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TESTING PERFORMANCE EFFICIENCY OF DEPOSIT MONEY BANKS IN NIGERIA: DATA ENVELOPMENT ANALYSIS (DEA) APPROACH

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ABSTRACT

This paper empirically examined the performance and operating efficiency of commercial banks in Nigeria over a three-year period (2012-2014). It measured and established the efficiency in the Nigerian banking system and its variation pattern within the period under consideration.

Ten banks were systematically sampled for this study. The performance efficiency of banks were determined using input and output oriented Data Envelopment Analysis(DEA) window to analyze the performance changes through time, of the Nigerian banking system within the period.

Of the ten banks studied, we found that only UBA and Zenith Bank had pure technical efficiency - management skills was very relevant in converting small inputs to large outputs. The remaining eight (8) banks were found to be below the efficiency level - showing that while the banking system is running at full capacity, it has limited contribution to the economy in terms of efficiency. We therefore recommended that managers of inefficient banks in Nigeria as identified above should imitate and benchmark UBA and Zenith Bank.

INTRODUCTION

The importance of an effective and efficient banking system in the economic development of a country cannot be overemphasized. This is because commercial banks are the media for borrowing money used by factoring companies and the public, as well as the strategic executors of the government thereby stabilizing the financial order. When there is operation crisis in banks, domestic stable economy could be influenced resulting in public panic and economic recession. Indeed, the competitiveness of commercial banks is directly related to their efficient and productive use of resources.

Efficiency assessment of banks is an important issue, as it encompasses all business players, including managers, shareholders, and investors. It demonstrates how shareholders and investors interests are affected and it informs on whether existing banks resources are used effectively and efficiently, and motivate management to implement strategies for further improvements. Several non-performing loans in the past years have oppressed the operating efficiency of banks in Nigeria; the non-performing loan ratio of some banks is so high that the increasing operating risks and the decreasing profits could result in bankruptcy at any time.

With regard to the overall situation of banking industry in the past years, the government has issued Standards Governing the Establishment of Commercial Banks, proceeded financial system reform, opened to the establishment of new banks, and formulated regulations for trust companies reforming commercial banks that the financial market presents a fresh atmosphere and the monopoly of old banks is broken. The deregulation of financial businesses aims to enhance the operating efficiency of domestic banks and activate the financial market. Nevertheless, the competitiveness has not been obviously enhanced after the openness to private banks and the privatization of large-scale public banks, but the banking system has been eroded because of changes of market structure, fierce competition, or non-performing loans resulted from government- business relations and bad loan-quality.

Moreover, domestic banks will inevitably face greater impact in the 21st century, from the aspects of the functions, businesses, and operating methods or the changes of external environment. The former includes the business integration of securities, investment, insurance, and banking, the emphasis of businesses beyond the balance sheet, and the introduction of information technology, like electronic and automatic devices. The latter covers the increasing weight of direct finance and the takeover and merging of banks. On that note, it is imperative that commercial banks determine their recourse utilization efficiency in order to measure and evaluate their performance.

Various approaches have been used for this purpose, one of which is financial ratio analysis; financial ratios have been used as tools to plan and control firm activities and assess their efficiency. However, findings show that, they can only be an appropriated method when firms manage a single input to generate a single output. Financial ratio analysis does not provide sufficient information when considering the effects of economies of scale and estimation of overall efficiencies measures. Data Envelopment Analysis (DEA) has proven to be an essential tool, because it measures relative efficiencies by using multi-inputs and multi-

Outputs. The efficiency of decision-making units (DMUs) is evaluated by comparing its performance with the best performing unit. The best performing unit should lie down on the efficiency frontier. If the unit is not on the efficiency frontier, it is considered inefficient. This decision- making units can be different type such as: business firms, number of schools, hospitals, and banks. The original purpose of DEA was to evaluate the relative efficiency of non-profit organizations such as schools and hospital. However, business firms and industries also use it to analyze monetary values (Erkut & Hatice, 2007). This study introduces the data envelopment analysis model for assessing performance. To illustrate the merit of DEA, this study uses data of 10 commercial banks listed in the Nigerian Stock Exchange, which includes the effects of economies of scale, benchmarking firm efficiencies and quantitative guidance for further improvement.

STATEMENT OF THE RESEARCH PROBLEM

It is interesting to know that over the years, great improvement has taken place in the banking sector and they include increasing freedom for banks in their decisions and activities, the increase of (domestic) deposits over Gross Domestic Products (GDP), the increase in number of foreign financial and banking institutions, and so on. At the same time, however, there were several negative ones as well. The negative side may include the number of closed or merged banking institutions and the unstable nature of the system (through the liquidation crisis at the end of 2008 or the high non-performance loans ratio which have affected the earning power and operating efficiency of banks, etc.). These are the results of the operation of the banking sector itself as well as macroeconomic policy of the Government, especially the monetary and fiscal policy. It is regarded as a primary issue for the general deposit account holders and the shareholders earlier knowing the operating problems of banks needs to select correct and stable investment to ensure personal profits. Accordingly, it is essential to ascertain the performance and evaluate the overall operating efficiency of banks in Nigeria. This study therefore set to analyze the efficiency of the banking system in Nigeria and how its performance was affected by macroeconomic policy through the period of 2012-2014.

