Int. J. Manag. Bus. Res., 2 (3), 233- 242, Summer 2012

Efficiency Performance of Manufacturing Companies in Kenya: Evaluation and Policies

*[1] *M. Haron,*[2] *J. A. Arul Chellakumar*

[1,2] *Department of Economics, Commerce and Financial Studies, Bharathidasan University, Tamil Nadu, India*

ABSTRACT: The objective of this paper is to determine the efficiency of manufacturing companies in Kenya over the period of 2009 to 2011 as well as suggesting appropriate policies to be employed by the manufacturing companies in Kenya based on the findings of the study. Three critical inputs variables (raw materials, staff expenses and plant and machinery) and two output variables (net sale and earnings after tax) are used to evaluate the relative efficiency of 30 manufacturing companies in Kenya. This study uses the two appropriate tools of analysis namely; Pearson correlation to indicate positive correlation between input and output variables and uses input approach of DEA model. Data is gathered from Kenya Association of Manufacturers database and these companies are categorized under large-sized (with assets above Kshs100 million), medium-sized (with assets between Kshs 40 million to Kshs100 million) and small-sized (with asset below Kshs 40 million).
The results indicate that small-sized company has the highest relative efficiency compared to medium-sized and large size company. In addition, the study finds that 1 large-sized company, 2 medium-sized companies and 3 small-sized companies operate under the most productive scale size throughout the three-year period. These results have important policy implications for the targeting policy prescriptions to increase manufacturing competitiveness to attain sustainable efficiency performance.

Keywords: *Efficiency performance, Manufacturing companies, Kenya*

INTRODUCTION

The manufacturing sector has a great potential on promoting economic growth and competiveness in the country like Kenya. It is the third leading sectors contributing to GDP in Kenya. The sector has experienced the fluctuations over the years under different financial conditions. It experienced the lowest real GDP growth rates in 2008 to 2009 as 1.7 percent in 2008 and improved to 2.6 percent in 2009 (East African Community Facts and Figures – 2010, March Issue, 2011). In the financial year 2010, the real GDP growth rate was 5.6 percent, revealing the improvement (East African Community Facts and Figures – 2011, October Issue, 2011). The lack of demand from the domestic market caused depreciation in Shilling and international demand was largely hit by global financial crises which caused the slower growth in the manufacturing sector. In terms of gross domestic product (GDP), the share of manufacturing sector maintained in the last 10 years from 2000-2001 as 10 percent to 2009-2010. On the other side, investment a "booster" of an economy, according to (East African Community Facts and Figures – 2011, October Issue, 2011) has shown a decreasing

***Corresponding Author, Email:** *miencha2005@gmail.com*

trend from 2008 to 2010.

Performance, a quality of any company, is achieved by valuable outcome such as higher returns. It can also be measured by the levels of efficiency and this can be analyzed by a variety of methods, such as the parametric (stochastic frontier analysis) and non parametric (data envelopment analysis). The management of any company would like to identify and eliminate the underlying causes of inefficiencies, thus helping their firms to gain competitive advantage and attain sustainable competitive advantage, or at least, withstand the challenges from others (Yang, 2006). In the economically competitive world, good financial management is a key indicator of a corporation performance. This study is motivated by the present status of manufacturing sector in Kenya which suggests that efficiency is a main issue and plays an important role in economic improvement during the present scenario. It is also important from a policy perspective because it provides information relevant to policy design for industry specific strategies. Notably, efficiency is main aspect for companies.

Literature Review

Various studies have been done on performance analysis, using conventional methods such as financial ratios. Since conventional methods can only support single input-output, the new approach introduced by Charnes et al. (1978) known as constant return to scale (CRS)-Data envelopment analysis. This model supports multi input-output data. Banker et al., (1984) further extended it to variable return to scale. Since then, it has been used extensively by various researchers in different fields of interests including manufacturing companies.

Aggrey et al. (2010), investigated the relationship between firm size and technical efficiency in East Africa manufacturing firms using DEA approach and GLS technique. Output was all output produced by firm in a year and inputs were cost of raw material solid and liquid fuel, electricity and water. They found negative association between firm size and technical efficiency in both Uganda and Tanzania manufacturing firms.

