EFFICIENCY OF THE INDUSTRIAL SECTOR OF THE NIGERIAN CAPITAL MARKET: A DEA APPROACH

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Abstract

The research empirically investigates the comparative performance efficiency of the industrial good sector of the Nigerian Stock Market, using twelve industrial goods firms listed for the period 2019-2020. The Firms include, Austin Lazarus Nig Plc, Beta Glass Company Plc, Premier Nig Plc, Berger Paints Nig. Plc, amongst others. Data envelopment analysis (DEA) analysis techniques are utilized for the efficiency analysis. The empirical analysis output reveals three (3) industrial firms understudied are technically efficient under the constant returns to scale (CRS) (2020), while five (5) of the firms are efficient under the variable returns to scale (VRS efficiency level, both for 2019 & 2020); and four (4) became efficient under the DEA scale efficiency model. Based on these findings, it is recommended that efficiency-stimulating policy measures and strategies-both internally and externally be put in place to enhance the industrial goods sector of the Nigerian capital market. These should be supported by enabling economic, political and institutional structures, as well as regulatory and supervisory mechanisms. As a result, the poorly performed firms should benchmark the highly efficient firms in the industry in order to be highly efficient.

Keywords: Market Efficiency, Financial Market, Industrial Sector, DEA, Nigerian Capital market

JEL classification: G140.

1. INTRODUCTION

According to the Nigerian Stock Exchange (2010). The efficiency of the Nigerian capital market industrial sector has been largely in doubts over the past four decades, as there has been certain very important hinderances that has played and still standing as hinderances to the development of the sector. Despite the huge importance of the sector to the development of the Nigerian economy, the industrial goods sector still contribute just a minute amount to the output (GDP) of the economy. Furthermore, the 2009 review of the sector showed a substantial decrease in capacity development, according to available statistics, from all high 46.7, to 42.7

percent at the end of 2010. The calculated indices of the industrial goods sector were estimated at 86.4 percent, and this was at December of 2009. It revealed a decrease in the previous year's indices with about 3.7 percent differences. The problems associated with the decline consisted of many factors such as: lateness in the release of the ultimate year's budget estimation, infrastructural drawbacks, inadequate supply of power generation, huge interest rates (lending rates), insecurity of personal properties and of lives, short supply of labor, mismanagement of scarce resources, multiple taxes and rates, as well as lack of purchase of local products (Central Bank of Nigeria, 2010). As a result of the aforementioned problems, a lot of industrial goods firms were shut down, with about 60 percent at the verge of collapse, while only ten percent were said to be operating at sustained level. Furthermore, the prevalence of the energy problems, which has contributed to poor performing outcomes, which has made unrealistic vision ''2020'' goals, which has also made the dream of making the Nigerian economy the biggest and most viable in the African clime; this dream even after four (4) years away from the vision 2020'', has still not been achieved.

Many studies have been done in this area of testing the technical efficiency of industrial good sector of the Nigerian capital market, most of which are foreign based, and they include Arzu and Tosun (2010), and Ephraim (2000), Mahedevan (2010), Mahedevan (2010), Bjurek and Duravell (2002), Nordin and Said (2010). The studies that have been conducted in Nigeria but not with the DEA approach indlude, Soludo and Adenikinju (1996), Egbon (1995), Adewuyi (2006). However these studies only made use of the panel regression technique as data analysis method. This implied that of all these studies, the ones that measured the performance efficiency of the industrial goods firms listed in the Nigerian capital market are still very few in literature. This gap we intend to fill in this research work.

2. LITERATURE ERVIEW

We reviewed some of the myriad empirical works that have been done in Nigeria and other countries of the world as well. In Nigeria, for example, a number of studies have examined banking and industrial sector efficiencies over time. Principal amongst them include, Adekanye (1991). In the study, the author examined the efficiency of banks in Nigeria using the non-parametric DEA approach and found that efficiency of banks in Nigeria was both internally and externally determined. More so, while some studies in efficiency of banks in Nigeria used conventional ratio analysis techniques, such as return on assets (ROA), return on equity (ROE) and the CAMELs, to proxy performance up to date, only very few studies have used the DEA to evaluate performance efficiency in Nigeria. This has made comparative efficiency of banks difficult in Nigeria. A study that examined the effect of gradual deregulation on the performance of banks in Nigeria. It also examined whether policy package results in an improvement in the technical efficiency of the industry. Using the DEA approach, the study reveals that banking industry efficiency declined significantly during years immediately following the adoption of deregulation. This study attributed this to the effect of inconsistent policies which the sector was

subjected to during the period (Olugbenga & Olakunle, 1998). Another study had investigated the impact of ownership structure on bank performance and found that diffuse ownership structure leads to poor performance efficiency of banks due to the potentially reducing effect of diffusion (Aburime, 2008).