Besides, to the limited knowledge of the author, so far, there is still little or no research on the efficiency/performance of the banking sector in Nigeria using data envelopment analysis over the decades. It includes the lack of research from foreign researchers, who of course may find it difficult in accessing the data of Nigeria banks (it is always difficult to get any data from any financial institutions because these data are confidential – except things from the Annual reports). It also includes the lack of research from Nigerian researchers as well as methodologies for analyzing the performance of banks individually and banking system as a whole. Therefore, the aim of the paper is to provide an empirical research on the operating efficiency of the Nigerian banking system (as a whole) over three years (2012-2014) in order to see how efficient the banking system is, and how it change during the above period.

LITERATURE REVIEW/THEORETICAL FRAMEWORK

The concept of Efficiency

According to Agbonifoh (1999), efficiency is the ratio of input to output. Efficiency is in a general sense the degree of reaching the goal which has been aimed at including a movement

Or a behavior as much as possible. Efficiency can be calculated with the formula as shown below. Efficiency is equal to Standard Performance (Value) multiplied by Real Performance (actual value). Efficiency of a production unit can be described as the ratio between data, which has been observed, related to outputs and inputs, and is at optimum values. The goal of the production unit is to reach to a level which will be considered as optimum. Comparing data observed to optimum is made either by comparing maximum output as much as possible at a certain input level or by comparing minimum input as much as possible at a certain output level. (Zhu, 1996) Production efficiency lies at the base of productivity. In another description, efficiency is efforts that businesses have spent to reach the goals which they have determined and as a performance indicator and, determines to what extent this goal has been able to be achieved. Efficiency is part of productivity. Productivity is not a relative concept because productivity of every unit can be measured alone. Because efficiencies of decision units cannot be determined independent from each other in the production system where there are a lot of outputs and inputs, it becomes a relative concept. It is not necessary to make comparisons with other decision unit to measure productivity. However other decision units that will be taken as a reference to calculate efficiency are necessary. One of the important stages of efficiency measurements is to decide on correct reference units.

Operating efficiency or Performance is considered as an effectiveness indicator inspecting the firm competitiveness of an enterprise (Hu & Shieh 2013). Favorable Operating efficiency reflects the effective business model and industrial investment environment of the enterprise as well as the effectiveness of governmental policies. Many indicators have been utilized for measuring Operating efficiency of an enterprise, such as Return on Investment, Growth Rate, Turnover Rate, and even Stock Market Index. Such measuring criteria for Operating Performance are further introduced in this study. Kang and Liao (2009) pointed out the indicators for measuring return on investment of an enterprise being growth rate, turnover rate, liquidity ratio, and risk diversification capacity. Where there is higher return on Investment, growth rate, turnover rate, and liquidity ratio, then the better the operating efficiency of an enterprise will be, while the risks should be the smaller the better.

Chen (2010) measured performance with earnings per share, sales growth rate, and yield rate. Weng (2009) proposed technological innovation performance as a part of Operating efficiency, including product innovation performance and process innovation performance, which mainly measures R&D expenses, new product listing ratio, product cost reduction, or profit creation. Chiu (2010) evaluated the investment strategies and performance of enterprises in Taiwan with sales growth rate, profit rate, and employee turnover rate. Ma (2009) evaluated operating performance of an industry with revenue, stability, and operating capacity, where the major evaluation indicators focused on earning power, productivity, and management performance, covering profit rate, net profit margin, gearing ratio, total asset turnover rate, and employee productivity. There are plenty of indicators used for evaluating operating efficiency of an enterprise. In short, operating efficiency is present in finance, productivity, and technique, where finance and productivity are commonly utilized for measuring operating

Performance of an enterprise; and, the performance of the three indicators are closely related. The excellent performance of production and technique is apparent in financial profits. In fact, at macro level, we can analyze the efficiency of a banking system as a single entity by applying the X-efficiency definition. Thus, a banking system is defined as efficient if it can fulfill its missions of providing banking services and monitoring its stability. Therefore, its efficiency can be calculated by comparing the outputs (quantity and quality of banking services) and the inputs (financial investments to the banking system) through Data Envelopment Analysis (DEA), a popular and powerful tool of the nonparametric approach. By applying this idea, Ngo (2011) assumed that all researched countries use the same financial investment to provide ten outputs (including Assets of banking system, Credits provided by banking system, etc.) and conducted a cross-country effectiveness analysis for the global banking system. This fruitful study proposed that we can use DEA for macro data in the banking and financial sectors as well.