Din et al. (2007), investigated the technical efficiency of the large scale manufacturing sector in Pakistan using DEA approach by output oriented model under CRS and VRS assumptions. Sample of 101 industries for 2 periods as 1995 to 1996 and 2000 to 2001 were considered. Inputs included were capital, labor, industrial cost and non-industrial cost and output was contribution of GDP. CCR model indicated that mean efficiency has improved from 0.23 in 1995-96 to 0.42 in 2000-01 and only 2 industries could maintain their ranking in both periods. On the other hand, under BCC model, average efficiency score has increased from 0.31 in first period to 0.49 in the second period. Later, Tahir and Memon, (2011) and Memon and Tahir (2011) adopted the approach to investigate the efficiency of top manufacturing companies in Pakistan.

Thakur (2005) evaluates the efficiency levels of 26 Indian state-owned electric utilities by CCR and BCC-DEA model. The CCR efficiency had a mean score of 68 percent with three (Decision Making Units (DMU's) on efficiency frontier and majority were below the average efficiency level. The results using BCC model showed that the average efficiency was 84 percent with 10 DMU's were considered efficient.

Thore et al. (1994), examined the productive efficiency of U. S. computer manufacturers using DEA. Their results showed that few corporations were able to stay at the productivity efficiency throughout the time period under study.

Abokaresh and Kamaruddin (2011) considered effect on efficiency of 21 Libyan manufacturing firms before and after privatization, from 2000 to 2008. The pre and post-privatized effect suggested no significant difference in technical efficiency. Average technical efficiency of all firms in the years (before privatization) was 49.5 percent, whereas, after privatization it became 62.3 percent. In addition, state-owned firms improved only 9.3 percent after privatization and private firms increased only 15.3 percent after privatization, though in all conditions there was no significant effect.

Qiang and Cai (2009) analyzed efficiency high-tech industries in China with two inputs and two outputs. R&D expenditure and R&D personnel were selected as input, while, patent and sale revenue were selected as the output variables. Output-oriented DEA model is used to examine efficiency by CCR model for 6 years. The results showed that average technical efficiency declined from 2002 to 2007. Herbal medicine industry achieved five times 100 percent efficiency in six years, followed by Entire Computer industry with 4 times 100 percent efficiency. However, three companies had decreasing variation from 2002 to 2007. Again decreasing trend showed by VRS model with only 5 efficient companies in 2007. However, 1 company achieved 100 percent score in six years.

Zhou et al. (2011), assumed similar technology on large and medium-sized enterprises from thirty provinces using both CRS and VRS for the period from 2006 to 2008. The decreasing trend of technical efficiency was found in three years. 2006 is considered as the most efficient year with 23.3 percent efficient firms. Mostly, scale inefficiencies (decreasing return to scale) were observed throughout the years.

Hajiha and Ghilavi (2012**)** assessed efficiency of 100 Tehran stock exchange listed manufacturing companies from Iran. BCC output oriented model was used to measure efficiency in seven years (2004-2010). Among 100 companies, there were only 37 percent DMU's who appeared to be as fully efficient in 2010. Furthermore, 1st and 2nd DMU's were efficient throughout the entire period.

Wu et al. (2006), examined the performance of the retailing industry in Taiwan using CCR DEA model. Four inputs and 2 outputs were employed for five years (1998-2002). It was found that on average 74 percent of companies were inefficient in five years and 2000 appeared as most efficient year with 12 efficient companies. Further, there were 6 companies which were consistently efficient in each year.

Objectives of the Study

1. To evaluate the efficiency performance of manufacturing companies in Kenya.
2. To suggest appropriate policy to be employed by the manufacturing companies in Kenya.

RESEARCH METHOD

Variable Selection and Data Collection

Input-output variables have been selected on the basis of production process in companies and previous studies. In this study we use three input variables and two output variables. Input variables are raw materials, staff expenses and plant and machinery, while output variables are net sale and earnings after tax. Table 1 presents the three input variables and two output variables that have been employed in previous research. The analysis contained in this study is based on a sample of manufacturing companies across Kenya. Data for 30 manufacturing companies was gathered from Kenya Association of Manufacturers database for the period 2009 to 2011. Companies are grouped by size into three categories: large-sized, medium-sized and small-sized company. The size is measured by their total assets.

