n \quad (6)$$

Where,
$Y_n = Y_n^*$ and
$Y_n^* \geq 0$ otherwise $Y_n^* \leq 1$

β is the set of parameters which is being measured and X_n shows the variable which is to be explained. Error is shown by μ_n latent variable is shown by Y_n^*. Y_n shows the efficiency of n^{th} company. Firstly, this study has taken DEA program to measure the efficiency of companies. Than we used Statistical Package for Social Sciences software for the purpose of measuring the descriptive and illative statistical analyses to show impact of

independent variable (which is working capital management) and the dependent variable (which is efficiency). Complete detail of analysis of secondary data is given in next chapter.

4. RESULTS AND DISCUSSION

Table 1 indicates that 15 companies require increase in inputs to attain better output whereas 6 companies require decrease in the input. However 16 companies have to consistent with their existing proportionate of inputs to sustain the output maximization.

The Table 2 indicates the inputs slack that such element need to rectify either it exists in input elements or in output elements. However inputs have greater importance for the slack values. It is because we have to redesign the policies for such firms regarding to the said input parameters. Output slack indicates that the results are not due to only these inputs it may be due to other elements as well.

Table 3 shows the descriptive analysis mean value, maximum and minimum values and standard deviation of the whole data. Table 3 indicates that total 222 observations were selected for analysis of each variable, which were ACP, GWCTR, SG, CR, financial debt ratio and efficiency. The results of efficiency indicate that it has maximum value 6.4837 and minimum value is 0.0922. The mean value is 1.3847 and the standard deviation is 1.2207 and has positive skewness. The ACP is 39.538 days and the CR is 1.7116 and the average SG is 15.97% of these manufacturing industries. However the average FLR is 49.92%.

Table 4 indicates efficiency is negative related to ACP and CR significantly. It means as ACP and CR will increase efficiency curve fall down. However efficiency has positive correlation with GWCTR and FLR significantly. It indicates that increase in GWCTR and FL will also increase the efficiency in positive dimension.

The Tobit regression analysis is given in the following Table 5 shows that ACP has significant negative impact on efficiency and CR, GWCTR and FLR have positive significant impact on efficiency.

Table 1: Efficiency report CRS input oriented model

DMU No.	DMU name	Input-oriented CRS efficiency	Sum of lambdas	RTS	Optimal lambdas with benchmarks
1	Abbott Laboratories (Pakistan) Ltd.	1.00000	1.000	Constant	1.000
2	Atlas Honda	0.97804	0.519	Increasing	0.291
3	Attock Patroleum	1.00000	1.000	Constant	1.000
4	Attock Refinery	1.00000	1.000	Constant	1.000
5	Bannu Woolen Mills	0.81150	0.030	Increasing	0.024
6	Crescent Steel & Allied Products Ltd.	0.81523	0.265	Increasing	0.004
7	D.G. Khan Cement Co. Ltd	0.87430	0.767	Increasing	0.190
8	Dawood Hercules Chemicals Ltd.	1.00000	1.000	Constant	1.000
9	Engro Corporation Ltd.	0.81855	5.363	Decreasing	0.850
10	Fauji Cement Co. Ltd.	0.98058	1.226	Decreasing	0.004
11	Fauji Fertilizer Bin Qasim Ltd.	0.95443	0.668	Increasing	0.222
12	Ferozsons Laboratories Ltd.	1.00000	1.000	Constant	1.000
13	Fauji Fertilizer Co. Ltd.	1.00000	1.000	Constant	1.000
14	Hub Power Company	1.00000	1.000	Constant	1.000
15	ICI Pakistan Ltd.	0.90166	0.468	Increasing	0.203
16	Indus Dyeing & Manufacturing Co. Ltd.	0.96277	0.571	Increasing	0.067
17	Indus Motor Co. Ltd.	0.96902	1.148	Decreasing	0.356
18	Kohat Cement Co. Ltd.	1.00000	1.000	Constant	1.000
19	Kot Addu Power Co. Ltd.	1.00000	1.000	Constant	1.000
20	Lucky Cement Ltd.	0.82514	1.091	Decreasing	0.708
21	Maple Leaf Cement Factory Ltd	0.66664	0.306	Increasing	0.217
22	Millat Tractors Ltd.	1.00000	1.000	Constant	1.000
23	National Refinery Ltd.	1.00000	1.000	Constant	1.000
24	Nishat (Chunian) Ltd.	0.88485	0.109	Increasing	0.079
25	Oil & Gas Development Co. Ltd.	1.00000	1.000	Constant	1.000
26	Packages Ltd.	0.63267	0.098	Increasing	0.042
27	Murree Brewery Co. Ltd.	0.75574	0.079	Increasing	0.048
28	Pakistan Oilfields Ltd.	0.84748	0.142	Increasing	0.014
29	Pak Suzuki Motor Co. Ltd.	0.93677	0.357	Increasing	0.294
30	Pioneer Cement Ltd.	0.83473	0.036	Increasing	0.020
31	Pakistan State Oil	1.00000	1.000	Constant	1.000
32	Pakistan Telecommunication Co. Ltd.	0.62516	6.413	Decreasing	0.369
33	Searle Pakistan Ltd.	1.00000	1.000	Constant	1.000
34	Pakistan Tobacco Co. Ltd.	1.00000	1.000	Constant	1.000
35	Shell Pakistan Ltd.	1.00000	1.000	Constant	1.000
36	Sui Northern Gas Pipelines Ltd.	0.83604	1.069	Decreasing	0.794
37	Lafarge Pak. Cement Ltd.	0.61428	0.118	Increasing	0.083

