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Research Paper

Pure and Scale Efficiency Change Consideration of Banking Industry in Nigeria

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ABSTRACT:- This paper evaluates the pure and scale efficiency change consideration of banking industry in Nigeria between 2003 and 2011. It is also anchored on the research measuring the relative efficiency change of Nigerian banks on pure and scale efficiency term. The study used Malmquist Productivity Index (MPI) to generate scores for both pure and scale efficiency change. The results indicate that the average level of the pure efficiency change (Pech*)* had gone up in a slight manner significantly from 0.999 in the year 2003 to 1.001 in year 2011 meaning that there is slight relative ability of banking operators to converts inputs into outputs. Reverse is the case for the scale efficiency change where in the year 2003 the score rose a little above the frontier at 1.005 but came down to 1.003 meaning that banking operators have been struggling to make use of the advantage of large scale production. The pure and scale efficiency change rose above the status quo in the years 2004, 2006 and 2010 whereas other years operated below the frontier i.e. 2003, 2005, 2007, 2008, 2009 and 2011respectively.

Keywords:- Malmquist index, pure efficiency change, scale efficiency change

I. INTRODUCTION

Banks, as financial intermediaries, provide various services for depositors and borrowers. They provide liquidity and safekeeping for savings, which allows depositors to smooth consumption over time. They also conduct credit analysis, disburse loans and monitor outstanding credits for borrowers who require more financing than they can generate from internal sources or from alternative sources of finance such as financial markets (Berger & Humphrey, 1993). And as a result of the aforementioned importance, firms in the developing countries depend heavily on bank lending to finance their business activities being recognized for its role as a channel of monetary policy transmission due to the under-developed capital market. Therefore, efficiency of the banking system remains an important issue in developing countries to guarantee the smoothness of the monetary policy transmission process and also to provide better pricing and services to the banking customers, meaning that an efficient financial sector is necessary for the optimal use of financial resources of the country. Financial sector in Nigeria has evolved from the state of nothingness. Now Nigerian financial sector consists of commercial banks, micro finance banks, discount houses, housing finance companies, stock exchanges and insurance companies. In the financial sector of Nigeria, commercial banks are important component of the financial sector and play an important role in the financing of national economy. A modern and growing developing country requires a modern banking sector to tackle the needs of the country (Zaidi, 2005). In an emerging economy like Nigeria, the issue of the efficiency of commercial banks becomes very important. The term "efficiency" is a relative concept. For example, the efficiency of the banks in 2006 could be measured relative to 1996 efficiency or it could be measured relative to the efficiency of another bank in 2006. These measurements provide a framework within which commercial banks performance can be measured. This paper estimates pure and scale efficiency of profits of commercial banks operating in Nigeria and evaluates the marginal contribution of various inputs to the level of pure and scale efficiency of the banks. Fare et al. (1994) used an enhanced decomposition of the Malmquist index by decomposing the efficiency change component calculated relative to the CRS technology into a pure efficiency component (calculated relative to the VRS technology) and a scale efficiency-change component which captures changes in the deviation between the VRS and CRS technology. The subset of pure efficiency change measures the relative ability of operators to converts

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inputs into outputs while scale efficiency measures to what extent the operators can take advantage of returns to scale by altering its size towards optimal scale.

II. STATEMENT OF THE PROBLEM

In a situation where banks provide additional or higher quality services, costs rise but revenues may increase by more than the cost increase. Looking at efficiency from either the cost minimization or revenue maximization perspective fails to capture the goal of banks to maximize profits by raising revenues as well as reducing costs and does not account well for unmeasured changes in output quality (Berger & Mester, 1997).

III. OBJECTIVE OF THE STUDY

- To evaluate the pure and scale efficiency change of Nigerian banking industry
- To measure the relative efficiency change of Nigerian banks

IV. REVIEW OF EMPIRICAL LITERATURE

There have been several studies analyzing banks scale and pure efficiency change in Nigeria and other countries of the world. Below are some of the related literature that are mostly picturing efficiencies of banks

Santos (2007) examined the Malmquist index and technical efficiency scores of Philippine commercial banks for the post-crisis period employing data envelopment analysis (DEA) approach. Using a balanced panel of 35 banks, the time-varying Malmquist index shows that on average, banks improved their productivity by 4.6% annually from 1998 to 2005.

Muhammad, Khizer and Shama (2010) employed data envelopment analysis (DEA) to estimate the relative efficiency of 12 commercial banks of Pakistan. The results of this study offer some very constructive managerial insights into evaluation and advancing of banking operations. The estimated result shows that 6 banks are relatively efficient when their efficiency is measured in terms of 'constant return to scale' and 8 banks are relatively efficient when their efficiency is measured in terms of 'variable return to scale'. By improved handling of operating expenses, advances, capital and by boosting banking investment operations, the less efficient banks can successfully endorse resource utilization efficiency.

