STOCHASTIC FRONTIER ANALYSIS OF THE EFFICIENCY OF NIGERIAN BANKS

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Abstract

Using the Stochastic Frontier Analysis (SFA) the efficiency of Nigerian banks was analysed. The result of the study proved that there is inefficiency in the Nigerian banking system and that the level of inefficiency ranged from 0 to 19 per cent of total cost. The study was able to derive the individual bank's level of inefficiency. Put differently, the study was able to derive the individual bank's level of efficiency.

Keywords: Efficiency, Banking and Performance

I. INTRODUCTION

In the last three decades, as bank regulators open their financial Industries for competition and liberalisation, many banks operated at a level that is less efficient and profitable leading to unsoundness or distress in the industry; thus generating concerns and worries among the bank stakeholders. There are a large number of studies which employ models to explain inter-bank differences in earnings, bank efficiency and continuous existence (failure) in the United States of America and other developed countries of the world. Similar studies have not been carried out using data from emerging markets like Nigeria especially when viewed against the background of the statement of Bartrop and McNaughton (1992) that financial analysis should be done within the context of the particular country and economic environment as each country has a different economic environment, different regulatory and legal environment, different commercial practices, different accounting standards and different risk characteristics. If this is the case, two organisations operating in different environments, may not attain the same result, not necessarily from the internal operating environment but as a result of the external environment. Therefore, experience of banks in developed countries may not necessarily be the same as those in a developing economy.

Consequently, there is the need to study and discover the factors that determine bank efficiency to enable bank stakeholders to evaluate their financial performance with a view to enhance manager's ability to plan and control, regulators and policy
makers to monitor and recommend appropriate measures, investors’ ability to
differentiate between efficient and inefficient banks.

A number of forces have fundamentally changed the world in which financial services
providers such as Banks compete, in diverse areas, in diverse areas, including technology,
regulations and economic changes. In competitive industries, according to Barr et al.
(1999), production units can be separated by some standards into those that perform
relatively well and those that perform relatively poorly. Financial researchers have
done this “separation” by applying nonparametric and parametric frontier efficiency
analyses. Barr et al. (1999) opine that success in competitive markets demand achieving
the highest levels of performance through continuous improvement and learning.
Comparative analyses and benchmarking information can alert institutions to new
paradigms and new practices leading to significant increases in firm efficiency and
effectiveness. Frontier analysis methodologies are essentially sophisticated ways of doing
this.

The lack of scientific way of determining factors that contributes or reduces bank’s
efficiency has created a lot of problems to bank stakeholders including managers,
stakeholders and investors, the Central Bank, Deposit Insurance Corporations, Depositors
and other bank customers, Bankers’ Associations, Auditors, Government and other
financial authorities. Therefore, the banks need instruments that will enable them to
scientifically evaluate bank’s efficiency. This is the issue of concern in this study.

In order to carry out the analysis of the issues raised in the study, hypotheses were
raised to be tested and they are stated thus: (i) there is no inefficiency in the Nigerian
banking system and (ii) there is no significant difference among individual bank’s
efficiency in Nigeria.

II. LITERATURE REVIEW

Berger, Hunter and Timme (1993) defined X-efficiency as the ratio of the minimum
costs that could have been expended to produce a given output bundle to the actual
costs expended. X-efficiency varies between 0 and 100 percent. X-efficiency includes
either technical inefficiency, or errors that result in general overuses of inputs, and
allocative inefficiency, or errors in choosing an input mix that is consistent with relative
prices. Berger and Humphrey (1997)’s review showed that 116 out of 130 studies related
to financial institution frontier efficiency across 21 countries were written or published

There are four types of X-efficiency estimation based on different assumptions. They
are the Data Envelopment Analysis (DEA), the Stochastic Frontier Approach (SFA),
the Thick Frontier Approach (TFA), and the Distribution-Free Approach (DFA). They
differ from one another on the basis of the arbitrary assumptions used to disentangle
efficiency differences from random error using a single observation for each firm. They
can be categorised into the parametric and non-parametric approaches.

