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EFFICIENCY PERFORMANCE OF SELECTED MANUFACTURING FIRMS IN NIGERIA

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Abstract:

Research background: The study examined the technical efficiency of quoted manufacturing companies in Nigeria selected at random. This study adopted Data Envelopment Analysis (DEA) with input-oriented variables of inventory, while the output variable is the revenue of the selected quoted manufacturing firms.
Purpose of the article: The study analyzed technical efficiency of thirty-one (31) selected manufacturing firms for the period 2013 to 2018 using the input and output oriented data envelopment analysis (DEA) approach.
Methods: The study findings shows that three firms account for 9% of the sampled firms, this indicates these firms operates at a positive level of efficiency. The result break down shows that twenty-eight (representing 91%) of the firms during the period operates at a low efficiency level. This was indicated and made more evident by the presence of recession occasioned in the period under review ending in 2016.
Findings & Value added: The study concluded that quoted manufacturing firms in Nigeria are not operating at optimal level of mix variables, this is as a result of high input costs then worsened by low patronage, rising inflation, increase in exchange rate, and stifling government policies. It is recommended that the firms that are operating at decreasing efficient levels needs to do the needful by scaling down their input and output variables, while those at the efficiency level needs to scale up their input and output variables. Also, government should do the needful in order to mitigate the challenges facing these manufacturing sector.

Keywords: technical efficiency, data envelopment analysis, firm efficiency

JEL Classification: M1, M10, M2, M21

1. Introduction

The manufacturing industry has attracted scholarly attention in recent times, based on the inept level of efficiency and export performance in developing countries especially in Sub-Saharan Africa (Lundvall and Battese, 2000; Tybout, 2000; Chapelle and Plane, 2005; and Faruq and Yi, 2010). The manufacturing sector is vital for the economic development of any country. The strategic sector roles involve creating backward and forward connections in the

economy, value addition, trade, and employment effects; all these are channels for economic growth (Lavopa and Szimai, 2012). The Nigerian manufacturing industry in the last four decades is encapsulated with some technical problems, which has affected the sector growth (Nigerian Stock Exchange, 2010). The Nigeria stock exchange (2010) indicates that about thirty percent of industries (manufacturing industry inclusive) were shutdown, sixty percent are considered indisposed or ailing, while only ten percent are effective and are at sustainable level. The implication holds that most quoted manufacturing industry is in doubt of survival and sustainability for lack of efficiency (Osamwonyi and Imafidon, 2016). Thus, making firm efficiency evaluation a critical issue for managers, scholars, and businesses in Nigeria based on current economic turbulence. Efficiency measures firm's performance. This indicates that efficiency is a business strategic approach that is encapsulated in minimizing use of input resources to achieve greater output, by leading to been competitive for a longer period in the industry (Mosfafa, 2007). A firm is regarded as efficient if it is able to employ small costs to generate higher revenue; and on the other hand, a firm is facing inefficiency when it is inefficient in terms of technical and allocative efficiency and that implies it is still not operating at its optimal level (Coeli et al., 2005).

Often efficiency performance in firms is proxy in terms of efficiency levels (Lombardi, Bruno, Mainolfi & Tartaglione, 2015). In particular, efficiency performance represents firm's successfully allocating inputs resource in ways to optimize output. Efficiency indicates firms producing at the optimal level and contextually delineate firms' ability to employ input resources at minimums level to achieve the highest level of productivity, for a considerable period (Al-tit, 2016). Greene (1997) argue that manufacturers are considered efficient if they produce at the maximum achievable production given the inputs employed at the least cost. From a microeconomic view, efficiency is contextualized from two different perspectives: allocative efficiency and technical efficiency. The study focus is on technical efficiency, which is the firm's ability to produce maximum output from a given set of factor inputs.

