MEASURING THE EFFICIENCY AND PERFORMANCE OF LISTED CONGLOMERATE FIRMS IN NIGERIA: DATA ENVELOPMENT ANALYSIS (DEA) APPROACH

IDOLOR ESEOGHENE JOSEPH
Faculty of Management Sciences, University of Benin
eseoghene.idolor@uniben.edu

AIGBOVO OMORUYI
Faculty of Management Sciences, University of Benin
omoruyi.aigbovo@uniben.edu

OGIEMUDIA A. OMOROSE
Faculty of Management Sciences, University of Benin
omorose.ogiemudia@mgtsci.uniben.edu

Abstract

This study empirically examines efficiency of listed conglomerate firms in Nigeria from 2018 to 2019. The study used Data Envelopment Analysis (DEA) techniques to measure and evaluates the performance efficiency of the conglomerate firms. Findings show that conglomerate firms in Nigeria are 66.67% grossly efficient in terms of CRS efficiency, VRS efficiency and SCALE efficient across board, respectively. This study therefore concludes that the inefficient firms should benchmark and bench race efficient conglomerate firms in Nigeria. And recommends that Greater managerial capacity is also required to enhance productive, allocative and scale efficiency in the sector.

Keywords: Constant Return to Scale Efficiency, Variable Return to Scale Efficiency, Scale Efficiency, Conglomerate Sector, Nigeria

JEL Classification: G11, G23

1. Introduction

One of the major tools that aid firms to understand their position relative to their counterpart is industrial analysis. And an important component of effective strategic planning is identifying and understanding the forces at work in the overall industry (Finance Walk, 2015). Understanding these forces at work in an industry goes beyond micro-level to incorporate determining factors at the macro-level. These macro elements (factors) corresponds innovation in the report of specific industry analysis, recent industrial developments etc. ((Financial Walk, 2015). Nigeria is the largest economy in Africa characterized with middle-income, mixed economy and

frontier market, with growing twelve major industrial sectors. In terms of nominal Gross Domestic Product (GDP), Nigeria is placed as the 21st and 20th largest economy in the world and with respect to purchasing power parity. In 2013, her developing real sector emerges as the largest on the continent. And this sector plays a pivotal role in the country's quest for the industrialization of the country and the country's millennium sustainable development goal (Wikipedia, 2016).

In terms of specific input and output variables of these industries, to clearly determine which industries among the twelve sector that contributed more to the country's total GDP ranking, as well as the specific input variables of assets, expenses and output variables of gross earning and profit after tax that make an industry to be more efficient and better positioned than its counterparts is difficult to know (Isibor, 2017 & Wikipedia, 2016). Hence, the quest to empirically investigate the quality and efficiency of converting certain inputs into outputs with respect to firm performance in different countries using the Data Envelopment Analysis (DEA) technique has spark different studies among researchers, academicians and policies makers in developed and emerging economies.

Some of these studies include Osamwonyi and Imafidon (2016), Jajri and Ismail (2006) examined the technical efficiency and performance of manufacturing firms in Nigeria and Malaysia, respectively. Ogieva and Omoregbe (2017), Yao and Sumiter (2007) studied the performance efficiency of insurance firms in Nigeria and China. While Igbinovia (2018) used DEA to investigate agricultural sector efficiency and performance in Nigeria. Aigbovo and Igbinoba, (2019), Isibor (2017), Novickyte and Drozdz (2018), Dadashi, Zarei, Dadashi, Emamgholipour, Mansourinia and Hozoori (2013), Eriki and Osifo (2014), Eken and Kale (2011), Edelstein, Paradi, Wu and Yom (2012) determine the performance efficiency of banks using DEA in Sub Saharah Africa, Nigeria, Lthuanian, China and Kenya. Osifo and Sibanda (2018), Ahmed and Mohamad (2017), Harun, Tahir and Zaharudin (2012) and Harris (2012) investigates efficiency and performance of Real Estates Investment Trust (REITs) in Sub Saharah Africa, Singapore and Malaysia. Choi and Jung (2017) measure the efficiency and effectiveness of highway management in the U.S using DEA approach.

However, it appears from the survey of empirical and theoretical literature that while plethora of studies on efficiency and performance of different industrial sectors have been studied both in developed and emerging countries like Nigeria using DEA. Only few or no study to the best of my knowledge on performance efficiency in conglomerate sector has been conducted in the case of Nigeria using DEA. Therefore, this study measures the technical and scale performance efficiency under the assumption of Constant Return to Scale (CRS) and Variable Return To Scale (VRS) of quoted conglomerates companies in Nigeria with the aid of DEA spanning the period of 2017 to 2018.