For individuals, researchers tend to focus more on efficiency evaluation but mostly at micro level. Nguyen (2007) conducted research on 13 commercial banks in Vietnam for the period of 2001-2003 and found that these banks were inefficient in both allocative (regulatory) and technical (managerial capacity) aspects, with technical inefficiency more serious. Nguyen and DeBorger (2008) enlarged the sample size to 15 commercial banks continuing to examine the technical efficiency of the Vietnamese banking system from 2003 to 2006. The authors showed that the productivity of these banks was on a decreasing trend. Nguyen, Giang, and Nguyen (2008) and Nguyen, Giang and Nguyen, (2010) expanded their research to 32 commercial banks (in the period of 2001-2005) through the slacks-based model DEA, and argued that there would be a room to improve the efficiency of those banks. This is consistent with Ngo (2010) and Vu & Turnel (2010), although the earlier applied DEA approach for the top-22 banks in Vietnam in 2008 and the latter applied a Bayesian SFA approach to investigate the Vietnamese banks in 2000-2006 periods.

DATA ENVELOPMENT ANALYSIS

Although DEA was initially developed by Charnes, Cooper and Rhodes (1978) (CCR) and by Banker (1984) (BCC) to evaluate the relative efficiency of similar economic production systems, studies that have been conducted to extend and apply the model have been numerous. Data Envelopment Analysis (DEA) is a nonparametric method for measuring the efficiency of a decision-making unit (DMU). Besides, DEA is a flexible method (Cook, Liang & Zhu, 2010; Tone & Tsutsui, 2010; Andre Herrero, & Riesgo, 2010 and Liu & Lu, 2010) that can be applied under different underlying economic assumptions and the returns to scale (Seiford & Zhu, 1999) yield different DEA models (Dula, 2002). For example, banks use labor and assets to generate deposits that are in turn used to generate load incomes. In such a setting, a DMU represents a two-stage process and intermediate measures exist in-between the two stages. The first stage uses inputs to generate outputs that become the inputs to the second stage. The first stage outputs are therefore called intermediate measures. The second stage then uses these intermediate measures to produce outputs. A key feature here is that the first stage's outputs are the only inputs to the second stage i.e. in addition to the intermediate measures, the first stage does not have its own outputs and the second stage does not have its own

Inputs. Recent expositions with this application can be found in Chen and Zhu (2004), Kao and Hwang (2008), Chen, Liang and Zhu (2009) and Cook, Liang and Zhu (2010). Application of the model has involved an efficiency assessment of the public sector (schools and hospital) because of their given inputs and outputs which are not measureable in unified units (Friedman & Sinuany-Stern, 1998; Wei et al. 2012). Similarly, it also has been used in efficiency evaluation of business and industries.

Friedman and Sinuany-Stern (1998) used the ranking method in DEA to rank industrial branches in Israel according to their level of efficiency and performance. Researchers used two methods based on multivariate statistics, such as canonical correlation analysis (CCA) and discriminant analysis of ratio (DR/DEA). The inputs used in the study were assets, labor cost and average wage gained by employees per hour of work; the outputs were the revenue and export revenue. Chandra et al. (1998) also used the DEA-CCR model to evaluate the efficiency of Canadian textile companies. The used inputs were the number of labor and average annual investment; whereas the used outputs were the annual sales values. Erkut and Hatice (2007) used the super slack based model of DEA with two inputs and three outputs to analyze the performances of 500 industrial enterprises in Turkey. The analysis result revealed that during 2003, only nine firms performed efficiently. El-Mashaleh et al. (2010) developed DEA with a CCR- oriented approach to benchmark the safety performance of 45 construction contractors. The authors demonstrated that after the research only eight contractors were considered to have superior safety performance.

Tahir and Yusof (2011) adopted the DEA-CCR and DEA-BCC with inputs-oriented assumptions to estimate the technical and scale efficiency of 14 Malaysian public listed companies. Two inputs and one output were used. The inputs employed were total expenses and total assets, and the output was sales revenue. The estimate result disclosed that only one company was relatively efficient. Joshi and Singh (2009) estimated the production efficiency of the ready-made garment industry using DEA technology. They considered the number of stitching machines and number of operators as inputs-variables and the number of garment pieces produced as output variables. The result revealed that, under constant returns to scale (CRTS), firms should increase their outputs by 25% with the existing level of inputs. Barros and Dieke (2007) evaluated the operational performance of 31 Italian airports using four data envelopment models. The types of model included: DEA-CCR, DEA-BCC, the cross- efficiency DEA model, and the super-efficiency DEA model. The outputs were measured by the number of planes, number of passengers, cargo, aeronautical receipts, handling receipts, and commercial receipts, and the inputs were labor costs, capital invested and operational costs. Liu et al. (2010) used DEA compared the relative efficiency of manufacturing companies of China and Turkey. They also used canonical correlation analysis, the same as the one conducted before (Friedman & Sinuany-Stern, 1998). The inputs variables included: the number of employees, inventory turnover, receivable turnover, total asset/total debt, cash flow, current ratio, and property plant and equipment/total asset, whereas the outputs variables included net income per employee, sales growth, net income per share, and EBIT margin. The results indicate that,

Chinese manufacturing firms are more highly efficient than Turkish manufacturing firms. In conclusion, these studies affirm the application of DEA to assess firm efficiency by undertaking various process and models. They also differ on number and type of inputs and outputs. This means that the test for best specification with respect to the most appropriate variable for DEA is not clear-cut.