Koopmans and Debreu (1951), and Farrell (1957) are credited with the discovery of efficiency performance and its measures for firms. Technical efficiency delineates the systematic means of resources utilization and as the building block to enshrine further improvements (Yu et al., 2014). Similarly, technical efficiency denotes if a firm produces at optimal capacity based on employed inputs. At the same time, technical efficiency measures determine if input resources provide the highest achievable output, given applied technology (Farrell, 1957). The manufacturing efficiency of output is a reflection of the recent level of technological know-how. Therefore, firms with operating frontlines that is characterized by efficient output level are adjudged to be technically competent. The Nigeria manufacturing industry is in recent times with painful stagnation without technical efficiency. If the trend continues to 2030 and beyond, the likelihood of the projected annual growth rate of 10 percent will be a mirage. Therefore, these challenges call for the urgent interventions of the sector, to at least have average technical efficiency and tackle factors affecting its nonperformance. It has been found that the manufacturing sector is key to sustained growth and performance, thus making impacts on the social, economic life of a state (Tybout, 2000). This is seen as most imperatives given Africa Nations reliance on heavy imports. That is why there has been considerable attention to the evaluation of efficiency within the region (Lundvall and Battese, 2000; Adeoti, 2013; Chirwa, 2001; Graner and Isaksson, 2007). Therefore, technical efficiency is mostly estimated using two approaches; Stochastic Frontier Analysis (SFA) and the Data Envelopment Analysis (DEA). Yu et al. (2014) indicate that data envelopment analysis (DEA) is an approximate measurement tool to handle efficiencies by using multi-inputs and

multioutput variables. However, Stochastic Frontier Analysis (SFA) and the Data Envelopment Analysis (DEA) have some areas of similarities and differences. Hence, data envelopment analysis (DEA) represents a non-parametric measure of efficiency, while the SFA represent a parametric technique to measure efficiency. A non-parametric approach assumes that the production frontier is deterministic. Essentially, non-parametric does not emphasized handling disturbances, while the parametric deals with how disturbances would be handled. This involves choosing specific production function procedure through which problems of estimation and model specification are likely to emerge (Coelli et al., 2005). The paper adopts Data Envelopment analysis (DEA) based on its precise measure of efficiency and lesser inadequacy compare to other approaches (Eriki & Osagie, 2014). This paper seeks to determine the technical efficiency of Nigeria manufacturing sector using the input and output mix variables.

2. Literature review

An efficient manufacturing sector is an important solution to resolving the problems of unemployment and sustainable economic growth (Asaleye et al., 2018). This indicate that efficiency measures the level of process which produces the maximum quantity of output using the lowest quantity of inputs (Kea et al., 2016; Singh, Narayanan and Sharma, 2019).

The study of technical efficiency has received considerable discourse across different disciplines, which are; engineering and economics as it is fundamental to the survival of a firm. The term technical efficiency (TE) is conceptualized as measures the ability of producers in manufacturing firms to produce the maximum amounts of output using available inputs and technologies (Kea et al., 2016). TE is also useful to estimate allocative, production, and economic efficiency of manufacturing firms (Rajesh, 2007; Bhatia and Mahendru, 2015; Kea et al., 2016; Fahmy-Abdullah et al., 2017; Singh et al., 2018).

Thus, the measurement of TE and its elements in firms or industries is a vital concept in production theories (Fahmy-Abdullah et al., 2017). However, there are studies carried out to unearth the factors possibly affecting the technical efficiency of firms. The survey by Osamwonyi and Imafidon (2016) empirically studied the technical efficiency of the Nigeria manufacturing industry on the Nigerian Stock Exchange. The study used the output-oriented data envelopment analysis approach. The study concludes that out of the fifty-eight companies selected for the study, only thirty-one is considered to be operating at a frontier, while twenty-seven companies were found not to be operating maximally. The study recommends the need for an organization within the region of the low boundary to integrate more efficient towards scaling down their inputs. That those within a positive experience should scale up their experience. In the study of Usman, Hassan, Mahmood, and Shahid (2014) that conducted a survey of Pakistan textile industry, using the use of data envelopment analysis to measure the technical efficiency of the sector from 2006 to 2011. The study findings show Pakistan textile firms are close to being efficient.

In this case Sen and Das (2016) examined the TE of various enterprises in the India manufacturing sector using the DEA approach. It shows that estimated TE varies across firms in India. Kumar and Sharma (2016) have assessed the influence of patenting on an estimated TE of Indian high and medium technologies firms. It has appeared that research & development (R&D) has a little impact on TE of high and medium technology firms in India.