Sufian (2004) utilised the non-parametric frontier approach, Data Envelopment Analysis (DEA), to analyse the technical and scale efficiency of domestic incorporated Malaysian commercial banks during the merger year, pre-and post-merger period. We found that Malaysian banks have exhibit a commendable overall efficiency level of 95.9% during 1998-2003 hence suggesting minimal input waste of 4.1%. Our results suggest that the merger programme was successful, particularly for the small and medium size banks, which have benefited the most from the merger and expansion via economies of scale. On the other hand our results suggest that the larger banks should shrink to benefit from scale advantages.

Ali, Can and Tarik (2002) examined productivity changes in the Kuwaiti banking industry and their underlying components over a four-year period (1994-1997). Results from the Malmquist index reveal that there has been a substantial increase (about 28%) in the productivity of Kuwaiti banks, which is mainly attributable to technological improvement (innovations in banking technology).

Fadzlan (2010) the paper employed the data envelopment analysis (DEA) method on quarterly data to construct the efficiency frontiers. The Malaysian banking sector is used for a case study. The results show that the Malaysian banking sector has exhibited the mean technical efficiency of 97.3%, suggesting the minimal input waste of 2.7%. The empirical findings suggest that the pure technical efficiency outweighs the scale efficiency in determining the Malaysian banking sector's technical efficiency. The results imply that, although the Malaysian banking sector has been efficient in managerial terms, it has been operating at a non-optimal scale of operations.

Krishnasamy et al. (2004) are among the first to examine the total factor productivity change in the Malaysian banking sector by employing the Malmquist Productivity Index (MPI), they have found that during the period 2000 2001, post-merger Malaysian banks exhibited a total factor productivity growth of 5.1%. They suggested that the merger programme among the domestic banks has not resulted in a better scale efficiency of Malaysian banks as all banks, except two, exhibited a scale efficiency regress.

Izah, Nor Mazlina and Sudin (2009), evaluated the efficiency of Malaysian banks using data envelopment analysis. Overall, pure technical and scale efficiencies were estimated for seven years, during 2000-2006. The results suggested that domestic banks were relatively more efficient than foreign banks. The results also suggested that domestic banks' inefficiency were attributed to pure technical inefficiency rather than scale inefficiency. In contrast, foreign banks inefficiency is attributed to scale inefficiency rather than pure technical inefficiency.

Chan (2011) examined the technical efficiency of commercial banks in China during the period 2001-2007 by employing the non-parametric approach, namely, Data Envelopment Analysis (DEA). Technical efficiency is

furthered decomposed into pure technical and scale efficiency to determine the sources of inefficiency of the commercial banks in China. Results found that commercial banks in China on average are relatively technically inefficient. In addition, technical inefficiency of the commercial banks in China has its origin in pure technical inefficiency. This means that the commercial banks are facing problem in the allocation of resources between its input and output mix.

V. METHOD OF DATA ANALYSIS

The Malmquist index (MI) evaluates efficiency change over time. It is measured as the product of catch up or recovery and frontier-shift or innovation terms, both coming from the DEA technologies. The concept of Malmquist productivity index, introduced by Malmquist (1953), It is an index representing total factor productivity (TFP) growth of a bank or decision-making unit (DMU). Since it is difficult to capture all the elements of TFP, the term multi-factor productivity (MFP) is used instead in this paper, reflecting progress or regress over time under the multiple inputs and multiple outputs framework. The first component of MI, the catch-up effect, is determined by the efficiencies being measured by the distances from the respective frontiers and is given by Equation 1.

$$Equation\ 1: \qquad C = \frac{\delta^t((x_0,\ y_0)^t}{\delta^s((x_0,y_0)^s)}$$

The notation is as follows: *x* and *y* represent the input and output vectors, respectively. Catch-up effect does not allow for the inclusion of input prices, hence the score computed is technical and not allocative efficiency. The subscript $_0$ designates the DMU number; and, δ^s and δ^t represent the efficiency score for periods *s* and *t* frontier technologies, respectively. Hence, catch-up effect, C, is measured by the ratio of the efficiency of $(x_0, y_0)^t$ with respect to period *t* technological frontier and the efficiency of $(X_0, y_0)^s$ with respect to period *s* frontier. When C>1, it indicates progress in the relative efficiency from period *s* to *t*, while C=1 and C<1 indicate no change and regress in efficiency, respectively. The catch-up effect is also termed as efficiency change or recovery in the literature. It can be further decomposed into its pure efficiency change (Pech) and scale efficiency change (Sech) components. On one hand, the pure efficiency change is relative to the variable return to scale (VRS) frontier and given by Equation 2. On the other hand, the scale efficiency change component is actually the geometric mean of two scale efficiency measures, given by Equation 3. The first is relative to the period *t* technology and the second is relative to period *s* technology. The extra subscripts *v* and *c* relate to the VRS and CRS (constant returns to scale) technologies, respectively.