According to the empirical studies carried out by Eriki and Osifo (2015), which examines the determinants of performance efficiency of 19 selected banks in Nigeria in 2009. About three performance efficiency measures were selected: of constant returns to scale (CRS), variable returns to scale (VRS) and scale performance efficiency, by employing the Data Envelopment Analysis (DEA) approach. Their findings also revealed that bank size and bank age were positively related to bank performance efficiency, while board independence and board ownership structure were negatively related to bank performance efficiency in Nigeria over the period. A plethora of studies on industrial performance efficiency have been done using the DEA analysis approach in other Africa countries. Al-Shammari (1999) applies the modified model of DEA to evaluate the operational performance of about fifty-five Jordanian industrial shareholding companies listed in the Amman Financial Market (AFM) using financial data for the year 1995. Zhu (2000) developed multi-factor performance model companies in 1995. A market efficiency study on top listed companies in Egypt was conducted by Mostafa (2007) using a two-stage approach. The study shows that performance efficiency of the understudied firms tend to rise with company size, and that there is sustainable changes in the distribution of efficiency across company sizes with some companies operating at the same or higher levels of performance efficiency than some larger companies in the industry.

3. METHODOLOGY

The study seeks to examine the performance efficiency (technical, scale) efficiency of listed industrial goods firms in the Nigerian capital market. The data envelopment analysis (DEA) approach has been adopted. Invariably, a cross-sectional time- series analysis of the performance efficiency and productivity of the selected listed industrial companies in Nigeria, using the DEA analysis techniques, using efficiency scores. The population of the study consists of all the twelve (12) listed firms in the Industrial goods sector of the Nigerian capital market as of 31st December 2020. The firms include Austin Laz. & Co Nig.Plc, Beta Glass Company Plc, Cutix Nig.Plc; Berger Paints Nig Plc, Cap plc; Dangote Cement Nig. plc; Greif Nig. Plc; Lafarge, Meyer Plc; Portland paints; Cement Bua Nig. Plc and Premier paints Nig. Plc. examined over the period 2019 &2020. This is a type of comparative study.

The data for the study are obtained from the annual reports of the firms. The estimation is carried out using the data envelopment analysis (DEA). A DEA test is a non-parametric statistical technique that measures the relative efficiency of multiple decision-making units. It entails the use of a non-parametric pricewise frontier to calculate the relative efficiencies of this frontier. As an efficiency measurement tool, the DEA, the extent of efficiency score, which could be 1, for

maximum efficiency and less than 1 for lower levels of inefficiency. In order to carry out robust analysis in this work, three DEA efficiency measures are employed. They include the constant returns to scale (CRS), the variable returns to scale (VRS) and the scale efficiency. We used frontier analysis software in the estimation process.

3.1. CHOICE OF INPUT AND OUTPUT VARIABLES

The right choice of outputs and inputs does play a critical part in studying performance with the DEA techniques. The output variable used here is Earnings before interest and taxes (EBIT), while four (4) input variables are used, to include Total Assets (TOAS), proxy by fixed and current Assets total, Total debt (TODT) (proxy by total liabilities), Total equity (TOEQ) (proxy by total of shareholders fund in the business) and Operational expenses (OPEX) (Proxy by all expenses incurred in the operation of the business during the period). These variables are easily and readily obtainable in the yearly performance records of the quoted companies employed in the study.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. DESCRIPTIVE STATISTICS

We present in Table 1 the descriptive statistics of the listed firms used for the analysis. The essence of descriptive statistics is to show the pattern as well as characterization of the series. From the descriptive statistics results, the mean earnings before interest and taxes (EBIT) is104.25, with a standard deviation value of 270.138. The minimum and maximum values are -311% and 679%, alike. The standard deviation, a measure of the variability, implies that the efficiency performance of the listed industrial good firms was characterized by relative divergence, with some of the firms having higher values that exceeded the mean EBIT over the period. The corresponding mean (average) value of Total asset, Total debt, Total equity and operating expenses are 120.75, 218.25, 161.25 and 166.92, respectively. Overall, the data are well distributed such that they will not distort the DEA outputs.