- Nonparametric linear programming approach – Data Envelopment Analysis
- Parametric Econometric Approaches – Stochastic Frontier Approach, Thick
  Frontier Approach, and Distribution-Free Approach
There has been a large number of academic studies that focussed on the efficiency of financial institutions using frontier analysis. Berger and Humphrey (1997) outlined 130 studies, covering 21 countries, multiple time periods and various types of institutions that three parametric (i.e. stochastic frontier approach (SFA), distribution free approach (DFA), thick frontier approach (TFA)) and two non-parametric (i.e. data envelopment analysis (DEA) and free disposal hall (FDH)) frontier approaches for determining the best practice frontier against which relative efficiencies are measured (Pasiouras and Kosmidou, 2007). The efficiency of a bank is measured relatively to that of the best practice banks of similar size with most studies focussing on cost efficiency rather than profit efficiency (Pasiouras and Kosmidou, 2007). Some other studies also consider both cost and profit efficiency (Berger and Humphrey, 1997; Berger and Mester, 1997; etc.), as well as risk variables (Berg et al., 1992; McAllister and McManus, 1993; Mester, 1996; Berger and DeYoung, 1997 and Rao, 2005).

None of the 130 reviewed studies mentioned above is on Nigeria. Only two studies on efficiency studies in Nigeria could be accessed during the study (Afeikhena, 2004 and Idialu, 2007). The Afeikhena (2004) study is Privatised Enterprises. The study evaluated technical efficiency in four privatised enterprises using Data Envelopment Analysis. Of the four enterprises, only one bank, the United Bank for Africa (UBA) is included and this means this particular study was not industry based. The study report did not state the period covered. On the choice of inputs and output for the UBA, he chose four inputs (number of full time employees, salary expenses, value of fixed assets and other non-interest expenses) and two outputs (earning assets and total interest income). He reported that the constant return scale results for UBA increased from 0.789 in the pre-privatisation period to 0.967 in the post-privatisation period. In the case of variable return to scale the values moved from 0.953 to 0.988. Since the efficiency of a bank is measured relatively to that of the best practice banks of similar size and in this case only one bank is involved, I doubt if the result will be the same when evaluated against similar banks.

The Idialu (2007) study was on Nigerian banks and covers the period 1999 to 2004 and also used the DEA methodology. The study examined the relative efficiency of Nigerian banks using both operating and intermediation approaches. For the operating approach, all his data were from the profit and loss statements of the banks and included four inputs (interest and related cost, overhead expenses, provision for bad and doubtful debts and capital related administrative expenses (depreciation)) and one output the gross earnings. For the intermediation approach, he used three inputs (fixed assets and other assets, number of employees and total deposits) and two outputs (total loans extended and investments). The result of the relative efficiency, operating approach, was on average between 0.758 and 0.889 (75.8% and 88.8%) and in the case of the intermediation approach, the average was between 0.643 and 0.881 (64.3% and 88.1%). The current study is different from this reported study in many respects. First it is using the stochastic approach instead of the DEA used in this study and second, although the period covered is almost the same; the number of banks involved in the current study is a lot more than those used in the reviewed study and thirdly, the input and output variables are not the same.

Bank performance is found to vary with size, time, location, loan portfolio-mix and location. Small banks appear best at lending to small local business. Small banks are
better at relationship banking than large banks due to superior information and greater discretion in applying information. Udell (1989) and Nakamura (1994) concluded that loan officers at large banks tend to follow bank rules and criteria more rigidly in loan review than their counterparts at small banks. Furthermore, Brickley, Linck, and Smith (2000) found that small local owned banks have a comparative advantage over branch banks of large banks in some environments. Thus, banks with smaller sizes might survive under the trend of bank consolidation.

Zimmerman (1996) and Neely and Wheelock (1997) showed that time plays an important role in bank efficiency. As the business environment varies from region to region, Neely and Wheelock and Zimmerman indicated that local economic factors affect the performance of local banks significantly. Bank location is a strong factor in determining loan portfolio-mix. Although large banks in the future are likely to dominate rural areas, recent changes in banking regulation are favourable to small banks in reducing their regulatory burden. They are now allowed to expand into new businesses. Gilbert (1997) showed evidence that competition from new entrants of large banks would also compel small banks in the rural areas to operate more efficiently. As small rural banks specializing in agricultural loans had not been the primary targets of interstate mergers and acquisitions.

The above-cited studies suggest that small banks might have comparative advantages, especially in the rural financial markets. Because of the profitability of small banks in the local financial markets, large banks are also attracted to enter those markets. The competitiveness of the local financial market will increase. Under these circumstances, operating efficiency will be an important issue for the survival of small banks. If small banks take advantage of their superior information in the local market and their increased flexibility, small banks may operate more efficiently than large banks. However, small banks are tied more closely to local economy. Thus, small banks operating in rural environments may be sensitive to agricultural production and prices within their local area. In Nigeria, however, small banks operate in the towns and cities instead of rural communities. Therefore the circumstances surrounding the Nigerian small banks may be different from the picture painted above. The Community banks now Microfinance banks were created to solve the problems of rural banking in Nigeria. The current study is not involving Microfinance banks.