Large-sized company are the companies with total assets above Kshs100 million, medium-sized have Kshs40 million to Kshs100 million by total assets; whereas small companies are those companies having assets under Kshs40 million. There are 10 companies under large-sized, 10 companies are medium-sized and 10 companies are small-sized company. Table 2 shows the companies which are included in the present paper.

Table 3 shows the descriptive statistics of the variables used Pearson correlation is also used to indicate positive correlation between input and output variables as depicted in table 4. As a requisite in DEA, the input and output variables should be positive correlated. It means that the input and output variables used in this study is appropriate as it satisfies the requisite of DEA.

Table 1: Input and output variables used in previous studies

Variables	References
Input Raw Material	Mazumdar and Rajeev, 2009; Sharma, 2008; Ar and Baki, 2007; Singh, 2007; Wu, 2005.
Salary and wages	Mazumdar and Rajeev, 2009; Sharma, 2008.
Plant & Machinery	Hajiha and Ghilavi, 2012; Mazumdar and Rajeev, 2009; Singh, 2007; Ar and Baki, 2007.
Output Net Sales	Hajiha and Ghilavi, 2012; Abokaresh and Kamaruddin, 2011; Zhou et al., 2011; Sharma, S. 2008; Wang. 2008; Lin, et al., 2005.
Earnings after tax	Abokaresh and Kamaruddin, 2011; Ling and Kamil, 2010; Qian and Dawai, 2009.

Source: Compiled by the Authors

Table 2: List of Manufacturing Companies

NO	COMPANY	TICKER CODE	NO	COMPANY	TICKER CODE
1	B.O.C Kenya Ltd	BOCK	16	Williamson Tea Kenya Ltd	WTK
2	British American Tobacco Kenya	BATK	17	A. Baumann Co. Ltd	ABCL
3	Carbacid investments Ltd	CIL	18	Bamburi Cement Ltd	BCL
4	East African Breweries Ltd	EAB	19	Crown Berger Ltd	CBL
5	Mumias Sugar Co. Ltd	MSC	20	East African Cables Ltd	EACL
6	Unga Group Ltd	UNGA	21	E. A. Portland Cement Ltd	EAPCC
7	Eveready East Africa Ltd	EEAL	22	Athi river Mining	ARM
8	Kenya Orchards Ltd	KOL	23	Kenya power & Lighting Co. Ltd	KPLC
9	Rea Vipingo Plantations Ltd	REA	24	BASF	BASF AG
10	Kapchorua Tea Co. Ltd	KAPC	25	Bata Shoe Company Kenya Ltd	BSKL
11	Eaagads Ltd	EAAGADS	26	Best Foods Kenya Ltd	BFKL
12	Kakuzi Ord	KAKU	27	Procter and Gamble EA Ltd	P&GEAL
13	Kakuzi	KUKZ	28	Kenya Oil Company	KENOL
14	Limuru Tea Co. Ltd	LIMT	29	Nestle Food Kenya Ltd	NFKL
15	Sasini Ltd	SASN	30	Unilever Tea Kenya Ltd	UTKL

Table 3: Descriptive Statistics of Input and Output variables used, 2009-2011 (in Thousand Kshs)

	Statistics	Net sale	Earnings after tax	Raw material	Staff expenses	Plant and Machinery
Large companies	Mean	240,590	22,480	28,465	22,013	12,610
	Std. Dev	169,642	21,352	17,653	59,572	132,435
	Minimum	41,361	454	6,300	872	5,777
	Maximum	734,280	79,944	138,446	510,406	637,160
Medium companies	Mean	54,638	5,556	7,855	4,880	25,546
	Std. Dev	35,667	5,779	6,601	3,322	13,105
	Minimum	13,996	25	2,275	750	3,941
	Maximum	170,022	32,047	35,531	17,002	43,943
Small companies	Mean	23,210	2,062	3,893	2,964	7,879
	Std. Dev	14,175	1,122	1,998	2,767	4,166
	Minimum	6,265	20	257	324	1,952
	Maximum	45,993	5,870	7,569	19,004	25,006