Objectives of the Study

The broad objective of this study is to measure the efficiency and performance of listed companies in Nigeria. The specific objectives are to;

1. determine the technical efficiency of conglomerate firms under a CRS assumption in Nigeria
2. study the technical efficiency of conglomerate firms under VRS assumption in Nigeria
3. examine the scale efficiency of conglomerate firms in Nigeria

Hypotheses of the Study

The hypotheses of this study are stated in their null form

Ho_1: Conglomerate firms are not technically efficient under a CRS assumption in Nigeria;

Ho_2: Conglomerate firms are not technically efficient under a VRS assumption in Nigeria; and

Ho_3: Conglomerate companies are not scale efficient in Nigeria

Significance of the Study

This study add value to the discussion on performance efficiency by focusing on conglomerates firms as study of this nature is scarce in the Nigeria case. The study deals with technical, scale and allocative efficiency that were discussed as performance proxies in prior literature and examine the empirical investigation between them in the conglomerate sector in Nigeria. The study will further give a quantitative proof on how Overall Technical Efficiency (OTE), Purely Technical Efficiency (PTE) and Scale Efficiency (SE) can be interpreted in the conglomerate sector in Nigeria, thereby updating existing literature in this regard. The findings of this study are of immense benefit to government and policy makers to understand the current position of productive efficiency and performance of conglomerate firms in Nigeria for better policy formulation to enhance efficiency in the sector.

2. LITERATURE REVIEW/ THEORETICAL FRAMEWORK

Concepts of Technical, Scale and Allocative Efficiency

Debreu (1951), Farrell (1957) and Koopman (1951) perceived technical efficiency as the firm's ability to use a given input level to maximize output level. Overall economic efficiency was coined from this concept, in which Technical Efficiency (TE) is an integral part of. Input or output perspective is an alternative way of perceiving efficiency. When perceived as input optimal mix to achieve a given output level it becomes Input Oriented (IO) approach and an output approach when perceived from a given input from optimal output level (Debreu, 1951). Specific technical efficiency measurement is hinged on observed output deviation from production efficiency frontier curve. If the ultimate production point resides on the frontier, the firm is adjudged to be absolute efficient; otherwise inefficient technically when it lies below the frontier (Herero & Pascoe, 2002).

Scale Efficiency (SE) measures deviation of a firm from optimal scale. In other words, SE ascertains inefficiencies due to operations size and input/output

combination to guide managers in choosing the resources optimum size for targeted firm (Ogieva & Omoregbe, 2017). Technical inefficiency in the conglomerate firms could be caused sometimes by inappropriate size (too large or too small). This is called scale inefficiency and it takes two forms: Decreasing and increasing returns-to-Scale. The former, also known as diseconomies of scale; reveals that firms cannot take complete advantage of scale because they are too large and has supra—optimum scale size. In contrast conglomerate firms experiencing Increasing Returns-to-Scale (IRS) operate at sub-optimum because it is too small for its operational scale. A firm is scale efficient when operating at constant return to scale (Ogieva & Omoregbe, 2017).

Allocative efficiency means firm's ability to utilize input effectively and efficiently at an available technology and at a given prices. Overall efficiency decomposition technique used in breaking down production unit into allocative and technical efficiency components was introduced by (Farrell, 1957). By not purchasing best quality of inputs at a given prices and marginal productivity makes productive units to be inefficient. Input and output slack reveal the allocative efficiency of a firm. The percentage of input reduction that still produces the same level of output is termed an input slacks; while the proportion by which output could be expanded by current level of input (Simone, Claudia & Mancuso, 2008).

Concept of Performance

Performance as mostly used involves productivity and efficiency. It means the success degree attained by the business in a specific period. Performance is the quantitative and qualitative explanation of where group, enterprise or individual on a work agreed on the approach to goal aim (objective), which is associated to work (Ramanthan, 2003). Performance has been measured with different indicators which include; growth rate, technological innovation, returns on equity and investment, return on asset, risk diversification capacity, liquid ratio among others (Weng, 2009; Kang & Liao, 2009)

Theoretical Framework

The Traditional Efficiency Theory (TET) also known as the classical economics cost minimization theory postulates that achieving optimal output with a given resources of input indicates that the organization is cost efficient without incurring additional cost of operation. That is least possible cost is used to achieve the same output level (Lehmann, 1990; Iyoha, 2004). TET is an input-output oriented approach. In line with this, given input prices and output combination, conglomerate firms are presumed to choose a production main plan that reduces cost and maximize profit (Kokkinou, 2012; Coelli, Rao, O'Donnell & Battese, 2005; Kokkinou, 2012). TET has three structural approaches to efficiency which corresponds; profit maximization, managerial utility maximization and cost minimization (Lehmann, 1990). Firms efficiency employing the structural approach is a function of economics cost minimization, where firm's performance equation stands for cost function (Cannon & Vogt, 1995).