III. METHODS
The bank efficiency study in this work is a replication of Girardone et al. (2004) study of Italian bank a developed country. The environment in which the Italian banks operate is different from the Nigerian bank environment. Therefore it may not be out of place to test Girardone et al. (2004)'s hypothesis in a developing economy such as the Nigerian economy. The period covered by their study is from 1993 to 96 whereas the current study is from 2000 to 2004. The controversy surrounding what is considered to be bank outputs in the literature is still unsettled but there is now a common agreement that a banking firm has multi-products (Sealey and Lindley, 1977 and Lamberte, 1982).

Girardone et al. (2004) used a variation of the intermediation approach with total costs (TC) as dependent variable and the independent variables includes total customer loans as output 1, other earning assets as output 2, (both output variables being based
on the original concepts of Sealey and Lindley, 1977), staff expenses/average number of personnel as Input Price 1, interest expenses/total customer deposits as Input Price 2, Other non-interest expenses/total fixed assets as Input Price 3, total equity as Financial Capital and Non-performing loans/total loans as Asset Quality. From the reviewed literature, these variables are the most used cost efficiency study and are all considered appropriate for the current study. They are included as variable for the study. Table 1 below provides the description of the variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total costs</td>
<td>TC</td>
<td>Staff expenses + other non-interest expenses + interest paid</td>
</tr>
<tr>
<td>Independent variables:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 1</td>
<td>Q₁</td>
<td>Total customer loans</td>
</tr>
<tr>
<td>Output 2</td>
<td>Q₂</td>
<td>Other earning assets</td>
</tr>
<tr>
<td>Input Price 1</td>
<td>P₁</td>
<td>Staff expenses/average number of personnel</td>
</tr>
<tr>
<td>Input Price 2</td>
<td>P₂</td>
<td>Interest expenses/total customer deposits</td>
</tr>
<tr>
<td>Input Price 3</td>
<td>P₃</td>
<td>Other non-interest expenses/total fixed assets and other fixed assets</td>
</tr>
<tr>
<td>Financial Capital</td>
<td>K</td>
<td>Total shareholders' funds</td>
</tr>
<tr>
<td>Asset Quality</td>
<td>S</td>
<td>Non-performing loans/total loans</td>
</tr>
</tbody>
</table>

The data used to construct the estimates for the cost function parameters are derived from financial statements of Nigerian banks sourced from the Financial Institution Training Centre (FITC) based in Lagos and Nigerian Banking, Finance and Commerce produced by Research and Data Services Ltd (redasel) for the various years. The sample comprises unbalanced panel of 339 bank observations distributed as follows: 76 in 2000, 74 in 2001, 70 in 2002, 66 in 2003 and 53 in 2004. These figures represented 86%, 82%, 78%, 74% and 60% of banks that operated in the Nigerian banking market in 2000, 2001, 2002, 2003 and 2004 respectively.

For the purpose of this study, the banks are classed into two groups; the 10 dominant banks and the rest banks. Whereas Girardone et al. (2004)'s study classified the Italian banks into five groups (very big, big, medium, small and very small) in terms of size using the banks' average assets, following Soludo (2004) statement, the Nigeria banks are classified into two groups (the ten top banks and the rest) also using the banks' average assets.

Girardone et al. (2004) reported that researchers investigating bank cost efficiency postulate a relationship between costs, input prices and output quantity. This relationship is based on the duality concept between production and cost functions. The production function \( Q = Q(X) \) summarises the technology of a firm, that is the existing relationship between inputs \( X \), and outputs \( Q \). The cost function \( TC = TC(Q,P) \) shows the relationship between total production costs, TC and the prices of variables inputs. The duality condition between the production and the cost function ensures that they contain the same information about production possibilities and that there is a unique
correspondence between both functions. Moreover, observable production plans and cost levels usually do not follow from perfectly rational and efficient decisions. On the contrary, such factors as errors, lags between the choice of the plan and its implementation, inertia in human behaviour and distorted communications and uncertainty are amongst the factors that might cause X-inefficiency to drive real data away from the optimum (Resti, 1997).

This study is employing the stochastic cost frontier approach to generate estimates of X-efficiencies for each bank over the years 2000-2004 in line with Girardone et al. (2004)’s study that covers the years 1993-96. Aigner et al. (1977) and Meeusen and van den Broeck (1977) were the first to use stochastic production frontier models.