Source: Calculated by the Authors

Table 4: Pearson Correlation coefficient by size

Large	**RM**	**SE**	**PM**	**NS**	**EAT**
RM					
SE	0.660				
PM	0.784	0.642			
NS	0.535	0.674	0.667		
EAT	0.565	0.456	0.550	0.765	
Medium	**RM**	**SE**	**PM**	**NS**	**EAT**
RM					
SE	0.158				
PM	0.124	0.154			
NS	0.378	0.546	0.245		
EAT	0.461	0.460	0.202	0.887	
Small	**RM**	**SE**	**PM**	**NS**	**EAT**
RM					
SE	0.187				
PM	0.385	-.094			
NS	0.323	0.359	0.229		
EAT	0.086	0.196	0.027	0.645	

Source: Authors Calculations

RESULTS

Data Envelopment Analysis

This research uses the non-parametric measure, the DEA. It is non-parametric measure because it requires no assumption on the shape or parameters of the underlying production function. The Data Envelopment Analysis (DEA) is a performance measurement technique used for evaluating the relative efficiency of productive units, such as business firms, schools, hospitals, and banks where the presence of multiple inputs and multiple outputs makes comparison difficult (El-Mashaleh et al., 2010; Wel et al., 2012). It is a non-parametric analytic technique which compares the relative efficiency of units using a benchmark and by measuring the inefficiencies in input combinations in units relative to the benchmark. Farrell (1957) measured the technical efficiency of production input in a single output case. The DEA program enables one to find the proper weights which maximize the efficiency of DMU and calculates the efficiency score and frontier. CCR-Model was originally developed by Charnes Cooper and Rhodes (1978) with the assumption of constant return to scale and has led to several extensions, most notably the BCC model by Banker et al. (1984). The CCR and BCC models can be divided into two terms; first is the input oriented model; the second is the output oriented model. The input orientation seeks to minimize the usage of inputs given a fixed level of output while the output orientation maximizes the level of output for a given level of inputs. This study uses CCR-Model using the following formula.

$$\text{Efficiency} = \frac{\text{Weighted sum of outputs}}{\text{Weighted sum of inputs}}$$

The weights for the ratio are determined by the restriction that similar ratios for every DMU have to be less than or equal to unity, thus reducing multiple inputs and outputs to a single virtual output without requiring pre-assigned weights. Therefore, the efficiency score is a function of the weights of the virtual input-output combination. The relative efficiency score of a given DMUo is obtained by solving the following linear programming model.

$$\max h_0(u,v) = \frac{\sum_{r=1}^{s} v_r y_{r0}}{\sum_{i=1}^{m} u_i x_{i0}}$$

Subject to

$$\frac{\sum_{r=1}^{s} v_r y_{rj}}{\sum_{i=1}^{m} u_i x_{ij}} \leq 1 ; j = 1,2,\ldots\ldots,n$$

$$u_i \geq 0 ; i = 1,2,\ldots\ldots,m$$

$$v_r \geq 0 ; r = 1,2,\ldots\ldots,s$$

v_r = weigt given to output r

Following the Charnes-Cooper transformation (1962), one can select a representative solution (u,v) for which

$$\sum_{i=1}^{m} u_i x_{i0} = 1$$

Where

X_{ij} = the amount of input i utilized by the jth DMU

Y_{rj} = the amount of output r utilized by the jth DMU

U_i = weight given to input i.

Inputs (X_{ij}) = Raw materials, Staff Expenses and Plant and Machinery.

Output (Y_{rj}) = Net Sale and Earnings after Tax.

The linear programming model shown above is run n times for identifying the relative efficiency score of all the DMUs. Each DMU selects input weights that maximize its efficiency score. Generally, a DMU is considered to be efficient if it obtains a score of 1.00, implying 100% efficiency whereas a score of less than 1.00 implies that it is inefficient. For the purpose of calculating data for this study, Data Envelopment Analysis Online Software (D.E.A.O.S) was used.