***Table 1. Descriptive** Statistics*

	No	Minim	Maxim	Mean	Standard Deviation
TODT	12	1	843	218.25	289.971
EBIT	12	-311	679	104.25	270.138
TOEQ	12	-213	897	161.25	334.670
OPEX	12	1	704	166.92	232.055
TOAS	12	1	497	120.75	186.424
Valid N (listwise)	12				

Source: Author's computation (2022)

4.2. ANALYSIS OF THE EFFICIENCY OUTPUTS

The software results are based on three (3) efficiencies:

(i) Data Envelopment Analysis overall technical efficiency measure, ranked as Constant Returns to Scale (CRS)
(ii) The real performance efficiency, which measures on variable returns to scale (VRS) basis and
(iii) Scale efficiency score, which is the ratio of constant returns to scale to variable returns to scale (i.e. CRS/VRS)

Performance efficiency refers to the limit by which the result of a decision-making unit is maximized for a determined quantity of productive inputs. In other words, the production possibility curve emerges when the decision-making unit operates on the production possibility frontier (efficiency frontier), implying optimal utilization of productive or input resources.

4.3 CRS RESULT 2020

Table 2*. Represents the Technical Efficiency Score of twelve (12) Firms based on CRS approach*

DM No	Industrial Firms	TE (crs)	Rts	DEA (peer)	Performance Efficiency
1	Austin Laz& co.	18.60%	IR	5	FALSE
2	Berger paints Nigplc	72.50%	IR	2	FALSE
3	BetaGlass Company Plc.	100.00%	IR	1	TRUE
4	Cap Nigplc	100.00%	IR	1	TRUE
5	CutixNig Plc.	53.60%	IR	3	FALSE
6	Dangote cement	17.50%	IR	5	FALSE
7	Greif plc	100.00%	CR	1	TRUE
8	Lafarge plc.	5.30%	IR	3	FALSE
9	Meyer plc	35.70%	IR	4	FALSE
10	Portland paints	25.10%	IR	5	FALSE
11	Premier paints	11.20%	IR	5	FALSE
12	Cement Bua	12.40%	DR	5	FALSE

Source: Author's computation (2022)

Table 3. *CRS RESULT 2019*

DMU No	Companies	TEcrs	RTS	DEApeer	Efficiency
1	Austin Laz& co.	28.80%	IR	5	FALSE
2	Berger paints Nigplc	0.80%	IR	2	FALSE
3	BetaGlass Company Plc.	3.90%	IR	5	FALSE
4	Cap Nigplc	19.10%	IR	5	FALSE
5	CutixNig Plc.	15.90%	IR	5	FALSE
6	Dangote cement	69.20%	IR	3	FALSE
7	Greif plc	100.00%	CR	1	TRUE
8	Lafarge plc.	11.90%	IR	5	FALSE
9	Meyer plc	3.60%	IR	5	FALSE
10	Portland paints	5.50%	IR	5	FALSE
11	Premier paints	12.50%	IR	5	FALSE
12	Cement Bua	13.80%	DR	5	FALSE

Source: Author's computation (2022) Using efficient frontier software

Table 4. *Results for 2019/2020 in Comparison for the 12 Firms on constant returns to scale measure.*

DM U	Companies	2020 (CRS)	2019 (CRS)	Efficiency
1	Austin Laz& co.	18.60%	28.80%	FALSE/ FALSE
2	Berger paints Nigplc	72.50%	0.80%	FALSE/ FALSE
3	Beta Glass Company Plc.	100.00%	3.90%	TRUE/FALSE
4	Cap Nigplc	100.00%	19.10%	TERUE/ FALSE
5	CutixNig Plc.	53.60%	15.90%	FALSE / FALSE
6	Dangote cement	17.50%	69.20%	FALSE/ FALSE
7	Greif plc	100.00%	100.00%	TRUE/TRUE
8	Lafarge plc.	5.30%	11.90%	FALSE/ FALSE
9	Meyer plc	35.70%	3.60%	FALSE/ FALSE
10	Portland paints	25.10%	5.50%	FALSE/ FALSE
11	Premier paints	11.20%	12.50%	FALSE/ FALSE
12	Cement Bua	12.40%	13.80%	FALSE/ FALSE