Input and output orientated approach is an off shoot of technical efficiency DEA relative efficiency. Chuweni and Eves (2017) opine that a firm is efficient in its performance if the tenets of input or output orientation are followed and this includes conglomerate firms. Combining both input and output orientation generated the financial performance efficiency model, in which performance efficiency scores of the sample firms are determine employing set of input and output variables of conglomerate listed firms in the Nigeria stock exchange.

Empirical Literature

Jajri and Ismail (2006) studied technological dynamics, technical efficiency and factor productivity growth of manufacturing sector in Malaysia from 1985 to 2000 using DEA approach. Findings indicate high economic inefficiency level. Zheng, Chau and Hui (2011), Harun, Tahir and Zaharudin (2012) and Harris (2012) used DEA framework to investigate the efficiency of real estate firms in China and Malaysia, respectively. Outcome indicates that scale, technical and operational efficiency was < 1. However, the efficiency values were above 0.77, respectively. Also, 69% of REITS in China are grouped under increasing return to scale (Zheng et al, 2011). In Malaysia, findings reveal that majority of the REITs companies were efficient out of the 13 firms considered due to economic recovery (Harun, 2012). Harris (2012) discovered that REITs were inefficient owing to decreasing return to scale over a substantive period covered by the study.

DEA model was used to produce peer reference which examined the nexus between staff and transaction activities of Canadian bank branches by Edelstein, Paradi, Wu and Yom (2012). Result shows that new grouping strategy provides fair and equitable benchmarking peers for every inefficient DMU (branch). DEA input orientation CRS and VRS were employed by Dadashi, Zarei, Dadashi, Emamgholipour, Mansourinia and Hozoori (2013) to ascertain the scale, technical and pure efficiency of eleven (11) Iranian banks for four (4) year period. Result point out that except for Sanat & Madan Bank that is the most efficient bank, all other banks are scale inefficient while nine (9) banks out of eleven were efficient technically under VRS assumption. Bootstrapping technique was employed by Abatania, Haliu & Mugera (2012) to examine the efficiency of 189 agricultural firms Ghana. Findings show that technical efficiency of sample farms is 77.26 with scale efficiency of 94.21%. Also, gender, farm location, labor and household age were significant determinants of technical efficiency as indicated by the second stage regression.

Eriki and Osifo (2014) used DEA technique to explore the scale, VRS and CRS efficiency of nineteen (19) deposit money banks in Nigeria. Result point out that mega banks are less efficient than small and medium banks. Helali, Tsagli & Kalai (2014) studied Togolese agricultural efficiency and its influence on economic growth under economics of scale assumption. Stochastic frontier analysis and DEA approach were used, and findings show that the Togolese agricultural sector is generally inefficient. Chiang, Tsaih and Hsiao (2016) and Chuweni and Eves (2017), Anderson, Springer, Fok, and Webb (2002) examine REITs efficiency in Singapore and Malaysia respectively using DEA methodology. Result showed that all sample

firms considered are technically inefficient. Osamwonyi and Imafidon (2016) studied the technical efficiency of fifty-eight (58) manufacturing firms in Nigeria using DEA approach. Finding show that thirty-one (31) firms were technically efficient (operating on the production frontier) while twenty-seven (27) firms were inefficient. The results showed VRS mean score of 85% and scale efficiency mean score of 76%.

Von-Ihnen (2016) employed DEA analysis to measure efficiency in the agricultural sector in Sweden. He used the stochastic frontier analysis to determine the efficiency frontier of the production of different crops. The results show that efficiency depends on the labor units, size of land, technology and cost of agricultural inputs used. Ahmed and Mohamad (2017) ascertained the technical efficiency of and performance of REITs from 2009 to 2013 using DEA approach in Singapore. Result point out that REITs efficiency improved with marginal productivity growth at the frontier within the studied period. Isibor (2017) empirically evaluates performance efficiency of 11 selected firms across some industries in Nigeria using the Data Envelopment Analysis (DEA) technique. Using the input variables such as total asset and expenses; output variables such as profit after tax and gross earnings, the empirical findings reveal that on the basis of CRS efficiency, 5 firms out of the 11 sampled firms are technically efficient, while on the basis of VRS, 7 firms are technically efficient. The five firms that are CRS efficient were also variable return to scale efficient; while two firms that were not constant return to scale efficient were variable return to scale efficient. Ogieva and Omoregbe (2017) employed DEA approach to determine the technical efficiency of quoted insurance firms in Nigeria. Findings reveal that only twenty-six (26) firms were scale efficient while seven firms were technically efficient and the mean scale efficiency coefficient of 87% revealed that Nigeria insurance firms are relatively efficient in relation to their operation size and scale choice. Maximum peer count was attributed to Standard Trust Assurance Company (STACO).