DMU: Decision making units, CRS: Constant return to scale, RTS: Returns to scale

Table 2: Input and output slacks

DMU No.	DMU name	Input slacks			Output slacks	
		CGS	SA	TA	Total sales	Profit after tax
1	Abbott Laboratories (Pakistan) Ltd	0.00000	0.00000	0.00001	0.00000	0.00001
2	Atlas Honda	0.00000	0.00000	0.00025	0.00000	667964.42
3	Attock Patroleum	0.00000	0.00000	0.00000	0.00000	0.00000
4	Attock Refinery	0.00108	0.00000	0.00000	0.00000	0.00006
5	Bannu Woolen Mills	0.00000	0.00000	496750.21	0.00000	14498.74
6	Crescent Steel & Allied Products Ltd.	0.00000	0.00000	0.00003	0.00000	203329.16
7	D.G. Khan Cement Co. Ltd.	0.00000	0.00000	25099953.80	0.00000	989281.66
8	Dawood Hercules Chemicals Ltd.	0.00000	0.00000	0.00000	0.00003	0.00000
9	Engro Corporation Ltd.	0.00000	0.00000	18050925.28	0.00000	15582544.15
10	Fauji Cement Co. Ltd.	0.00000	0.00000	15237654.79	0.00000	20142.54
11	Fauji Fertilizer Bin Qasim Ltd.	0.00000	0.00000	0.00000	0.00000	1675546.02
12	Ferozsons Laboratories Ltd.	0.00000	0.00000	0.00000	0.00000	0.00000
13	Fauji Fertilizer Co. Ltd.	0.00000	0.00000	0.00000	0.00000	0.00009
14	Hub Power Company	0.00056	0.00000	0.00189	0.00000	0.00000
15	ICI Pakistan Ltd.	0.00000	0.00000	0.00017	0.00000	1993265.32
16	Indus Dyeing & Manufacturing Co. Ltd.	0.00000	0.00000	0.00001	0.00000	23670.82
17	Indus Motor Co. Ltd.	0.00000	0.00000	0.00039	0.00000	841666.11
18	Kohat Cement Co. Ltd.	0.00000	0.00000	0.00001	0.00000	0.00000
19	Kot Addu Power Co. Ltd.	0.00048	0.00000	0.00000	0.00000	0.00000
20	Lucky Cement Ltd.	0.00000	0.00000	0.00069	0.00000	3668067.29
21	Maple Leaf Cement Factory Ltd.	0.00000	0.00000	0.00000	0.00000	5101372.73
22	Millat Tractors Ltd.	0.00020	0.00000	0.00000	0.00000	0.00000
23	National Refinery Ltd.	0.00000	0.00000	0.00014	0.00000	0.00006
24	Nishat (Chunian) Ltd.	0.00000	0.00000	3560379.85	0.00000	1701355.23
25	Oil & Gas Development Co. Ltd.	0.00007	0.00000	0.00261	0.00000	0.00000
26	Packages Ltd.	0.00000	0.00000	10324946.38	0.00000	2875522.50
27	Murree Brewery Co. Ltd.	0.00000	0.00000	0.00000	0.00000	552764.08
28	Pakistan Oilfields Ltd.	0.00000	0.00000	922523.96	0.00000	2162080.47
29	Pak Suzuki Motor Co. Ltd.	0.00000	0.00000	0.00000	0.00000	1869683.94
30	Pioneer Cement Ltd.	0.00000	0.00000	2695063.32	0.00000	768050.74
31	Pakistan State Oil	0.00000	0.00000	0.00000	0.00000	0.00060
32	Pakistan Telecommunication Co. Ltd.	0.00000	0.01335	0.00000	0.00000	22579369.83
33	Searle Pakistan Ltd.	0.00000	0.00078	0.00000	0.00000	0.00074
34	Pakistan Tobacco Co. Ltd.	0.00000	0.00022	0.00027	0.00000	0.00000
35	Shell Pakistan Ltd.	0.00000	0.00000	0.00000	0.00000	0.00006
36	Sui Northern Gas Pipelines Ltd.	0.00000	0.00000	0.00000	0.00000	21056546.93
37	Lafarge Pak. Cement Ltd.	0.00000	0.00000	0.00002	0.00000	2995434.86