DISCUSSION

Large-Sized Company

The results for large-sized manufacturing companies are shown in table 5. The constant return to scale (CRS) indicates that the manufacturing company has reached the best scale. The increasing return to scale (IRS) shows that an increase in inputs leads to a more than proportionate increase in output while decreasing return to scale (IRS) shows that an increase in inputs leads to a less proportionate increase in output. As shown in table 5, the results show that the average CRS efficiency of large-sized Kenya manufacturing companies is 61 percent in 2009, 67 percent in 2010 and 78 percent in 2011. In 2009, 3 companies have perfect relative efficiency, 3 companies have perfect relative efficiency in 2010, while in 2011, 4 companies have perfect relative efficiency. Under pure technical efficiency (PTE), 4 companies are considered efficient in 2009 and 2011. One DMUs; EAB has perfect relative efficiency is consistently efficient throughout the study period. As can be seen from the table, the main cause of inefficiency of large-sized company is scale inefficiency. In other words BATK, and KPLC, should improve their scale efficiency.

Table 5: DEA results of the efficiency scores for large-sized company for 2009-2011

		2009				2010				2011			
No	**DMU**	**OTE**	**PTE**	**SE**	**TRS**	**OTE**	**PTE**	**SE**	**RTS**	**OTE**	**PTE**	**SE**	**RTS**
1	B.O.C.K	0.51	1	0.52	DRS	0.92	1	0.94	DRS	1	1	1	CRS
2	BATK	0.37	0.41	0.97	IRS	0.58	0.62	0.98	DRS	0.58	0.66	0.91	DRS
3	EAB	1	1	1	CRS	1	1	1	CRS	1	1	1	CRS
4	MSC	0.54	0.84	0.65	DRS	1	1	1	CRS	1	1	1	CRS
5	KPLC	0.54	0.55	1	IRS	1	1	1	CRS	0.76	0.82	0.92	DRS
6	EEAL	1	1	1	CRS	0.85	0.91	0.95	IRS	1	1	1	CRS
7	REA	0.52	0.68	0.80	IRS	0.48	0.65	0.79	IRS	0.55	0.67	1	IRS
8	EAAGADS	0.26	0.82	0.34	IRS	0.75	1	0.76	IRS	0.44	0.54	1	IRS
9	LIMT	1	1	1	CRS	0.65	0.86	0.77	IRS	0.51	1	0.68	IRS
10	WTK	0.39	0.46	0.87	IRS	0.43	0.57	0.84	IRS	1	1	0.95	IRS
	Avg	0.611	0.776	0.815		0.674	0.861	0.903		0.784	0.869	0.946	

Source: Authors Calculations

Medium-Sized Company

The results of efficiency scores for medium-sized company are shown in table 6. The results show that the average CRS efficiency of medium-sized company is 65 percent in 2009, slightly increase to 71 percent in 2010 and fall again to 68 percent in 2011. Overall technical efficiency (OTE) results show that 3 companies in 2009, 3 companies in 2010 and 4 companies in 2011, have perfect relative efficiency. Under PTE, 4 companies are considered efficient in 2009, in 2010, 5 companies are considered efficient and in 2011, 6 companies were considered efficient. It is also revealed that 2 companies are perfectly efficient throughout the study period (2009 to 2011) namely KOL and BCL. Similarly with the large-sized company, the cause of inefficiency in medium-size manufacturing companies is also scale efficiency and these companies need to improve their scale efficiency.

Small-Sized Company

Table 7 brings out the results related to the small-sized company showing that the average OTE efficiency in 2009 is 78 percent, 87 percent in 2010 and 84 percent in 2011. The results also clearly show that, out of 10 small companies only 3 DMUs i.e. EACL, BSCL and NFKL maintain their efficiency throughout the study period. Overall technical efficiency (OTE) results show that 3 companies in 2009, 5 companies in 2010 and 6 companies in 2011 have perfect relative efficiency. Under pure technical efficiency (PTE), 3 companies are considered efficient in 2009, in 2010, 6 companies were considered efficient and in 2011, 6 companies were also considered efficient.