Laughlin and Kean (2002) used DEA for benchmarking in strategic planning. In this study, the data was obtained and analyzed for comparing teaching and research activities in textiles and clothing programs. Chandra et al. (1998) used DEA to evaluate the performance of 29 Canadian textile companies using the Cooper and Rodes model. Goncharuk (2007) investigated the impact of political changes on industrial efficiency. Tongzon (2001) used DEA procedure to calculate the selected port efficiencies in Australia for which the output measures were taken as cargo throughput and ship working rate. Gonzalez and Trujillo (2008) applied DEA analysis in order to measure the efficiency and productivity in the port industry. Taymaz and Saatci (1997) investigated the rate and direction of technical change in three industries which were textile, cement and motor vehicles by using the technical efficiency level which was described as the ratio of its actual output level to the maximum possible output that could be produced by inputs utilized by the plant in the same period.

Alvarez and Crespi (2003) determined the factors that could explain the observed differences in technical efficiency and the factors lying beneath the differences such as experience of workers, modernization of physical capital and innovation in products. Jajri and Ismail (2006) analyzed the trends of technical efficiency, technological change and total factor productivity growth in the Malaysian manufacturing sector for which the data was taken from the Industrial Manufacturing Survey of 1985 to 2000 collected by the Department of Statistics Malaysia using Data Envelopment Analysis. Worthington (2001) measured inefficiency in education using DEA which was preferred to regression analysis that lacked the allowance for the tradeoff between different educational outcomes. The performances of the companies in the Turkish textile and apparel industry were evaluated by using DEA for several researchers so far in which the input and the output parameters were selected differently. By using input oriented model,

INPUT AND OUTPUT VARIABLES

According to Gunawan and Shieh (2014), Inputs/outputs in financial industry are not easily measured as those in manufacturing industry therefore the selection of inputs/outputs in various research on financial system performance evaluation is also distinct. For instance, Fukuyama and Weber (1999) considered 2 inputs (labor, real capital) and 2 outputs (brokerage income, underwriting business revenue); Wang et al. (2003) included 2 inputs (labor, floor area) and 3 outputs (brokerage income, self-employment income, underwriting business revenue); Zhang et al. (2006) used 3 inputs (labor reward, cost of capital, ownership equity) and 5 outputs (commission, margin loan profit, investment income, asset management income, total revenue); Fang and Hu (2009) applied 3 inputs (fixed assets, financial capital, general and administrative expenses) and 1 output (brokerage and self-employment trading market shares); and, Hu and Fang (2010) set 2 inputs (number of branches, commission discount) and 2 outputs

(Brokerage trading market shares0brokerage income). It is therefore considered that labor, constant assets, and borrowed funds are the basic inputs in a financial system for engaging in brokerage, underwriting, or self-employed securities businesses as well as dealing with financial and securities loan businesses and other businesses related to operation in order to acquire incomes and earn profits. The inputs and outputs are then set in this study, where the input variables include annual total assets, Equity (Share capital), and the output variables contain Net interest income and Gross earnings. Such input/output variables are defined as below.

INPUTS

Annual total assets (combination of annual fixed, current and intangible assets), Equity (Share capital)

OUTPUTS

Gross earnings (the total income that accrues from buying and selling and other business dealings with customers). Net interest income (the interest incomes related to dealing with financial loan businesses, loose bond, and other operation).

RESEARCH METHODOLOGY

The current study applied two DEA models with an output oriented version. The first model developed by Charnes et al. (1978) was called the CCR model. The second model was named the BCC model, developed by Banker (1984). The CCR model is built on the assumption of constant returns to scale (CRS), whereas the BCC model is built on the assumption of variable returns to scale (VRS). The relative efficiency evaluated by the CCR model is the overall efficiency score and the one estimated by the BCC model is the pure technical efficiency score. These scores are typically defined on the interval [0, 1].

THE CCR MODEL

According to Charnes et al. (1978), the fractional form of the CCR linear programming model is given as follows:

$$\eta_o MA = \frac{\sum_{r=1}^{S} U_r Y_r o}{\sum i \epsilon ID \, {}^{V}{}_{I} X_{io}}$$

Subject to

$$\frac{\sum_{r=1}^{S} U_r Y_{rj} - \sum i \epsilon I_F \, Vi(x_{ij} - x_{io})}{\sum i \epsilon ID \, {}^{V}{}_{i} X_{io}} \quad < \quad J \epsilon [1 \ldots\ldots N]$$

$U_r \, V_{i} > \epsilon >$ for $r \epsilon [1 \ldots\ldots S]$ and $i \epsilon I_D$

$Vi > 0$ for $i \epsilon \, I_F$

Where u and v are the weights of the input and output, i and rare output and input of DMU. According to Liu et al. (2010), the model is difficult to solve because of its fractional model. Therefore, the dual liner model is required to reduce the number of constraints and facilitate solving the linear problem. However, the model is modified based on the Cooper's modification

$$\text{Max } \phi_O + \varepsilon\left[\sum_{r=1}^{S} S^-_{ro} + \sum_{r=1}^{M} S^+_{io}\right]$$