Choi and Jung (2017) used DEA techniques to examine highway management efficiency and effectiveness at state level in the U.S for eleven (11) years. Significant association was detected between efficiency and effectiveness as indicated by spatial autoregressive and fixed effect panel model. Igbinovia (2018) used DEA to examine production and technical efficiency of 5 selected agricultural firms in Nigeria. This is examined over the period 2004-2015. The empirical results reveal a technical efficiency score of 88.0 %. Large number of the firms is also found to be scale inefficient, apparently due to managerial incompetence. The decomposition of the firms in terms of return to scale further show that 40% of the sampled agricultural firms operate under conditions of CRS, while 60% operate under increasing returns to scale, with 1 of the sampled firms operating under conditions of the most productive scale size.

The efficiency performance of thirty (30) REITs was studied by Osifo and Sibanda (2018) using DEA approach in Sub-Sahara Africa (SSA) from 2014 – 2016. Result confirmed 23.3% under VRS were efficient. 33.3% and 6.67% were efficient

under CRS and scale efficient, respectively. Generally, the result implied that listed REITs firms in SSA are not technically efficient. Novickyte and Drozdz (2018) adopted DEA framework to explore the banks performance efficiency in low interest rate zone under VRS and CRS assumptions. Result shows that local banks perform better under VRS assumption.

Aigbovo and Igbinoba (2019) investigated whether publicly traded banks Sub-Saharan African nations are working on the frontier of production, or if they are technically and economically efficient. In order to do this, the study used non-parametric data envelopment analysis (DEA), with the outcome variables being interest income, profit after tax, and loans and advances to customers, while input factors being interest expenditures, operational expenses, client deposits, and total assets. The study's findings show that most banks in the banking sector in the Sub-Saharan African nations are effective in transforming their inputs into outputs.

Statement of Research Gap

From the existing studies reviewed it is apparent that DEA studies have been carried out majorly in the banking sector, insurance sector, manufacturing sector, REITs using DEA approach to determine performance efficiency in these sectors. It has been observed that very little or no attempt has been made to apply DEA in evaluating performance efficiency of conglomerate sector in Nigeria, thereby leaving gap to be filled in the literature and more studies are needed in this regards. Hence, this study employs DEA to examine the performance efficiency of conglomerate sector in Nigeria using two input factors of total asset and operating expenses, and two output factors of profit after tax and gross earnings from 2018 to 2019.

3. METHODOLOGY

Research Design, Population and Sample and Source of Data

This study used the longitudinal research design because the inputs and output variables under consideration are historical in nature. Hence, cannot be manipulated by the researcher. All firms listed in the conglomerates sector of the Nigeria Stock Exchange (NSE) as at 2019 constitute the population of this study. However, only the companies that published their annual financial statement from 2018 to 2019 with the input and output variables of total asset, operating expenses, profit after tax and gross earnings constitute the sample of this study. All variables were obtained from the financial statement of the conglomerate companies as published in the NSE Fact book 2019.

This study used two (2) input-output variables respectively to evaluate the technical efficiency of the sampled six (6) listed conglomerate firms in Nigeria listed in the NSE.

Table 3.1 *DEA Variables*

Input	Output
Total Asset	Gross Earnings
Operating Expenses	Profit After Tax

Source: Researcher's Compilation (2019)

Data Analyses Plan and Model Specification

This study is made up of two broad models. The first model focused on measuring performance efficiency of quoted conglomerate companies in the Nigerian stock market using DEA input oriented CCR model, the second model examined how some factors could affect the generated DEA efficiency scores. The second model relied on the famous Ordinary Least Square (OLS) multiple regression techniques and was splinted into three based on the types of DEA efficiency scores generated. The following subsection provides detailed explanation of these two models. The Stata DEA software 13.0 is used to carry out this operation. The use of this software was informed by its ability to add other DEA models, it provides reports tools, statistical analysis and optimization procedures for managers. Finally, the output of DEA program can feed in directly into other Stata routines for further analysis.