Table 6: DEA results of the efficiency scores for medium-sized company for 2009-2011

		2009				2010				2011			
No	**DMU**	**OTE**	**PTE**	**SE**	**TRS**	**OTE**	**PTE**	**SE**	**RTS**	**OTE**	**PTE**	**SE**	**RTS**
1	CIL	0.69	0.70	0.98	DRS	0.65	0.66	0.96	IRS	0.83	1	0.83	DRS
2	KOL	1	1	1	CRS	1	1	1	CRS	1	1	1	CRS
3	KAPC	0.42	0.63	0.61	IRS	1	1	1	CRS	1	1	1	CRS
4	KAKU	0.52	0.55	0.97	DRS	0.63	0.66	0.99	DRS	0.44	0.53	0.87	DRS
5	UNGA	1	1	1	CRS	0.55	0.59	0.93	IRS	0.46	0.55	0.86	IRS
6	SASN	0.56	0.65	0.93	IRS	0.63	0.72	0.86	IRS	1	1	1	CRS
7	ABCL	0.27	0.48	0.64	IRS	0.55	0.60	0.87	IRS	0.37	0.44	0.88	IRS
8	BCL	1	1	1	CRS	1	1	1	CRS	1	1	1	CRS
9	ARM	0.42	0.53	0.89	IRS	0.64	0.71	0.89	IRS	0.33	0.43	0.74	IRS
10	EAPCC	0.65	0.67	0.97	IRS	0.46	0.47	0.95	IRS	0.34	0.43	0.84	IRS
	Avg	0.653	0.621	0.899		0.711	0.741	0.945		0.677	0.738	0.902	

Source: Authors Calculations,
OTE = Overall technical efficiency, PTE = Pure technical efficiency, SE = Scale efficiency and
RTS = Return to scale

Table 7: DEA results of the efficiency scores for small-sized company for 2009-2011

		2009				2010				2011			
No	DMU	OTE	PTE	SE	TRS	OTE	PTE	SE	RTS	OTE	PTE	SE	RTS
1	CBL	0.77	0.81	0.97	IRS	1	1	1	CRS	1	1	1	CRS
2	EACL	1	1	1	CRS	1	1	1	CRS	1	1	1	CRS
3	KENOL	0.41	0.52	0.90	IRS	0.76	1	0.77	DRS	0.48	0.52	1	IRS
4	UTKL	0.80	0.93	0.90	IRS	0.85	0.95	0.99	DRS	0.84	0.86	0.96	DRS
5	KUKZ	0.85	0.86	1	DRS	1	1	1	CRS	1	1	1	CRS
6	BASF	0.55	0.57	1	DRS	0.58	0.69	0.86	DRS	1	1	1	CRS
7	BFKL	0.75	0.78	0.98	IRS	0.74	0.74	1	IRS	0.55	0.60	1	CRS
8	BSCL	1	1	1	CRS	1	1	1	CRS	1	1	1	CRS
9	NFKL	1	1	1	CRS	1	1	1	CRS	1	1	1	CRS
10	P&GEAL	0.65	0.75	0.97	IRS	0.75	0.75	1	IRS	0.53	0.58	0.99	DRS
	Avg	0.778	0.822	0.972		0.868	0.913	0.962		0.840	0.856	0.995	

Source: Calculated by the Authors
OTE = Overall technical efficiency, PTE = Pure technical efficiency, SE = Scale efficiency and
RTS = Return to scale