Subject to

$$\sum_{J=1}^{N} \gamma_j y_{rj} - S^-_{ro} = \phi_O y_{ro}, \; r\epsilon[1.....S]$$

$$\sum_{J=1}^{N} \gamma_j y_{ij} + S^+_{io} = x_{io}, \; i\epsilon\,[1.....M$$

$$\phi_o, \gamma_j, S^-_{ro}, S^+_{io} > O$$

Where, $\phi_O$is the measure of efficiency of the DMU "O" in the set of j =1, 2.....n DMUs rate related to other, ε is e an infinitesimal positive number used to make both the input and output coefficients positive; $S^-_{ro}$is the slack variables for input constraints, which are all constrained to be nonnegative, and S^+_{io} is the slack variables for output constraints, which are all constrained to be non-negative. γ_j is the dual weight assigned to DMUs.

THE BCC- MODEL

According to Banker (1984), the BCC-model enables expression of the (input) technical efficiency measure for DMU. Thus, it has the same equation employed in the CCR-model, but with convexity constraint for modification.

$$\text{Max } \phi_O + \varepsilon\left[\sum_{r=1}^{S} S^-_{ro} + \sum_{r=1}^{M} S^+_{io}\right]$$

Subject to

$$\sum_{J=1}^{N} \gamma_j y_{rj} - S^-_{ro} = \phi_O y_{ro}, \; r\epsilon[1.....S]$$

$$\sum_{J=1}^{N} \gamma_j y_{ij} + S^+_{io} = x_{io}, \; i\epsilon\,[1.....M$$

$$\sum_{J=1}^{N} \gamma_{j=1}$$

$$\phi_o, \gamma_j, S^-_{ro}, S^+_{io} > o$$

DATA ACQUISITION AND VARIABLES

Data for this study were obtained from the database of the Nigerian Stock Exchange which contains the annual report and financial statement of commercial banks for the period of 2012 to 2014. The choice of the year is based post IFRS accounting standards. The data obtained from the annual report consist of commercial banks. 10 banks were chosen from the twenty existing commercial banks. The banks are First bank of Nigeria Plc, United Bank for Africa Plc, Guaranty Trust Bank Plc, Zenith Bank Plc, Access Bank Plc, Diamond Bank plc, Fidelity Bank plc, FCMB plc, Stanbic IBTC and Union Bank Plc.

DMUs No	SAMPLED BANKS
1	ACCESS
2	DIAMOND
3	FIDELITY
4	FIRST BANK
5	FCMB
6	GTB
7	STABIC IBTC
8	UBA
9	UNION
10	ZENITH

Source: Author's computation (2016)

Data were sourced from the Annual Reports and Accounts of the banks in the sample. The justifications for banks in the sample include;

- The banks under review have been largely homogenous to the extent that their ownership structures are significantly unaffected by the spate of mergers and acquisitions that characterized the revolution in commercial banking in Nigeria since 2004 and 2015.
- The ten banks relatively account for over fifty percent of the total deposit liability in the industry. As at December 2015, the total deposit in the industry was about N10.99 trillion, out of which the ten selected banks accounted for N6.17 trillion, representing 56.13% of the total deposit.
- In terms of credit score ratings, the banks have moved from stability to the positive credit rating as of the January 2016 rating (Fitch, Standard and Poors, & Agusto and Co.).
- The banks have a large customer base and are active players on the Nigerian Stock Exchange (NSE).

A commonly held view of previously conducted studies is that specification of the most appropriate variable for the DEA program is not clear-cut. Therefore, this study specified the annual total assets (X1), Equity (Share capital) (X2) as two inputs, whereas the outputs are annual total gross earnings (Y1) and net interest income (Y2).

DATA PRESENTATION AND ANALYSIS OF RESULT

In this study we used two inputs and outputs to measure the relative bank performance efficiency of the sampled 10 banks in Nigeria.

TABLE 1: DEA DATA AND VARIABLES

OUTPUT	INPUT
Net interest income	Total Asset
Gross earnings	Equity (Share capital)

We use DEA analysis. In this study the bank performance efficiency scores of the sampled banks will be computed by the DEA and DEA Frontier Software will be used to perform the calculation. The input and output adopted in this study clearly shows that our focus is on the performance efficiency of Nigerian banks in terms of how well the banks can convert total asset and equity input into profit measured as gross earnings and net interest income. The choice of the above outputs was based on the assumptions that they are not suggested to management earnings manipulation. Following the above, is table 3, is the descriptive statistics of the selected banks output and input variables.