Source: Author's computation (2022)

Three tables are presented above: in the first table, three (3) firms are technically efficient on the constant returns to scale (CRS) basis, while the remaining nine (9) firms are inefficiently performed. The three (3) firms that can use their inputs-resources (asset, debt, equity and expenses) to generate better output (earnings-i.e. EBIT) include, Beta glass, NigPlc, Cap plc and Greif Nig, Plc, while the remaining nine are technically inefficient under the CRTS. Thus, not a large proportion of the firms sampled are able to generate the same output return from increasing input by the same proportion, while others could. Apparently, the inefficient firms had under-utilization of productive inputs in their inability to maximize very large portion of their productive inputs into generating desired outputs/earnings, when compared with their peers in the industry. However, the result in table 3 shows the penultimate year's performance efficiency, which has only one out of the twelve firms, as efficient and the efficient firm being Greif plc. This implies that Greif plc, amongst others, stood out in both years' performance comparisons. The CRS peer show that Greif Nig Plc, Bet glass, Plc and Cap Nig. Plc, were examples of 'best –practice or well-rounded generated performers' for 2020, while Greif plc, stood out for 2019 only. And this implies that the less efficient companies should benchmark the more efficient ones.

Table 5. *Variable Returns to Scale Result for 2020*

DMU No	Companies	TEvrs	RTS	DEApeer	Efficiency
1	Austin Laz& co.	100.00%	IR	1	TRUE
2	Berger paints Nigplc	11.60%	IR	5	FALSE
3	BetaGlass Company Plc.	76.00%	IR	2	FALSE
4	Cap Nigplc	73.30%	IR	2	FALSE
5	CutixNig Plc.	35.40%	IR	4	FALSE
6	Dangote cement	100.00%	IR	1	TRUE
7	Greif plc	100.00%	CR	1	TRUE
8	Lafarge plc.	74.80%	IR	2	FALSE
9	Meyer plc	100.00%	IR	1	TRUE
10	Portland paints	38.20%	IR	5	FALSE
11	Premier paints	100.00%	IR	1	TRUE
12	Cement Bua	60.90%	DR	3	FALSE

Source: Author's computation (2022)

Table 6. *VRS 2019*

DMU No	Companies	TEcrs	Rts	DEA peer	Efficiency
1	Austin Laz& co.	97.40%	IR	2	FALSE
2	Berger paints Nigplc	1.80%	IR	5	FALSE
3	BetaGlass Company Plc.	10.90%	IR	5	FALSE
4	Cap Nigplc	100.00%	IR	1	TRUE
5	CutixNig Plc.	88.80%	IR	2	FALSE
6	Dangote cement	100.00%	IR	1	TRUE
7	Greif plc	100.00%	CR	1	TRUE
8	Lafarge plc.	27.00%	IR	5	FALSE
9	Meyer plc	28.50%	IR	5	FALSE
10	Portland paints	22.70%	IR	5	FALSE
11	Premier paints	100.00%	IR	1	TRUE
12	Cement Bua	100.00%	DR	1	TRUE

Source: Author's computation (2022)

Table 7. *Results For 2019/2020 In Comparison for 12 Firms Based on VRS DEA Model*

DMU No	Companies	2020VRS	2019VRS	Efficiency
1	Austin Laz& co.	1000.00%	97.40%	TRUE/ FALSE
2	Berger paints Nigplc	11.60%	1.80%	FALSE/ FALSE
3	Beta Glass Company Plc.	76.00%	10.90%	FALSE /FALSE
4	Cap Nigplc	73.30%	100.00%	FALSE/TRUE
5	CutixNig Plc.	35.40%	88.80%	FALSE / FALSE
6	Dangote cement	704.30%	100.00%	FALSE/ TRUE
7	Greif plc	1000.00%	100.00%	TRUE/TRUE
8	Lafarge plc.	74.80%	27.00%	FALSE/ FALSE
9	Meyer plc	25.30%	28.50%	FALSE/ FALSE
10	Portland paints	38.20%	22.70%	FALSE/ FALSE
11	Premier paints	1000.00%	100.00%	TRUE / TRUE
12	Cement Bua	60.90%	100.00%	FALSE/ TRUE

Source: Author's computation (2022)

Under the VRS technical efficiency (TEvrs), it can be observed that five of the industrial firms are efficient. Hence, a shift from the CRS performance output to VRS has made two additional firms more efficient. It can also be observed from the table that Austin Laz& CoPlc (1) and Greif Plc (1), Dangote cement (1), Premier paint and Cement Bua, operated business model that generated remarkable returns, and the firms can be refer to as 'role models to the others in the industry. Invariably, for 2020 & 2019, five (5) firms under the VRS DEA became efficient, due apparently to higher economies of scale, cost reduction and managerial efficiency.