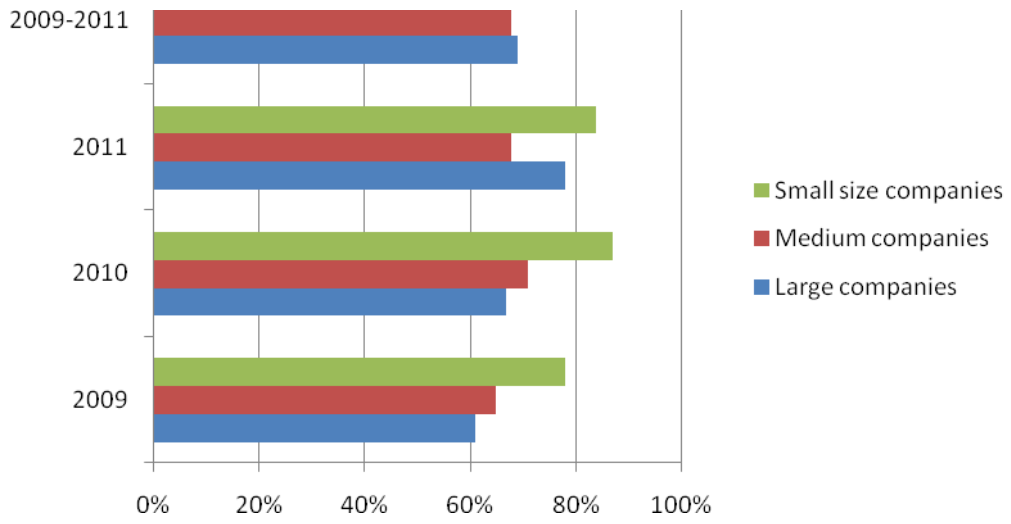

Figure 1: The overall efficiency trend of each size from 2009 to 2011

Overall Technical Efficiency Trend

Figure 1 shows that 2009, the OTE for large-sized company is 61 percent, medium-sized company is 65 percent and small-sized company is 78 percent. In 2010, the OTE for large-sized company is 67 percent, 71 percent for medium-sized company and 87 percent for small-sized company. In 2011, the OTE for large-sized company is 78 percent, 68 percent for medium-sized company and 84 percent for small-sized company. The study indicated that small-sized companies are more relatively efficient with 83 percent as compared to medium and large companies with 68 percent and 69 percent respectively.

Pearson Correlation Results

Pearson correlation results for all the variables used are shown in table 4. The results show that the input and output variables are positively correlated. It means that the input and output variables used in this study is appropriate as it satisfies the requisite of DEA model.

CONCLUSION

The objective of this paper is to evaluate the efficiency performance of manufacturing companies in Kenya for the period 2009 to 2011. Also suggest appropriate policy to be employed by the manufacturing companies in Kenya. The study uses three input variables, raw materials, staff expenses and plant and machinery and two output variables, net sale and earnings after tax. The Pearson correlation results show that the input and output variables used from 2009 to 2011 are positive and this indicates that the DEA analysis is appropriate as it satisfies the requisite of DEA model.

The average OTE efficiency of large-sized company is 61%, 67% and 78% in 2009, 2010 and 2011 respectively. This study finds that 1 company had maximum efficiency score of 100 percent in 2009, 2 companies in 2010 and in 2011, there were 3 companies too with maximum efficiency score of 100 percent. The results for the medium-sized company show that the average OTE is from 65%, 71% and 68% in 2009, 2010 and 2011 respectively. The average OTE scores for small-sized companies being 78%, 87% and 84% in 2009, 2010 and 2011 respectively. The findings also reveals out clear that inefficiency which is observed in manufacturing companies of Kenya are scale rather than pure technical inefficiencies.

The small-sized manufacturing companies are the best performing companies in terms of relative efficiency (83 percent). They are followed by large-size manufacturing companies (69 percent) and medium-sized manufacturing companies (68 percent) in that order. The results of this study provide a valuable reference for top manufacturing companies in Kenya in terms of reviewing their efficiency levels, as this would help them to achieve companies' competitiveness and sustainable performance.

RESERENCES

Abokaresh, M. S. M. and Kamaruddin, B. H. (2011). Performance Rating of Privatized and Non-Privatized Firms Using Data Envelopment Analysis Technique. *Journal of Information Engineering and Applications*, 1 (4), pp. 1-12.

Aggrey, N., Eliab, L., and Joseph, S. (2010). Firm Size and Technical Efficiency in East African Manufacturing Firms. *Current Research Journal of Economic Theory*, 2 (2), pp. 69-75.

Ar, D. M. and Baki, B. (2007). Measuring and Evaluating Efficiency of a Glass Company through Data Envelopment Analysis. *Problems and Perspectives in Management*, 5 (1), pp. 72-81.

Banker R. D., Charnes A. and Cooper W. W. (1984). Some Models for Estimating Technical and Scale Inefficiencies in Data Envelopment Analysis. *Management Science*, 30 (9), pp. 1078–1092.

Charnes A., Cooper, W. W. and Rhodes. E. (1978). Measuring the Efficiency of Decision Making Units. *European Journal of Operational Research*, 2 (6), pp. 429-444.

East African Community Facts and Figures – 2010. (2011). March Issue, pp. iii.