DEA input oriented CCR model

The DEA linear programming model was developed by Charnes, Cooper and Rhodes (1978) which was extended by Farrell's (1957) from single to multiple input and output efficiency measures. The is aimed at optimizing input / output ratio by ascertaining the group weight that fulfill the linear equation system (Rouse, 1996) and Osifo and Sibanda (2018), Ogieva and Omoregbe (2017) and Isibor (2017) used similar method which this study adapted given as:

$$Max\ \aleph_m \aleph_m \partial_n \quad ---------- (1)$$

Subject to:

$$\aleph_m \partial_n - \sum_{n=1}^{p} \partial_{rn} + A_{rn} = 0 \quad ---------- (2)$$

r = 1,…Conglomerate firms output

$$W_{DV} - \sum_{n=1}^{p} \partial_{n,w} Kg - edv = 0 \quad ---------- (3)$$

K= 1,… Conglomerate firms input

$$\partial_n \geq 0, A_{rn} > 0, edv \geq 0 \quad ---------- (4)$$

M,n = 1,…n Conglomerate firms in the sample
Where:
$\aleph_m$ = possible percentage for output increase

A_r= r-th output slack
edv = v-th input slack
∂_n = Weight variable adopted to obtain the entire feasible linear combination of sample DMUs
If $\aleph_m$ coefficient in Eq (1) = 1, then $\partial_n = 1$ and $\partial_n = 0$ for n? m

The i-th DMUs lies on the frontier and is efficient technically.

Furthermore, efficient firms will have zero output and input slacks. Inefficient firms may also have some positive output or/and input slacks. The output based technical efficiency index of the i-th firms (Te_n) can be computed as follows:

$$\mathrm{Te_n} = \frac{1}{\partial_n} \quad (5)$$

r-th output frontier of i-th firms is stated as:

$$H_{rn} = \sum_{n=1}^{p} \partial_{rn} H_{rm} = \aleph_m H_{rn} + A_{rn} \quad (6)$$

In Eq(6) the two output component of the project are the proportional increase in all output ($\aleph_m H_{rn}$) and the A_{rn} which explain the non-proportional increase or output slack. Maximum output maximization is estimated from output – oriented and fixed inputs DEA in Eq(1), together with excess inputs (input slack) that need to be optimized for inefficient firms to be fully efficient.

4. DATA PRESENTATION AND ANALYSIS OF RESULT

Descriptive Statistic

Table 4.1: *Summary Statistic*

Variables	Tasset	Oexpenses	Grosse	Pat
Mean	3.33e+07	3982667	4972311	1964284
Std.Dev.	3.66e+07	5428090	5420400	3194458
Min	2030	-115729	813	93
Max	8.98e+07	1.44e+07	1.41e+07	1.07e+07

Source: Researcher's Computation Using Stata 13.0 (2020)

Table 4.1 shows the average value (mean) for each of the variable and their degree of dispersion (standard deviation), including their corresponding minimum and maximum values. The results provide some insight into the nature of the selected companies that were used in the study. The mean variable of 3.33% for TASSET on average is lower than those of OEXPENSES, GROSSE and PAT. This indicates the ability of some of the firms in using certain amount of low inputs to generate higher output and in turn generate higher profits.

The small standard deviation of company's total assets (TASSET) and the high standard deviation of operating expenses (OEXPENSES) show that the nature of total assets and operating expenses employed do differ much from each other as

the companies in the industry spends almost different amount on total assets and operating expenses respectively. The sampled companies can then be said to be different in their operating asset and expenses. But those of GROSSE and PAT are quite high and higher than those of TASSET (except for OEXPENSES). Again, the degree of variability among the data set is extremely high considering the difference between the maximum and the minimum values.

Technical and Scale Efficiency Scores of Quoted Conglomerate Companies in Nigeria

Here, we developed an efficiency score of 6 conglomerate firms in Nigeria within periods (2018 to 2019). The DEA efficiency scores generated is based on the following measures:

(i) DEA Overall technical efficiency score (CRS_TE): we compute this on the occasion that all firms are operating on their efficient frontier. It implies increase in inputs by 1% generates a corresponding 1% increase in output.
(ii) DEA pure technical efficiency score (VRS_TE): This occurs when the position of no constant increase or decrease is taken, in which an increase in DMUs' input by 1 % would cause more than 1% increase output. This score emphasizes managerial skill with respect to input-output ratio.
(iii) Scale efficiency (SCALE): This buttresses the CRS to VRS ratio. That is $\frac{CRS}{VRS}$