TABLE 3: DESCRIPTIVE STATISTICS FOR DEA INPUT AND OUTPUT VARIABLES

	TOTAL ASSET	EQUITY	NET INTEREST INCOME	GROSS EARNINGS
STATISTIC	**INPUT**		**OUTPUT**	
Mean	706,408	10,230	32,740	87,342
Standard Dev	546,642	8,881	27,007	62,538
Minimum	75,696	3,010	3,473	18,561
Maximum	2,033,204	44,722	98,435	214,400
SAMPLE	10	10	10	10

Source: Author's computation (2016)

The descriptive statistics in table 3, shows that the sampled mean of the 10 banks for the period of 2012 to 2014 fiscal year, in terms of total asset was N706,408 million, equity was N10,230, gross earnings was N87,342 while net interest income stood at N32,740 million. The sample mean results shows that banks like First Bank (N2,033,204 billion), GTB (N1,072,362 billion), UBA (N1,562,112 billion), Union Bank(N1,015,528 billion) and Zenith (N1,686,915 billion) had total asset that were far above the sampled peer banks average of N706,408 million as at 2009. This implies that the Mega Banks in Nigerian in terms of asset base were First Bank, GTB, Union bank, UBA and Zenith Bank and any possible slack or under-utilization of their total asset would serious impair their rating compared to their peers in the industry. The minimum and maximum values as shown in table 2 and with reference to table 1, shows that the bank with the highest total asset was First Bank. On the output side, the average net interest income of the sampled 10 banks stood at N32, 739 million. The bank with the highest net interest income was Zenith Bank (N98, 435 million). In terms of gross earnings, fidelity bank (N18, 561

million) recorded the lowest. In the light of our analysis so far, it would be difficult to ascertain the efficiency of these banks in terms how well they have use their asset and equity input to generate gross earnings and net interest income. This single problem necessitated the need for DEA analysis since descriptive statistics cannot show their relative performance in context of weighted inputs and outputs.

The performance efficiency scores that were generated from the DEA methodology is based on the three efficiency measures; (1) **DEA Overall technical efficiency score (CRS):** This is obtained when we assume a constant return to scale for all the sampled banks. This implies increases in bank input (total asset and equity) by 1% would lead to a 1% increases in its output (gross earnings and net interest income). These neglect management skills in converting small inputs to large outputs. (2) **DEA Pure technical efficiency score (VRS):** This is obtained when we assume a variable return to scale for all the sampled banks. This implies increases in bank input (total asset and equity) by 1% would lead to more than 1% increases in its output (gross earnings and net interest income). This focus on measuring the extent management skills was relevant in converting small inputs to large outputs and (3) **Scale efficiency score (SCALE):** This is the ratio of constant return to scale to variable return to scale (CRSE/VRSE).

CRS DEA Results

The DEA models involved in assessing the performance of the selected 10 banks were solved using DEA Frontier software. The "overall" technical efficiency score (i.e technical efficiency relative to the CRS DEA model) for each of the 10 banks is presented in table 3. Also presented in the table are the referenced efficient banks (peer) sets for inefficient banks as well as frequency with which a particular bank appears in the efficient sets of other banks. The CRS DEA model is based on the assumption of constant return to scale for all the sampled banks. This implies increases in bank input (total asset and equity) by 1% would lead to a 1% increases in its output (gross earnings and net interest income). These neglect management skills in converting small inputs to large outputs. The CRS DEA results are presented in table 4 and discuss below;

TABLE 4: TECHNICAL EFFICIENCY SCORES OF THE 10 SAMPLED BANKS BASED ON CRS DEA MODEL

DMU No	COMPANIES	TEcrs	RTS
1	ACCESS	0.48402	IR
2	DIAMOND	0.42474	IR
3	FIDELITY	0.23687	IR
4	FIRST BANK	0.52645	IR
5	FCMB	0.37327	IR
6	GTB	0.72823	DR
7	STABIC IBTC	0.61361	IR
8	UBA	0.96646	DR
9	UNION	0.79138	IR
10	ZENITH	0.94845	DR

Source: Author's computation (2016)

In the table 4 above, we found that on the basis of CRS Technical efficiency scores (**TEcrs)**, that none of banks out of the 10 sampled banks were efficient. This means that most Nigerian banks are technically inefficient. That is they were not able to use their total asset and equity input to generate better outputs (i.e gross earnings and net interest income). This means that they used fewer inputs to produce relative better output. In the same results we also observed that most of the Mega banks in Nigeria were seriously inefficient in converting their large total asset and equity to income as compared to some of their peers that had small asset and equity inputs. Table 5, below shows the inputs and output slacks in the inefficient banks;

TABLE 5: INPUTS AND OUTPUTS SLACKS OF THE 10 SAMPLED BANKS BASED ON CRS DEA MODEL

DMU No.	DMU Name	Input Slacks		Output Slacks	
		TOTAL ASSET	EQUITY	NET INTEREST INCOME	GROSS EARNING
1	ACCESS	0.00000	0.00000	0.000000	16737
2	DIAMOND	0.00000	0.00000	0.00000	7549
3	FIDELITY	0.000000	0.00000	0.00000	5061
4	FIRST BANK	468933	0.00000	0.00000	0.000000
5	FCMB	0.000000	0.00000	0.00000	6023
6	GTB	95042	0.00000	0.00000	0.00000
7	STABIC IBTC	0.000000	0.00000	0.00000	16402
8	UBA	487134	0.00000	0.00000	0.00000
9	UNION	469103	0.00000	13589	0.00000
10	ZENITH	351118	0.00000	0.00000	20430

Source: Author's computation (2016)

In the table 5 above, we found that on the basis of input slacks that all the mega banks in the Nigeria had serious total asset slack or under-utilization and this was largely responsible for their relative poor performance in generating better income compared to some of their peer banks. Among the mega banks, Union Bank had the highest total asset slacks of N469,103 million while Zenith Bank had the least total asset slack (N351, 118 million).