East African Community Facts and Figures – 2011. (2011). October Issue, p. 28.

El-Mashaleh, M. S., Rababeh, S. M. and Hyari, K. H. (2010). Utilizing Data Envelopment Analysis to Benchmark Safety Performance of Construction Contractors. *International Journal of Project Management*, 28 (1), pp. 61–67.

Hajiha, Z. and Ghilavi, M. (2012). Presenting a Model for Determination of the Efficiency of the Production Companies Listed in Tehran Stock Exchange Based on Financial Variables. *International Journal of Business and Behavioral Sciences*, 2 (1), pp. 1-11.

Musleh-ud-din, Ghani, E. and Mahmood, T. (2007). Technical Efficiency of Pakistan's manufacturing Sector: A Stochastic Frontier and Data

Envelopment Analysis. The *Pakistan Development Review*, 46 (1), pp. 1-18.

Lin, W. C., Liu, C. F. and Chu C. W. (2005). Performance Efficiency Evaluation of the Taiwan's Shipping Industry: An Application of Data Envelopment Analysis. *Eastern Asia Society for Transportation Studies*, 5, pp. 467-476.

Ling, O. P. and Kamil, A. A. (2010). Data Envelopment Analysis for stocks selection on Bursa Malaysia. *Archives of Applied Science Research*, 2 (5), pp. 11-35.

Mazumdar, M. and Rajeev, M. (2009). Comparing the Efficiency and Productivity of the Indian Pharmaceutical Firms: A Malmquist-Meta Frontier Approach: *International Journal of Business and Economics*, 8 (2), pp. 159-181.

Memon, M. A. and Tahir, I. M. (2011). Relative Efficiency of Manufacturing Companies in Pakistan Using Data Envelopment Analysis. *International journal of Business and Commerce*, 1 (3), pp.10-27.

Qian, L. and Dawei, L. (2009). Efficiency and Productivity in the Chinese Maritime Seaports. Paper presented at the International Conference on Information Management, Innovation Management and Industrial Engineering.

Sharma, S. (2008). Analyzing the Technical and Scale Efficiency Performance: A Case Study of Cement Firms in India. *Journal of Advances in Management Research*, 5 (II), pp. 56-63.

Singh, S. P. (2007). Performance of Sugar Mills in Uttar Pradesh Ownership, Size and Location. Prajnan, *Journal of Social and Management Sciences*, XXXV (4), pp. 333-359.

Tahir, I. M. and Memon, M. A. (2011). Applying DEA in Analyzing the Efficiency Of Top Manufacturing Companies in Pakistan. *Journal of Public Administration and Governance*, 1 (2), pp. 225-239.

Thakur, T. (2005). Benchmarking Study for the Indian Electric Utilities Using Data Envelopment Analysis. Paper presented at The Proceedings of the Thirty-Seventh Annual North American Power Symposium.

Thore, S., Kozmetsky, G. and Phillips, F. (1994). DEA of Financial Statements Data: The U.S. Computer Industry. The *Journal of Productivity Analysis*, 5 (3), pp. 229-248.

Wang, W. K. (2008). An Intelligent Support System for Performance Evaluation of State Owned Enterprises of Electronic Industry. Citeserx Digital Library, pp. 40-51.

Wei, C. K., Chen, L. C., Li, R. K., Tsai, C. H. and Huang, H. L., (2012). A Study of Optimal Weights of Data Envelopment Analysis – Development of a Context-Dependent DEA-R Model. *Expert Systems with Applications*, 39 (4), pp. 4599-4608.

Wu, H. L. (2005). A DEA Approach to Understanding the Performance of Taiwan's Steel Industries 1970-1996. *Asia Pacific Management Review*, 10 (6), pp. 349-356.

Wu, C.-C., Kao, S.-C., Wu, C.-H. and Cheng, H.-H. (2006). Examining Retailing Performance via Financial Index. *Asia Pacific Review*, 11 (2), pp. 83-92.

Yang, Z. (2006). Data Envelopment Analysis Evaluation of Canadian Resource Companies. Paper presented at the Portland International conference on Management of Engineering and Technology 2006 (PICMET) Technology management for the Global future.