The results of the standard DEA technical efficiency estimate under CRS, VRS and scale efficiency (SCALE) score are given in table 4.2:

Table 4.2: *DEA Technical Efficiency Estimates*

S/N	Firm Names	Firms	CRS_TE	VRS_TE	SCALE	RANK
1.	John Holt Plc	dmu:1	0.778946	1.000000	0.778946	6
		dmu:2	1.000000	1.000000	1.000000	1
2.	A.G Leventis	dmu:3	1.000000	1.000000	1.000000	1
		dmu:4	1.000000	1.000000	1.000000	1
3.	Chellerams Plc	dmu:5	1.000000	1.000000	1.000000	1
		dmu:6	0.803963	0.804035	0.999911	8
4.	Scoa Nig. Plc	dmu:7	0.278077	0.304158	0.914250	11
		dmu:8	0.890632	0.890696	0.999928	7
5.	Transcorp T.C. of Nig. Plc	dmu:9	0.280137	0.548460	0.510771	10
		dmu:10	0.187253	0.236827	0.790674	12
6.	UAC of Nig. Plc	dmu:11	1.000000	1.000000	1.000000	1
		dmu:12	0.500022	0.564917	0.885125	9
"TE = Technical Efficiency"						

Source: Researcher's Computation Using Stata 13.0 (2020)

In the table, the results indicate that many conglomerate firms are technically efficient both under the CRS and VRS, respectively. Thus, a large proportion of the sampled conglomerate firms can generate same output outcome from increasing

input by the same proportion. This tends to increase technical economies of scale for large production and efficiency.

Specifically, it is found under CRS_TE, four (4) of the companies out of six (6) listed conglomerates is efficient as shown by their corresponding decision-making unit (dmu: 2 to 5 and dmu11). This implies that most listed conglomerates in Nigeria are technically efficient.

It revealed that operating expenses and total asset (that is, gross earnings and profit after tax) have been maximized by conglomerate firms in Nigeria to give a superior output. Put differently, these firms relatively used minimal input to achieve maximum output. Similarly, total asset and operating expenses of large firms are efficiently used to generate the highest possible income when compared to firms that are smaller in size of asset, and they are not efficient. From foregoing explanation, the null hypothesis that conglomerate firms are not technically efficient under CRS is rejected. Four (4) out of six (6) firms are efficient and this result is in tandem with that of Harun, Tahir and Zaharudin (2012) and Dadashi et al. (2013) in the literature.

DEA Variable Return to Scale (VRS) Technical Efficiency

It is noticed in table 4.2, on the strength of VRS_ET that 4 out of 6 conglomerate firms are efficient while two (2) are inefficient. The 4 DMUs that efficiently translate asset and operating expenses to achieve better output (that gross earnings and profit after tax) are; dmu:1 to dmu:3 and dmu11. This means that with zero slack, efficient DMUs succeeded in employing minimal inputs to achieve proportional better output when compared to other inefficient DMUs.

Similarly, large DMUs like dmu 9 is not efficient in transforming given level of input to outputs with respect to its asset base, but large DMUs like dmu:1, 2, 3 and dmu:11 showed their efficiency technically in transforming their corresponding inputs to outputs. It can be inferred that these firm's management are efficient in using relatively small resources input to achieve relative better income than their counterpart. Hence, the null hypotheses is rejected under the VRS assumption since 4 out of 6 sampled conglomerate firms are efficient which is in conformity with the findings of Eriki and Osifo (2014), Osamwonyi et al. (2016) and Chiang et al (2016) in the literature.

Scale Efficiency Results

Output must be raised further to most productive scale by firms, for the firm to be scale efficient. In Table 4.2, only dmu 2, to 5 and dmu11 are scale efficient. This implies that operating expenses and total assets of these firms were used to get better outputs in relation to earnings and net profits during the period under focus. Thus, the null hypothesis that all listed conglomerate companies in Nigeria are not scale efficient is rejected in this study. This means that listed conglomerate companies in Nigeria are scale efficient under both CRS and scale efficient assumptions. This result conforms to that of Chuweni and Eves (2017) and Isibor (2017) in the literature.