Following the above analysis, we therefore suggest that hypotheses one **(H1; All Nigerian banks are technically inefficient under a constant return to scale assumption)** in this study should be accepted.

VRS DEA RESULTS

The "pure" technical efficiency score (i.e technical efficiency relative to the VRS DEA model) for each of the 10 banks is presented in table 5. Also presented in the table are the referenced efficient banks (peer) sets for inefficient banks. The VRS DEA model is based on the assumption of variable return to scale for all the sampled banks. This implies increases in bank input (total asset and equity) by 1% can lead to a more than 1% increases in its output (gross earnings and net interest income). This implies that management skills in converting small

inputs to large outputs are captured by the VRS DEA model. The VRS DEA results are presented in table 6 and discuss below;

TABLE 6: TECHNICAL EFFICIENCY SCORES OF THE 10 SAMPLED BANKS BASED ON VRS DEA MODEL

DMU No	COMPANIES	TEvrs
1	ACCESS	0.59609
2	DIAMOND	0.55167
3	FIDELITY	0.36813
4	FIRST BANK	0.53458
5	FCMB	0.56449
6	GTB	0.73505
7	STABIC IBTC	0.71522
8	UBA	1.00000
9	UNION	0.94389
10	ZENITH	1.00000

Source: Author's computation (2016)

In the table 6 above, we found that on the basis of VRS Technical efficiency scores (**TEvrs)**, that two (2) banks out of the 10 sampled banks were efficient while 8 banks were found to be inefficient. The two banks (2) efficient banks that were able to use their total asset and equity input to generate better outputs (i.e. gross earnings and net interest income) are; UBA plc and Zenith Bank plc. This implies that these banks used fewer inputs to produce relative better output compared to other sampled banks. In the same results but on the VRS DEA model, we also found out that some Big banks with huge total asset base like UBA and Zenith Bank were found to be efficient in converting their given inputs to outputs when compared to other mega banks like First Bank, GTB and Union bank. This in other words, means that management of these two banks was successful in using their relatively small input resources to generate income was relatively better than other peer banks. In the same results we also observed that some of the Mega banks in Nigeria based on the VRS DEA model were also inefficient in converting their large total asset and equity to income as compared to some of their peers that had small asset and equity inputs, thereby creating from asset slacks or under-utilization. Table 7, below shows the inputs and output slacks in the inefficient banks under VRS DEA model;

TABLE 7: INPUTS AND OUTPUTS SLACKS OF THE 10 SAMPLED BANKS BASED ON VRS DEA MODEL

DMU No.	DMU Name	Input Slacks		Output Slacks	
		TOTAL ASSET	EQUITY	NET INTEREST INCOME	GROSS EARNING
1	ACCESS	0	0.00000	0	1166
2	DIAMOND	0	0.00000	313	0

3	FIDELITY	0	0.00000	0	16444
4	FIRST BANK	454097	0.00000	1836	0
5	FCMB	0	0.00000	0	3372
6	GTB	7467	0.00000	0	0
7	STABIC IBTC	0	0.00000	0	27954
8	UBA	0	0.00000	0	0
9	UNION	380856	0.00000	26166	0
10	ZENITH	0	0.00000	0	0

Source: Author's computation (2016)

In the table 7 above, we found that on the basis of input slacks that only a few of the mega banks in the Nigeria still had serious total asset slack or under-utilization under the VRS DEA assumption and this can be attributed to the failure of their management in successfully using the large input resources to generating better income compared to some of their peers banks. Among the mega banks, Union Bank, GTB and First Bank still experienced total asset slacks (see table 7). The VRS DEA slacks results also shows that Mega banks like UBA and Zenith bank under the context of management, had successful mangers that were able to reduce total asset idleness or slacks. The output slacks for these banks in terms of net interest income and gross earnings in reported in table 7.

Following the above analysis, we therefore suggest that hypotheses two **(H2; All Nigerian banks are purely technically inefficient under a variable return to scale assumption)** in this study should be rejected since we found two banks among our sampled banks to be efficient.