Furthermore, Faruq and Yi (2010) estimated the TE of manufacturing firms in Ghana using the DEA technique. It observed that the firm's size, age of the firm, foreign ownership and labours are the critical factors affecting the TE of firms in Ghana. Alvarez and Crespi (2011)

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have evaluated the firm's efficiency affecting factors in the Chilean manufacturing sector. It observed that the efficiency of firms is positively associated with the experience of workers, modernization of physical capital and innovation in products. Haran and Chellakumar (2012) explored the technical efficiency of Kenya manufacturing sector. The study concludes that the ability of smaller firms has greater efficiency compared to other medium and larger firms from 2009 to 2011in the Kenya manufacturing sector.

In contrast, the study conducted by Chen and Tang, (1987) holds that sizes and structure of firms affect their efficiency, especially the large firms are deemed to have efficiency than other medium and larger firms based on the capacity to produce much more than smaller firms. In addition, firm's ownership is found to be relevant to locally developed firms, ahead of foreign firms. However, it was discovered that ownership and structure could affect locally made firms, especially where the management is inept to drive new use of technology for production. Lundvall and Battese (2000) research estimated the translog stochastic frontiers of production function using for 235 manufacturing firms in Kenya. The study concludes that technical efficiency has positive relationship with firms' size and age. In specific, the study affirms that firm size had a significant favorable influence on firms, especially those in the wood and textile sectors. The effect of these became apparent for as the business grows, especially to other sectors except those in the textile industry.

Moreover, Arig (2011), Altin (2010), Yalama and Sayim (2008) also examined the efficiencies of manufacturing firms including the textile, apparel and leather industry quoted in the Istanbul Stock Exchange. The study employed financial ratios as input and output measures for different periods. Although the study did not evaluate these sectors separately, this, however, could mislead other researchers based on the cumulative result found. Also, the survey by Graner and Isaksson (2007) examined the relationship between efficiency and export position of Kenya manufacturing firms from 1992 to 1994 using a stochastic frontier analysis framework. The study discovered that the mean average technical efficiency of Kenya manufacturing industry, and it was established that firms with exporting orientation are better off in terms of efficiencies, then those with less exporting firms. In particular, it was discovered that exporting firms command high values in technical efficiency for textiles firms, more than the wood industry. Likewise and Asid (2010) carried out a study to determine the technical efficiency of manufacturing firms in Malaysia. The study adopts a stochastic frontier model. The study findings show that technical efficiency of the selected firms was on snowballing at 0.01 percent annually. The factors responsible for the increase is the input-driven mode of production used by the firms. Also, the study state that the rising rate was at a decreasing rate. Ngeh (2014) examined the technical efficiency using the stochastic frontier analysis technique to determine the efficiencies levels of Cameroon's manufacturing industries.

The findings discovered that firms operating for above 20 years were found to be technical efficiency with a mean score of 35.97 percent. Olatunji (2002) research investigated the efficiency of manufacturing firms in Nigeria and discovered that firms with massive investment in technology are technically efficient. However, it was discovered that firm's inefficiency was as a result of firms' characteristics. Also, the study concludes that firm's efficiency increased alongside their size. While the study established that local firms decline alongside growth as against foreign firms. Hence, the study found that workers skills contribute to firm's technical efficiency. Fahmy-Abdullah et al. (2017) estimated the TE of selected 130 transport manufacturing firms in Malaysia using SFPFA. It perceived that employees' wage rate and cost of information are significantly associated with TE of transport manufacturing firms in Malaysia. The study conducted by Dogan et al. (2019) assessed the determinants of performance of companies operating in manufacturing industries in Turkey. It perceived that

the performance of manufacturing firms is significantly associated with innovation, R&D, and exports, this drives them to be technically efficient.

3. Methodology

Data Envelopment Analysis (DEA) was used in this study to measure the sampled firms' technical efficiency. DEA is one of the non-parametric tools to determine firm's efficiency. A panel DEA approach was employed to determine the sampled firms' technical efficiency for the period. Malmquist with input-oriented approach was adopted in this study. Malmquist Productivity Index using DEA frontier in Stata was employed in this study for the analysis. Since all the firms operate under the same environment and conditions, and have existed for a long period, Constant Return to Scale was adopted to test their technical efficiency.