5. CONCLUSION AND RECOMMENDATIONS

This study employed indigenous DEA technique to empirically look at performance efficiency of listed conglomerate firms in Nigeria from 2017 to 2018. The study concludes that resource utilization of conglomerate firms in Nigeria is fairly efficient as 66.67% are VRS, CRS and SCALE efficient. These are strong signals that conglomerate firms Nigeria are relatively doing well, owing to the federal government conscious policies and financial attention to the real sector since 2016 to promote and revitalize the economy out of recession. Also, technological advancements and strong regulatory institutions in this sector are in the right direction. This study recommends that inefficient DMUs (Scoa and Transcorp) should bench race and mark efficient DMUs (John holt, A.G Leventis, Chellerams Plc and UAC of Nig) in the sampled data set. Greater managerial capacity is also required to enhance productive, allocative and scale efficiency. Finally, stable macroeconomic policies particularly with respect to stable interest rate and exchange rate are needed to curtail the increasing dimension of input prices to enhance output for rapid national growth and development.

REFERENCES

Abatania, L.N., Haliu, A. & Mugera, A. W. (2012). Analysis of Farm Household Technical Efficiency in Northern Ghana Using Boostrap DEA. Paper presented at the 56th Annual Conference of the Australian Agricultural and Resource Economics Society, Esplanade, February, 2013.

Ahmed, A.A. & Mohamad, A. (2017). Data Envelopment Analysis of Efficiency of Real Estate Investment Trusts in Singapore. *International Journal of Law and Management*, 3(2), 17-29.

Aigbovo, O, & Igbinoba, N.O. (2019). Efficiency of Listed Banks in Selected Sub-Saharan African Countries: A Data Envelopment Analysis Approach. *Dutse Journal of Economics and Development Studies (DUJEDS , 8*(2019), 241 – 261.

Anderson, R. I., Fok, R., Springer, T. & Webb, J. (2002). Technical Efficiency and Economies of Scale: A Non-Parametric Analysis of REIT Operating Efficiency. *European Journal of Operational Research, 139*(3), 598 – 612.

Cannon, S.E. & Vogt, S.C. (1995). REITs and Their Management: An Examination of Organizational Structure, Performance and Management Compensation, *Journal of Real Estate Research*, 10(3), 297-317.

Charnes, A., Cooper, W.W. & Rhodes, E. (1978). Measuring the Efficiency of Decision Making Units, *European Journal of Operational Research*, 2(1), 429-444.

Chiang, H.C., Tsaih, Y.C. & Hsiao, W. (2016). The Efficiency Analysis of Singapore Real Estate Investment Trusts. *Eurasian Journal of Business and Management*, 4(4), 9-20.

Choi, N. & Jung, K. (2017). Measuring Efficiency and Effectiveness of Highway Management in Sustainability. *Sustainability*, 9(1347), 2-15.

Chuweni, N.N. & Eves, C. (2017). A Review of Efficiency Measures for REITS and Their Specific Application for Malaysian Islamic REITS, *Journal of Islamic Accounting and Business Research*, 8(1), 41-53.

Coelli, T.J., Rao, D.S.P., O'Donnell, C.J., Battese, G.E. (2005). *An Introduction to Efficiency and Productivity Analysis.* US: Springer.

Dadashi, I., Zarei, S., Dadashi, B., Emamgholipour, M., Mansourinia, E & Hozoori, M (2013). A Data Envelopment Analysis of Banks Performance in Iran, *International Research Journal of Applied and Basic Sciences*, 4(9), 2422-2426.

Debreu, G. (1951). The Inefficiency of Resource Utilization, *Dan Econometrical*, 1(5), 273-292.

Edelstein, B., Paradi, J. C., Wu, A & Yom, P (2012). Bank Branch Grouping Strategy, an Unusual DEA Application, *Journal of Service Science and Management*, 5, 355-364.

Eken, M. H & Kale, S. (2011). Measuring Bank Branch Performance Using Data Envelopment Analysis (DEA): The Case of Turkish Bank Branches. *African Journal of Business Management*, 5(3), 889–901.

Eriki, P.O & Osifo, O (2014). Performance Efficiency of Selected Quoted Commercial Banks in Nigeria. *International Journal of Economics, Commerce and Management*, 2(9), 1-16.

Farrell, M.J. (1957). The Measurement of Productive Efficiency. *Journal of the Royal Statistical Society*, 120 (3), 253-281.

Finance Walk (2015). https://www.financewalk.com/industry-analysis/

Harris, J. A. (2012). Real Estate Investment Trust Performance, Efficiency and Internationalization. (Doctoral Dissertation, University of Central Florida). Retrieved from http://stars.library.ucf.edu/etd/2364

Harris, J.A. (2012). Real Estate Investment Trust Performance, Efficiency and Internationalization. *Electronic Theses and Dissertations*, 2(3), 64-79.