DMU: Decision making units, CGS: Cost of goods sold, TA: Total assets, SA: Selling and admin expenses

Table 3: Descriptive analysis

Variables	EFF	ACP	CR	GWCTR	SG	FLR
Mean	1.3847	39.538	1.7116	0.4714	0.1597	0.4992
Median	0.9893	16.0417	1.3777	0.4492	0.1448	0.5029
Maximum	6.4837	329.507	6.9193	0.9699	1.6507	1.0048
Minimum	0.0922	0.0091	0.2642	0.0032	−0.4721	0.0156
Standard deviation	1.2207	59.0739	1.1388	0.2460	0.2574	0.2137
Skewness	1.8295	2.5610	1.8560	0.3132	1.7922	0.0288
Kurtosis	6.4205	9.9209	7.5161	2.0909	10.976	1.9818
Jarque-Bera	232.07	685.754	316.12	11.2746	707.43	9.6192
Probability	0.0000	0.000000	0.000	0.0035	0.0000	0.0081
Sum	307.42	8777.582	379.99	104.67	35.45	110.82
Sum Sq. Dev.	329.31	771229.3	286.64	13.376	14.64	10.100
Observations	222	222	222	222	222	222

ACP: Average collection period, SG: Sale growth, EFF: Efficiency, CR: Current ratio, GWCTR: Gross working capital turnover ratio, FLR: Financial leverage ratio

The Table 6 shows null hypothesis is strongly rejected and hence results indicates that independent variables are jointly significant because $P < 0.00001$.

Figure 1 indicates the positive skewness in the residuals and provides the justification for the use of Tobit regression model.

Figure 2 indicates the behavior of whole variables in a given panel for the year 2009-2014.

Table 7 indicates the null hypothesis is strongly rejected and the Wald test indicates the true value of the parameter as given in our sample of the study.