SCALE EFFICIENCY DEA RESULTS

Following the above, we learned that overall technical efficiency (CRS DEA model) is based on relative efficiency in terms of using the right scale of operation without consideration for managerial skill while the pure technical efficiency (VRS DEA model) shows the success of bank management at input to output "conversion". The scale efficiency which is the ratio of overall technical efficiency (TEcrs) to pure technical efficiency (TEvrs) measures how much a bank can improve its efficiency by being projected from VRS to CRS, that is the ability of further increasing its outputs radically, it reflect the efficiency of the bank irrespective of whether it operate the at the right returns to scale or not. For a bank to become scale efficient it should increase its output further to reach the most productive scale size. In the table 8 below, we found that on the basis of scale efficiency scores (**TEcrs/TEvrs)** that none of banks out of the 10 sampled banks were scale efficient. This means that no banks were able to use their total asset and equity input to generate better outputs (i.e gross earnings and net interest income) under both VRS and CRS DEA assumptions. The results of the scale efficiency are presented in Table 8 below;

TABLE 8: SCALE EFFICIENCY SCORES OF THE 10 SAMPLED BANKS BASED ON DEA MODEL

DMU No	COMPANIES	Overall technical efficiency Input-oriented Tecrs	Pure technical efficiency input-oriented Tevrs	Scale efficiency (TEcrs/TEvrs)
1	ACCESS	0.48402	0.59609	0.812
2	DIAMOND	0.42474	0.55167	0.770
3	FIDELITY	0.23687	0.36813	0.643
4	FIRST BANK	0.52645	0.53458	0.985
5	FCMB	0.37327	0.56449	0.661
6	GTB	0.72823	0.73505	0.991
7	STABIC IBTC	0.61361	0.71522	0.858
8	UBA	0.96646	1.00000	0.966
9	UNION	0.79138	0.94389	0.838
10	ZENITH	0.94845	1.00000	0.948

Source: Author's computation (2016).

Following the above analysis, we therefore suggest that hypotheses three **(H3; All Nigerian banks are scale inefficient)** in this study should be accepted since we found no banks among our sampled banks to be efficient under both constant and variable return to scale assumptions.

CONCLUSION AND RECOMMENDATIONS

This study provides a framework for DEA application in determination and comparison of efficiency performance in an industry level. We were able to analyze those of banks whose information were obtained from the database of the Nigerian Stock Exchange. Efficient banks were determined by using input and output oriented DEA model. Only United Bank for Africa (UBA) and Zenith Bank were found to have pure technical efficiency meaning that management skills was very relevant in converting small inputs to large outputs while the remaining 8 banks were found to be below the efficiency level. According to the research results, several domestic banks present continuous loss because of unfavorable Operating Performance. A thorough analysis of the problem shows that unfavorable Operating Performance and increasing risks of bankruptcy are mostly responsible for decreasing profits of banks in Nigeria. In a general sense, inefficient banks must consider their non-interest expenses, their interest expenses seriously. DEA appears to be a strong method that would be used to measure relative performances of decision making units. DEA is a model which determines efficient ones from among decision making units which were included into the study and produces values regarding betterments which are needed to be done in their parameters for inefficient decision making units to become efficient. Therefore, it is necessary to consider the choice of decision making units which will be included into the study after parameters to be compared are determined. The result derived from the DEA approach shows that only United Bank for Africa (UBA) and Zenith Bank achieved an acceptable overall level of efficiency during the testing period, with an

Average (TEvrs) efficiency of 1.0000 each. The slack variable analysis identified possible ways to improve the performance of those inefficient firms. The results show that reduced investment in fixed assets followed by more non-operating revenue creation is the most effective method for improving the operational performance of inefficient firms. Frontier analysis enables us to estimate the target for measuring and explaining the determinants of each firm performance, including the assessment of effect of economies of scale and an overall objective numerical score. Frontier analysis also suffers from drawbacks, which is the reason further research is needed with other input and output factors. The findings of this study can hopefully benefit managers of inefficient companies to help them restructure their organizational scope and business style and review resource utilization for improving their performance and efficiency.

It is therefore recommended that managers of inefficient banks in Nigeria as identified above should imitate and benchmark United Bank for Africa (UBA) and Zenith Bank which have pure technical efficiency by urgently and necessarily engaging in actions and activities that in addition to passively preventing malpractice must also actively increase profits. Besides, the financial policies of the government should prevent financial institutions from problems, try to establish the profits of banks and create the enabling environment for them to make profit which is the primary reason for their existence. In accordance with the regulations and other mechanisms(such as deposit insurance), the financial supervisory units could properly, accurately and continuously expose the operating conditions of banks to reach the information transparency. In this case, banks with favorable operating conditions could acquire better transaction conditions and opportunities; the public and enterprises could well select banks to reduce the uncertainties when making decisions; and, the government could release some duty for bank supervision and management to the market constraints. The banks therefore could be automatically segmented by virtue of their level of operating conditions, their systematic risks, and the supervision pressure could be reduced so that the operating efficiency of the financial market could be fundamentally enhanced. Therefore, continuous development and restructuring of financial institutions in Nigeria is important to finance the capital needs of the economy now and in the near future. Regarding macroeconomic policy such as monetary and fiscal policy, we suggests that Nigerian banking system may work better under tighten monetary and/or loosen fiscal policy regimes Moreover, the results were enriched with the additional analysis of input excesses and output shortfalls by expanding the study to cover the factors lying beneath the inefficiencies. Within these regards, DEA is a suitable tool to make performance evaluation and to compare the performances of industries thus enabling decision makers to better analyze the situation.

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