Harun, S.L., Tahir, H.M. & Zaharudin, Z.A., (2012). *Measuring Efficiency of Real Estate Investment Trust Using Data Envelopment Analysis Approach.* Paper presented at The Fifth Foundation of Islamic Finance Conference, IFIFC, Malaysia.

Helali, K., Tsagli, K & Kalali, M. (2014). Efficiency Impact of the Agricultural Sector on Economic Growth in Togo. *African Journal of Agricultural Research*, 9(42), 3139-3145.

Herrero, L.; Pascoe, S. (2002) Estimation of Technical Efficiency: A Review of some of the Stochastic Frontier and DEA Software, *Computer in Higher Education Review*, 5, 12-39.

Igbinovia, L.E. (2018). Data Envelopment Analysis and Industry Analysis: Evidence from the Agricultural Sector. Ph.D Seminar Presented in Banking and Finance Department, University of Benin, Nigeria. 2-18.

Isibor, E. (2017). Data Envelopment Analysis and Industry Analysis in Nigeria. Ph.D Seminar Presented in Banking and Finance Department, University of Benin, Nigeria. 1-22.

Iyoha, M. A. (2004). *Foreign Aid and Economic Development in Africa*. Macroeconomic: Theory and Policy, Mindex Press, Benin City.

Jajri, I. & Ismail, R. (2006). Technical Efficiency, Technological Change and Total Factor Productivity Growth in Malaysian Manufacturing Sector, *Journal of Management Sciences*, 2(3), 32-55.

Kang, H.H & Liao, K.C. (2009). A Study on the Feasibility of the Application of Portfolio Model on the Strategy of Diversification in Direct Investment. *NTU Management Review*, 5(4) 171-197.

Kokkinou, A. (2012). An Industry and Country Analysis of Technical Efficiency in the European Union, 1980 - 2005. Ph.D thesis, Department of Economics, University of Glasgow. https://theses.gla.ac.uk/3660/1/2012kokkinouphd.pdf

Koopmans, T.C. (1951) (Ed) *Activity Analysis of Production and Allocations*, New York: Wiley.

Lehmann, B. N. (1990). Fads, Martingales, and Market-Efficiency. *Quarterly Journal of Economics*, 105, 1-28.

Novickyte, L. & Drozdz, J. (2018). Measuring the Efficiency in the Lithuanian Banking Sector: the DEA Application. *International Journal of Financial Studies*, 6(37), 2 -15.

Ogieva, O.F. & Omoregbe, O. (2017). Measuring the Efficiency and Performance of Quoted Insurance Companies in Nigeria: Data Envelopment Analysis (DEA) Approach. *Annals of the University of Petroşani, Economics,* 17(1), 187-208.

Osamwonyi, I.O & Imafidon, K. (2016). The Technical Efficiency of Manufacturing Companies on the Nigerian Stock Exchange, *Journal of Applied Finance & Banking*, 6(1), 127-138.

Osifo, O. & Sibanda, M. (2018). Measuring Performance Efficiency of Listed Real Estate Investment Trust (REITS) in Sub-Sahara Africa. *Amity Journal of Corporate Governance*, 3(1), 44-54.

Ramanathan, R. (2003). *An Introduction to Data Envelopment Analysis: A Tool for Performance Measurement*, New Delhi: Sage Publishing, 4-38.

Rouse, P. (1996). *Alternative Approaches to the Treatment of Environmental Factors in DEA: An Evaluation*, Department of Accounting and Finance, University of Auckland.

Simone, G., Claudia, C. & Mancuso, P. (2008). New Evidence on the Efficiency of Italian Airports*:* A Bootstrapped DEA Analysis. *Knowledge and Process Management*, 15(4), 270-279.

Von, I. (2016). Farm Efficiency in Sweden: Evidence from DEA : *Swedish Journal of Agricultural Sciences*, 5(2), 71-90.

Weng, M.X. (2009). A Study on Technological Strategies of Enterprises, Governmental Policies to Encourage Research and Development of Enterprises, and Technological Innovation Performance of Enterprises, *Modern Management Monthly*, 5(3), 64-66

Wikipedia (2016). https://en.wikipedia.org/wiki/Economy_of_Nigeria

Yao, B. & Sumiter, B. (2007). Functional Forms of Stochastic Frontier Production Function and Models for Technical Inefficiency Effects, *Journal of Product Analysis*, 8(8), 395-414.

Zheng, X, Chau, K. & Hui, E.C.M. (2011). Performance and Efficiency Assessment of Listed Real Estate Companies: An Empirical Study of China. *International Journal of Strategic Property Management*, 15(2), 91- 104.