The population consists of manufacturing firms listed on the Nigerian Stock Exchange for the period covered by this study. The researcher employed a non-probability sampling technique to select the final firms used for the analysis. A quota sampling method was used. In this sampling method, the researcher uses his or her own discretion in the final selection of samples from the population, thus, 31 firms with consistent annual financial reports for the period 2013 to 2018 were selected.

4. Results

The Malmquist DEA approach was applied using Stata 15 statistical software. Below is an extract from the results obtained. Malmquist efficiency INPUT Oriented DEA: The data sourced from the financial reports of the selected firm was analyzed using The Malmquist DEA approach based of Constant Return to Scale (CRS) was applied using Stata 15 statistical software. The table below shows an extract from the results obtained.

The result obtained from table 1 above indicated that for year 2013 based on constant return to scale (CRS) only one firm was super-efficient (Eternal Oil and Gas), while two had relatively fair efficiency scores (Dangote Cement Plc with 52% and Oando Plc with 77%). The remaining twenty-eight firms were not efficient with scores as low as 4% efficiency score. This could be as a result of high input cost and relatively low sales during that period in Nigeria.

From table above, the result for 2014 based on CRS, only Eternal Oil and Gas Plc. was super-efficient during that period, while Forte Plc. (54%), MRS Oil Nigeria plc (94%), Nestle Nigeria Plc 51% were relatively efficient. The remaining twenty-seven firms had low efficiency scores. The low efficiency trend recorded in the previous year continued in 2014 due to high cost of input factors of production coupled with low patronage of these products during the period 2014.

Table 1 shows the result for 2015, only Oando Plc. had super efficiency score for that period, while Eternal Oil and Gas previous efficiency scores dropped to 84% due to high input cost for that period then competitions from firms like Oando Plc. would have led to low patronage of their products. Beside those two firms, no other firm had good efficiency score for the year 2015; a result of high input costs and low patronage for the period

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Table 1: DEA of firm efficiency scores for the year 2013-2018

SN	Firms	2013	2014	2015	2016	2017	2018
1	A.G. Leventis Nigeria Plc	0.090351	0.097314	0.029837	0.074523	0.09025	0.081054
2	Berger Paints Plc	0.176279	0.229747	0.073234	0.128411	0.196935	0.172926
3	Cadbury Nigeria Plc	0.5531	0.497952	0.160001	0.091335	0.584084	0.446224
4	CAP plc	0.357107	0.470139	0.115694	0.204994	0.408601	0.343738
5	Cement Company of Northern Nigeria plc	0.027677	0.03175	0.026408	0.075448	0.019625	0.030663
6	Dangote Cement Plc	0.524869	0.399457	0.112954	0.214364	0.495614	0.398172
7	Dangote Flour Mills Plc	0.100005	0.305452	0.096067	0.141451	0.173501	0.166697
8	Dangote Sugar Refinery Plc	0.307511	0.261548	0.079409	0.103034	0.307211	0.243565
9	Eternal Oil & Gas plc	1	1	0.847536	0.742603	1	0.962261
10	Flour Mills Nigeria plc	0.183318	0.211437	0.053391	0.186919	0.180853	0.169073
11	Forte plc .402901	0.402901	0.544376	0.137936	0.896851	0.334205	0.420237
12	Glaxo Smithkline Consumer Nigeria Plc	0.173062	0.157014	0.045984	0.091007	0.170346	0.14177
13	Guinness Nigeria Plc	0.331611	0.316549	0.122733	0.220022	0.327016	0.28473
14	Honeywell Flour Mill Plc	0.152096	0.190546	0.043539	0.255921	0.135855	0.149013
15	International Breweries Plc	0.237362	0.322837	0.082107	0.193689	0.264761	0.235021
16	Lafarge Africa Plc	0.277911	0.271449	0.081028	0.108569	0.289506	0.23363
17	Learn Africa plc	0.047628	0.058254	0.013419	0.030972	0.051789	0.044205
18	Livestock Feeds Plc	0.107316	0.066535	0.029757	0.051099	0.094491	0.078057
19	May and Baker Nigeria PLC	0.143088	0.217421	0.053638	0.138565	0.164781	0.150593
20	MRS Oil Nigeria plc	0.37855	0.942971	0.154757	0.440128	0.569624	0.521345
21	Neimeth Pharmaceuticals Nigeria Plc	0.092649	0.075062	0.021138	0.077473	0.081499	0.073542
22	Nestle Nigeria Plc	0.449815	0.510781	0.155763	0.247645	0.48523	0.408308
23	Nigerian Breweries plc	0.433379	0.365196	0.115195	0.282118	0.40454	0.348237
24	Nigerian Enamelware Plc	0.318316	0.124006	0.030684	0.17875	0.239742	0.19878
25	Oando plc	0.770498	0.134503	1	1	0.49315	0.61747
26	Presco plc	0.132866	0.263508	0.105227	0.310821	0.146768	0.176815
27	PZ Cussons Nigeria Plc	0.210234	0.1999	0.061493	0.1362	0.206033	0.177192
28	Seven-up Bottling Company Plc	0.244517	0.321454	0.09595	0.209305	0.267477	0.240986
29	Total Nigeria plc	0.088762	0.119327	0.133191	0.234204	0.076342	0.112358
30	Unilever Nigeria plc	0.28597	0.252695	0.106824	0.198452	0.272249	0.239575
31	Vitafoam Nigeria Plc	0.148732	0.162932	0.05563	0.105236	0.153801	0.134778