$$Equation\ 2:\ Pech = \frac{\delta_v^t(x_0,y_0)^t}{\delta_v^s(x_0,y_0)^s}$$

$$Equation\ 3:\ Sech = \left[\frac{\delta_v^t\ (x_0,y_0)^t\ /\ \delta_c^t(x_0,y_0)^t}{\delta_v^t(x_0,y_0)^s\ /\ \delta_c^t(x_0,y_0)^s} \times \frac{\delta_v^s(x_0,y_0)^t\ /\ \delta_c^s(x_0,y_0)^t}{\delta_v^s(x_0,y_0)^s\ /\ \delta_c^s(x_0,y_0)^s}\right]^{1/2}$$

The second component of MI is the frontier shift (innovation) effect or technological change. It is taken into account in order to fully evaluate the productivity change since the catch-up effect is determined by the efficiencies being measured by the distances from the respective frontiers. The frontier shift effect is given by the formula:

$$Equation\ 4: F = \left[\frac{\delta^s((x_0,\ y_0)^s}{\delta^t((x_0,y_0)^s)} \times \frac{\delta^s((x_0,\ y_0)^t}{\delta^t((x_0,y_0)^t)}\right]^{1/2}$$

The frontier-shift effect has in turn two components. The first component is the frontier-shift effect at $(x_0, y_0)^s$ evaluated as the ratio of efficiency of $(x_0, y_0)^s$ with respect to period *s* and *t* frontiers, respectively. The second component is the frontier-shift effect at $(x_0, y_0)^t$ evaluated as the ratio of efficiency of $(x_0, y0)^t$ with respect to period *s* and *t* frontiers, respectively. Hence, frontier-shift effect is defined by the geometric mean of the two components. The frontier-shift effect F>1 indicates progress in the frontier technology around the DMU_0 from period *s* to *t*, while F =1 and F<1 indicate the status quo and regress in the frontier technology, respectively.

VI. DATA AND MODEL SPECIFICATION

The data for the research were obtained from the published financial statements of Nigerian banks from *2002-2011*. Information required for the analysis was extracted for all the banks randomly sampled operating in Nigeria for the period of ten years. The banks include; first bank, Union bank, UBA, Zenith, GTbank, Diamond bank, Wema bank, Access bank, FCMB and Fidelity. All financial data are denominated in terms of Nigerian

Naira (in thousands). Inputs used in the study are deposits (D), operating expenses (OE) and other assets (OA), while the outputs represent loans and advances (L), investment (I), interest income (IY) and non-interest income (NIY). Deposits, one of the main inputs, are the overall resources available to banks for carrying out their activities like lending and investment. Operating expenses is the cost incurred in the banking financial intermediation, this include the cost of labour and all other labour-related expenses. And other asset is in form of liquid assets made available for intermediation. The outputs chosen for the study constitute one of the major activities of banks, i.e. to channel their funds into investments, advancing loans for profits and provide miscellaneous services to generate significant amount of interest and non-interest revenues.

VII. RESULTS AND DISCUSSION

Table 1.

Malmquist Index Summary Of Annual Means

Years	2003	2004	2005	2006	2007	2008	2009	2010	2011	Mean
Pure Eff. Change	0.999	1.014	0.993	1.013	1.000	0.986	0.953	1.064	0.990	1.001
Scale Eff. Change	1.005	1.024	0.994	1.032	0.997	0.934	1.036	1.036	0.974	1.003

Source: Field Data (2014)