4.4 SCALE EFFICIENCY ANALYSIS

The scale efficiency is the ratio of overall technical efficiency (TEcrs) to pure technical efficiency (TEvrs). It underscores the capacity of a firm to improve its efficiency whether it is operating at the desired returns to scale. For a company to be referred to as efficient, under the scale efficiency model, it must improve its proportion of returns to the most productive and efficient scale. Here, apart from internal factors, the influence of the macroeconomic environment on the output/return of firms is accounted for. A further analysis of the scale operations of

the sampled listed firms, the degree of their scale efficiency is examined. The estimates of the overall efficiency score are hereby reported in table 8 below.

Table 8.the *Scale Efficient Score of the twelve (12) Firms*

DMU Number	Firms	''The overall technical efficiency- input oriented''Tecrs''	''The pure technical efficiency- input oriented''Tevrs''	,''Scale Efficiency (TEcrs/TEvrs)''
1	Austin Laz& co.	18.60	1.00000	0.196
2	Berger paints Nigplc	1.00000	1.00000	1.0000
3	Beta Glass Company Plc.	1.00000	0.76	0.1315
4	Cap Nigplc	1.00000	1.00000	1.00000
5	CutixNig Plc.	0.8825	1.00000	0.790
6	Dangote cement	0.867	0.17043	0.50871
7	Greif plc	1.0000	1.0000	1.0000
8	Lafarge plc.	0.1340	0.1018	0.1689
9	Meyer plc	0.3930	0.5380	0.7304
10	Portland paints	0.3060	0.6090	0.5024
11	Premier paints	1.0000	1.0000	1.0000
12	Cement Bua	0.2620	0.1609	0.1628

Source: Author's computation (2022)

The scale efficiency outputs reveal only four (4), out of 12 industrial good firms are scale efficient, and the others are less efficient over the period. Thus, under the constant returns to scale and variable returns to scale, these are the companies that were able to convert their efficiencies to generate higher output levels. They include Berger paints NigPlc, Cap NigPlc, Premier paint and Greif Plc. Invariably, their company's management were able to increase their efficiency scale to a higher performance level. Important to note on the results, is that one of the industrial firms, Dangote Nig Plc, which was previously more performing on the Variable Returns to Scale, became less efficient, owing to diseconomies of scale to internal and external factors.

5. CONCLUSION

This study employed the ingenious DEA efficiency measure to investigate the performance of listed industrial good companies of the Nigerian capital market over the period 2019-2020: A comparative analysis. Three efficiency DEA scores model was determined in the paper, which consisted of CRS (constant returns to scale), VRS (variable returns to scale) and SE (scale efficiency) were employed in the analysis. Findings revealed mixed evidence of technical performance efficiency and inefficiency, pure technical efficiency and inefficient, and scale efficient and inefficient levels. The findings are due to both cost, efficient factors, allocative and technical, factors, and the exogenous macroeconomic environment. Three (3) industrial firms are technically efficient under the CRS scale efficiency measure, five (5) are efficient on the VRS, and while four (4) are efficient on the scale efficiency basis over the period.

Against the backdrop that improved level of efficiency implies better performance in the market, it is hereby recommended that:

- There is a need to put appropriate measures in place to steer efficiency amongst firms in the industry. In this regard, appropriate policy measures and initiatives should be implemented to make the industrial goods sector virile and sustainable, generating better performance for investors in the market. This is important because efficiency of the industrial sector has positive spillover effects on the capital market and Nigerian economy in general, as investors' confidence are built, and the economy is better off.
- That the less efficient firms should always benchmark the more efficient ones, in terms of resource allocation and utilization to generate and maintain optimal performance amongst the firms in the industry.
- Performance efficiency should be carried out, especially among firms of the same industry, to create heathy competition among firms that are quoted in the same industry, in the Nigerian capital market. This will not only create improved performance of the firms but also boost performance efficiency in the market.

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