Table 4: Correlation matrix

	EFF	ACP	CR	GWCTR	SG	FLR
EFF	1					
ACP	−0.1269	1				
CR	−0.1019	0.1056	1			
GWCTR	0.5012	0.3065	0.0862	1		
SG	0.0700	0.0020	0.0062	0.0205	1	
FLR	0.3109	0.2129	−0.7027	0.1916	0.0330	1

ACP: Average collection period, SG: Sale growth, EFF: Efficiency, CR: Current ratio, GWCTR: Gross working capital turnover ratio, FLR: Financial leverage ratio

Table 5: Tobit regression analysis

Dependent variable: EFF				
Method: ML - Censored normal (Tobit)				
Variable	**Coefficient**	**Standard error**	**z-statistic**	**P**
C	−1.159747	0.330813	−3.505747	0.0005
ACP	−0.008298	0.001171	−7.086941	0.0000*
CR	0.216902	0.084554	2.565260	0.0103*
GWCTR	2.591246	0.274377	9.444102	0.0000*
SG	0.210775	0.240429	0.876660	0.3807
FLR	2.495849	0.462179	5.400183	0.0000*
Error distribution				
Scale: C(7)	0.918613	0.043595	21.07134	0.0000
Mean dependent var	1.384791	S.D. dependent var		1.220711
S.E. of regression	0.931080	Akaike info criterion		2.731160
Sum squared resid	186.3855	Schwarz criterion		2.838451
Log likelihood	−296.1587	Hannan-Quinn criter.		2.774477
Avg. log likelihood	−1.334048			
Left censored obs	0	Right censored obs		0
Uncensored obs	222	Total obs		222

*P<0.05. ACP: Average collection period, SG: Sale growth, EFF: Efficiency, CR: Current ratio, GWCTR: Gross working capital turnover ratio, FLR: Financial leverage ratio

Table 6: Redundant variable test

Null hypothesis: ACP CR GWCTR SG FLR are jointly insignificant			
Specification: EFF C ACP CR GWCTR SG FLR			
Redundant variables: ACP CR GWCTR SG FLR			
	Value	**df**	**P**
Likelihood ratio	125.2374	5	0.0000
LR test summary:			
Restricted LogL	−358.7774	220	
Unrestricted LogL	−296.1587	215	

Restricted test equation				
Dependent variable: EFF				
Method: ML - Censored normal (Tobit) (Quadratic hill climbing)				
Variable	**Coefficient**	**Standard error**	**z-statistic**	**P**
C	1.384791	0.081744	16.94058	0.0000
Error distribution				
Scale: C(2)	1.217958	0.057802	21.07131	0.0000
Mean dependent var	1.384791	S.D. dependent var		1.220711
S.E. of regression	1.225966	Akaike info criterion		3.250247
Sum squared resid	330.6582	Schwarz criterion		3.280902
Log likelihood	−358.7774	Hannan-Quinn criter.		3.262624
Avg. log likelihood	−1.616115			
Left censored obs	0	Right censored obs		0
Uncensored obs	222	Total obs		222

ACP: Average collection period, SG: Sale growth, EFF: Efficiency, CR: Current ratio, GWCTR: Gross working capital turnover ratio, FLR: Financial leverage ratio

5. CONCLUSION

This research has been performed for dealing with some of the important working capital management policies and firm efficiency regarding to firm specification. For this purpose, a detailed analysis has been performed on manufacturing firms. DEA and Tobit regression analysis has been performed to achieve the objective of this study. Analysis revealed some important areas from which the firm efficiency can be improved and an optimum level can be achieved. Moreover, with the help of above stated tools, analysis has made to measure the impact of working capital management on firm efficiency. DEA results indicate that only fifteen companies require increase in inputs to attain better output whereas six companies require decrease in the input. However sixteen companies have to consistent with their existing proportionate of inputs to sustain the output maximization. Further results indicate that the input slack requires to rectify either it exists in input elements or in output elements. However inputs have greater importance for the slack values. It is because we have to redesign the policies for such firms regarding to the said input parameters. Output slack indicates that the results are not due to only these inputs it may be due to other elements as well.