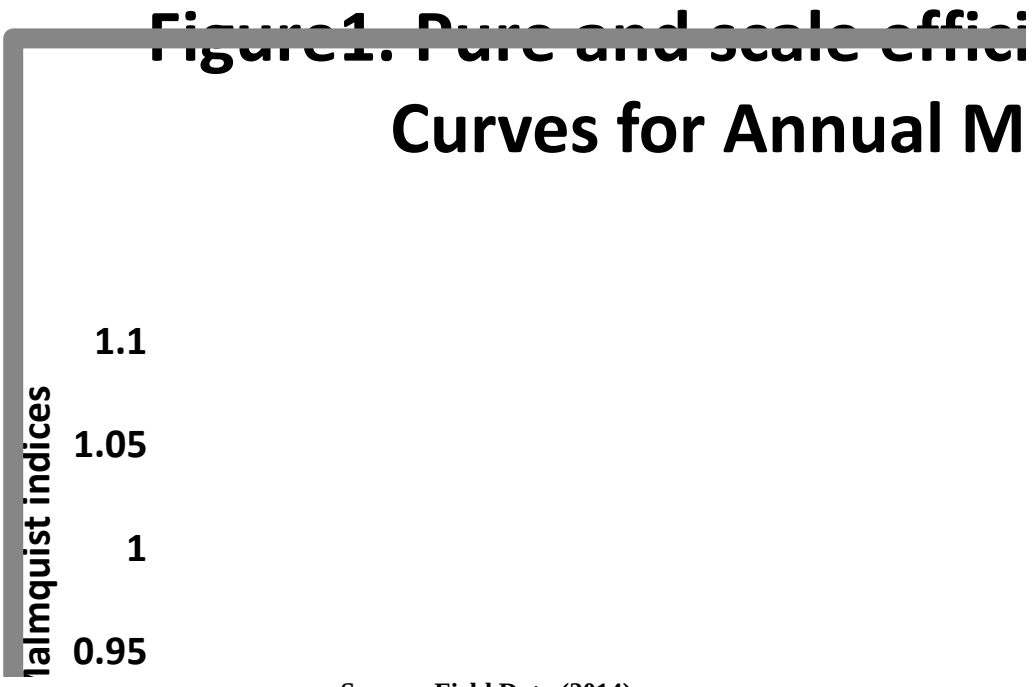
Table 2.

Malmquist Index Summary Of Firm Means

Firm	First bank	Union bank	UBA	Zenith	GTB	Diamond	Wema	Access	FCMB	Fidelity	Mean
Pure Eff. Change	1.000	1.016	1.005	1.000	1.000	1.000	1.000	1.000	1.000	0.989	1.001
Scale Eff. Change	0.998	1.025	1.019	1.000	1.000	1.000	0.992	1.000	1.000	0.998	1.003

Source: Field Data (2014)

Figure 1.



Source: Field Data (2014)

The above results from table 1 indicate that the average level of the pure efficiency change (Pech.*)* had gone up in a slight manner significantly from 0.999 in the year 2003 to 1.001 in year 2011 meaning that there is slight relative ability of banking operators to converts inputs into outputs. Reverse is the case for the scale efficiency change where in the year 2003 the score rose a little above the frontier at 1.005 but came down to 1.003 meaning that banking operators have been struggling to make use of the advantage of large scale production. The pure and scale efficiency change rose above the status quo in the years 2004, 2006 and 2010 whereas other years operated below the frontier i.e. 2003, 2005, 2007, 2008, 2009 and 2011respectively.

In general, the benefits realized via the technological progress by the banks under the study between the years 2007 to 2011 reflected in the efficiency change level of each bank in the sample for pure efficiency change. First bank, zenith, GTB, Diamond, Wema, Access and FCMB maintained the frontier i.e. status quo. Only Fidelity dropped down the frontier, whereas Union bank and UBA came up a little above the frontier. Zenith, GTB, Diamond, Access and FCMB maintained the status quo for scale efficiency. Just as in the pure efficiency change, Only Union bank and UBA rose above the unity at 2.5% and 1.9% respectively. First bank, wema and Fidelity were matter of concern because they operated below the frontier by 0.2%, 0.8% and 0.2% respectively. However, the mean pure and scale efficiency change rose above the frontier by 0.1% and 0.3% respectively. In figure 1, the annual mean of pure and scale efficiency change were shown by the graph. Mostly, the year 2010 was remarkable for pure efficiency change whereas, 2009 and 2010 were remarkable for scale efficiency change.

VIII. GLOBAL MANAGERIAL IMPLICATIONS AND CONCLUSION

Decomposition of the efficiency change index into its mutually exhaustive pure technical and scale efficiency components suggest that the decline in efficiency change is due to decline in both pure efficiency change and scale efficiency change. This would suggest that further steps need to be taken to improve efficiency in the banking industry substantially. In addition, banks have put in place measures to clean their balance sheets of non-performing loans and advances net of provisions, growth of asset base, customer deposits, and technological innovations has further contributed to improve both pure and scale efficiency change slightly as it can be seen in the result above. A bank which efficiently mobilizes its deposits, other funds and staff through its managerial acumen will earn high profits powered by both pure and scale efficiency change . Technological change or the innovation component dominated and offset the negative efficiency change or the catch-up effect component of the index. Where it is found that there is positive pure and scale efficiency change, it is largely driven by the massive innovation undertaken by banks to accommodate e-banking as well as build ATM and network infrastructure, both in-site and off-site locations signaling to the fact that on average the commercial banks in Nigeria had improved in terms of their technology which make some banks to break the frontier. The scores analyzed above justify the fact that the commercial banks have improved a bit in their general level of efficiency above average because the difference in the scores has been proven to be statistically significant and positive.

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