Source: Stata15 DEA output

The result for 2016 as shown in table above, Oando Plc had a super efficiency score for the period, while Forte Plc (89%) and Eternal Oil and Gas Plc (74%) other firms sampled during the period had low efficiency score. The result signified that the costs of inputs were still high for most of the firms and the patronage of their products were not encouraging as well.

The result for 2017 as shown in the table, Eternal Oil & Gas Plc. had a super efficiency score for the period, while other firms sampled during the period had low efficiency score. The result signified that the costs of inputs were still high amidst the rising inflation, increase in exchange rate, stifling government policies on the operations of firms.

The result for 2018 as shown in table above, Eternal Oil & Gas Plc. had fair efficiency score for the period, while other firms Oando plc, MRS Oil Nigeria plc, and A.G. Leventis Nigeria Plc sampled during the period had fair efficiency score. The result signified that lingering economic decline as a result of rising inflation, increase in exchange rate, stifling government policies is having impacts on the real sector operations and efficiency.

5. Discussion

The analyzed data indicated that most firms operating in Nigeria during the period under review operated below efficiency. An indication of high input costs then worsened by low patronage, rising inflation, increase in exchange rate, and stifling government policies. Barely three firms for each period, which account for 9% of the sampled firms, had encouraging efficiency scores. The remaining twenty-eight (representing 91%) of the firms during the period had low efficiency scores. This study differs from Osamwonyi and Imafidon (2016) study findings that show that Nigeria quoted manufacturing firms are efficient with an average return of mean score of 85%. Thus, the periods of low efficiency scores among over 90% of manufacturing firms in Nigeria was an indication of a recession within the economy. The high cost of inputs worsened by low patronage was an indication that the recession reigned through all the periods sampled. The findings are in line with existing literatures of a recession in Nigeria during the period which was evident in the year 2016.

6. Conclusion

The study was to examine the technical efficiency of manufacturing firms for period 2013 to 2016. A panel approach was chosen with the help of Malmquist efficiency Input Oriented DEA using Stata 15 statistical software, the researcher was able to analyze the data of the sampled firms. The results indicated that most of the manufacturing firms within the country during the period reviewed had similar problems of high input costs and low patronage, rising inflation, increase in exchange rate, and stifling government policies. This also indicated that an economic recession was present during this period. In this context, the study found that other firms are struggling with technical efficiency. This is in contrast to Olatunji (2002) research that that conclude firm's inefficiency was as a result of firms' characteristics, aside external factors. On the other hand, the study affirms Osamwonyi and Imafidon (2016) empirical study that Nigerian firms had the problem of being technically efficient, hence only thirty-one of the firm considered is fairly efficient, while twenty-seven companies were found not to be operating maximally. The study recommended that the firms that are operating at decreasing efficient levels needs to do the needful by scaling down their input and output variables, while those at the efficiency level needs to scale up their input and output variables. Also, Nigerian government should do the needful in order to mitigate the challenges facing these manufacturing firms with low efficiency scores so that they would not cease to exist in the nearest future.

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