Further results shows that the efficiency variable is positively skewed in descriptive statistics. Correlation results conclude that efficiency is negatively related to ACP and CR significantly. It means as ACP and CR will increase efficiency curve fall down. However efficiency has positive correlation with GWCTR and FLR significantly. It indicates that increase in GWCTR and FL will also increase the efficiency in positive dimension. Tobit regression analysis concludes that ACP has significant negative impact on efficiency and CR, GWCTR and FLR have positive significant impact on efficiency. The primary focus of this study is to determine the impact of working capital management on firm efficiency and the results hence indicate that all variables have significant impact on firm efficiency except growth rate. The computations reveal that most of the ratios have a significant relationship with firm efficiency, and by controlling these ratios, the efficiency can be effectively enhanced. Resultantly, the determinants for efficiency in working capital management are identified and hence the financial managers and policy makers

must have focus on these elements to increase the performances of the manufacturing sector.

In a very tidy and competitive environment, every firm not only focuses on more profitability but also gives a lot of importance to work efficiently and in order to attain the optimum efficiency, our study is considered to be useful for policy makers, managers, planners and scholars in evaluating the efficiency of firms and the impact of working capital management on firm efficiency. This study is also expected to be more supportive to the management of manufacturing companies to make their companies more efficient with the help of variables of working capital management. It also gives the statistical values of variables to estimate how much the independent variables are affecting dependent variable. Our study also provides important information to stakeholders to evaluate how much this sector is managing working capital constituents and how efficiently this manufacturing sector is working in current scenario. It has been highlighted that in order to make companies more efficient, they need to focus on ACP, GWCTR, SG and financial debt ratio, because these variables have shown significant impact on firm efficiency. Moreover, the optimum level can also be attained by controlling these variables effectively.

Previous topic of limitations reveals the opportunities for researchers to consider the unconsidered areas and methods. As we have taken only the manufacturing sector of Pakistan, this research can be done on all sectors in order to check their efficiency and working capital management's impact. Moreover, due to lack of time and resources, we have taken only limited companies for our analysis but it can be extended up to maximum companies of the whole population in order to get more precise results.

Considering the same methodology, this study can be extended within the same country market of any other foreign market, with more companies and more working capital management ratios. Furthermore, this study includes DEA and Tobit regression analysis but other methods like parametric method and ratio analysis can also be used for calculating the impact of working capital management on firm efficiency.

Figure 1: Residuals histogram

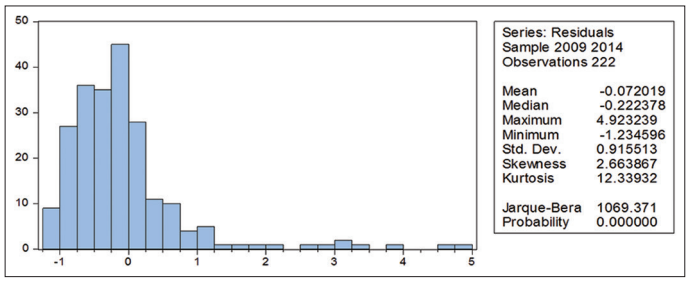

Figure 2: Gradients of the objective function

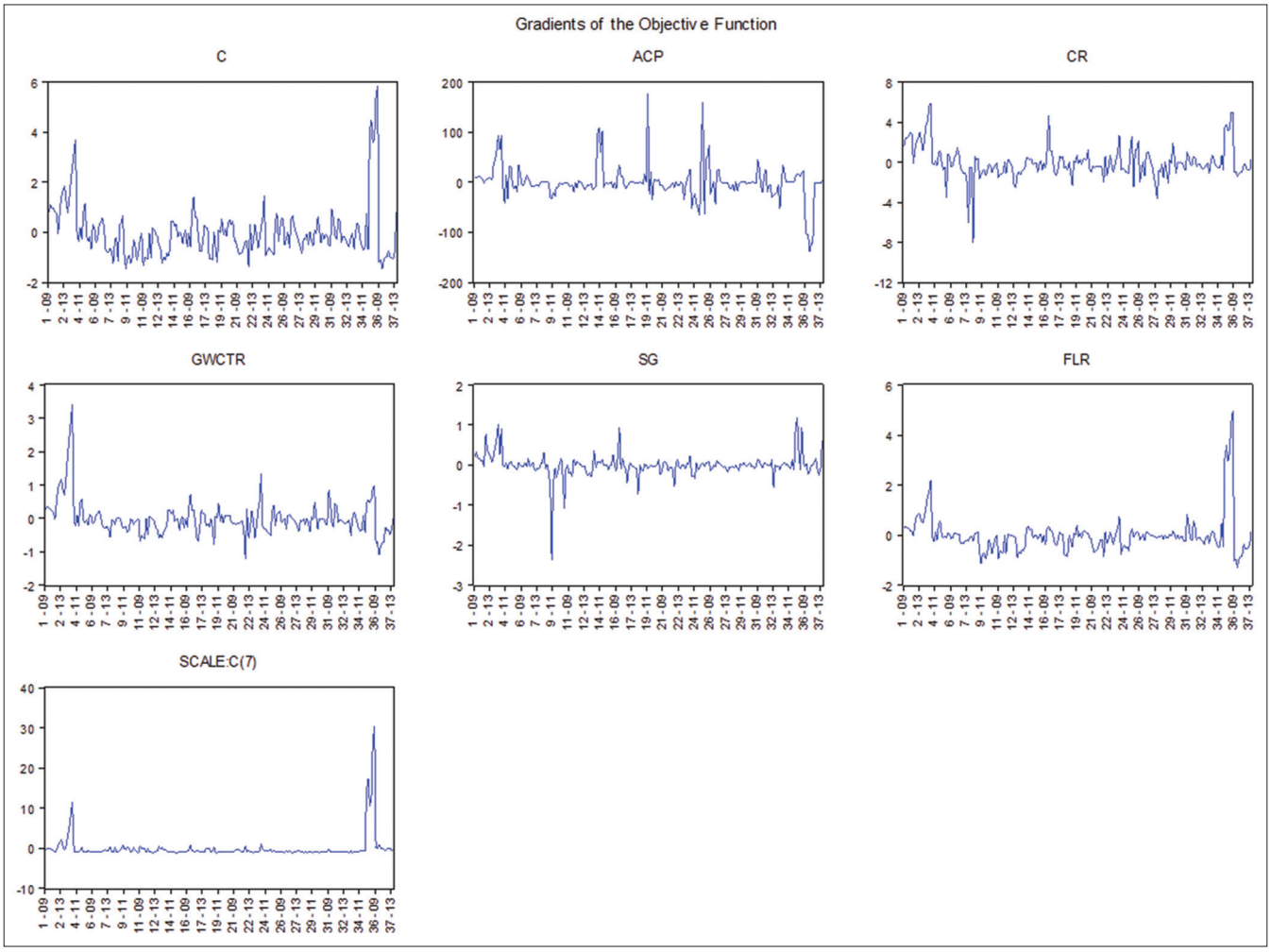

Table 7: Wald test

Test statistic	Value	Df	Probability
F-statistic	33.65178	(5, 215)	0.0000
Chi-square	168.2589	5	0.0000

Null hypothesis: C(2)=C(3)=C(4)=C(5)=C(6)=0
Null hypothesis summary:

Normalized restriction (=0)	Value	Standard error
C(2)	−0.008298	0.001171
C(3)	0.216902	0.084554
C(4)	2.591246	0.274377
C(5)	0.210775	0.240429
C(6)	2.495849	0.462179

Restrictions are linear in coefficients
Sample: 2009 2014
Included observations: 222

Autocorrelation	Partial correlation		AC	PAC	Q-stat	Prob*
.|*****|	.|*****|	1	0.699	0.699	109.82	0.000
.|***|	*|.|	2	0.419	−0.135	149.49	0.000
.|***|	.|**|	3	0.375	0.272	181.35	0.000
.|**|	.|.|	4	0.336	−0.037	207.17	0.000
.|*|	*|.|	5	0.157	−0.193	212.85	0.000

*Probabilities may not be valid for this equation specification. The autocorrelation function shows that there exists no autocorrelation exists in the observations

Lastly, this study can be extended with more companies and more sectors, or may be considered for the comparison of companies belongs to two or more different economies, which can give more reliable, vast and diverse results. It can also be used to estimate the efficiency of the companies operating in same country.

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