A fundamental element of stochastic frontier analysis is that each bank potentially produces less than it might because of a degree of inefficiency. Specifically,

\[ q_{it} = f(z_{it}, \beta) \xi_{it} \]

Where \( \xi_{it} \) is the level of efficiency for bank \( i \) at time \( t \); \( \xi \) must be between 0 and 1. If \( \xi_{it} = 1 \), the bank is achieving the optimal with the technology embodied in the production function \( f(z_{it}, \beta) \). When is \( \xi_{it} < 1 \), the bank is not making the most of the inputs \( z_{it} \) given the technology contained in the production function \( f(z_{it}, \beta) \). The degree of technical efficiency is assumed to be strictly positive \( \xi_{it} > 1 \) since the output is assumed to be strictly positive \( q_{it} > 0 \).

Output is also assumed to be subject to random shocks, implying that

\[ q_{it} = f(z_{it}, \beta) \xi_{it} \exp(v_{it}) \]

Taking the natural log of both sides yields

\[ \ln(q_{it}) = \ln(f(z_{it}, \beta)) + \ln(\xi_{it}) + v_{it} \]

Assuming that there are \( k \) there are \( k \) inputs and that the production function is linear in logs, defining \( u_{it} = -\ln(\xi_{it}) \) yields

\[ \ln(q_{it}) = \beta_0 + \sum_{j=1}^{k} \beta_j \ln(z_{jit}) + (v_{it}) - u_{it} \]

Since \( u_{it} \) is subtracted from \( \ln(q_{it}) \), restricting \( u_{it} \geq 0 \) implies that \( 0 < \xi_{it} \leq 1 \), as specified above.

Kumbhakar and Lovell (2000) provide a detailed cost version of the above derivation and specified it to be

\[ \ln(c_{it}) = \beta_0 + \beta_q \ln(q_{it}) + \sum_{j=1}^{k} \beta_j \ln(p_{jit}) + v_{it} + \mu_{it} \quad \text{(equation 1)} \]

Where \( q_{it} \) is output, the \( z_{jit} \) are input quantities, \( c_{it} \) is cost, the \( p_{jit} \) are input prices, and \( s = 1 \).

Intuitively, the inefficiency effect is required to raise expenditure.

Coelli (1996) stated that in the cost function, the \( \mu_{it} \) defines how far the firm operates above the cost frontier. If allocative efficiency is assumed, \( \mu_{it} \) is closely related to the cost of technical inefficiency. If this assumption is not made, the interpretation of the \( \mu_{it} \) is less clear, with both technical and allocative inefficiencies possibly involved.
Schmidt and Lovell (1979) noted that the log-likelihood of the cost frontier is the same as that of the production frontier except for a few line changes.

The measure of cost efficiency relative to the cost frontier is defined as:

\[
EFF_i = \frac{E(Y_i^* | U_i, X_i)}{E(Y_i^* | U_i = 0, X_i)} \quad \text{(equation 2)}
\]

Where \( Y_i^* \) is the cost of the \( i \)-th firm, which will be equal to \( Y_i \) when the dependent variable is in logs. In the case of a cost frontier, it will take a value between one and infinity.

**IV. DATA PRESENTATION AND ANALYSIS**

The result of data analysed is presented in form of tables and described descriptively. Two models were developed. STATA 10 package was deployed for the analysis. The 83 banks’ data for the five years were constituted into a panel of data. There were 338 observations that could be regarded as unbalanced panel data since some observations were missing for some banks involved in the study. The result of the STATA analysis is summarised in Table 2.

From Table 2, the fitted model from the analysis is:

\[
\ln TC = 6.85 + 0.2377\ln q1 + 0.1312\ln q2 - 0.0251\ln p1 - 0.0174\ln q2
\]

\[
+ 0.1964\ln p3 + 0.1060\ln k - 0.0599\ln \text{Ins} \quad \text{(equation 3)}
\]

Where \( \ln TC \) = logarithms of total cost; \( \ln q1 \) = logarithms of customer loans; \( \ln q2 \) = logarithms of other earning assets; \( \ln p1 \) = logarithms of salaries; \( \ln p2 \) = logarithms of interest; \( \ln p3 \) = logarithms of other overheads; \( \ln k \) = logarithms of capital and \( \ln \text{Ins} \) = logarithms of non-performing loans.

From the above fitted model, the positively signed predictor variables are directly related to the dependent variables. That is they increase as the dependent variable increases and versa versa. The negatively signed independent variables are inversely related to the dependent variable which implies an increase in the independent variable will lead to a decrease in the dependent variable.

When all the independent variables are set to 0, total cost will be 6.85, since the variables are in logarithms, the coefficients are elasticities. When there is 1% decrease in customer loans, it will decrease total cost by 23.8%. A 1% decrease in the estimated elasticity of earning assets, other overheads cost and capital will lead to a decrease of in total cost by 13.1%, 19.6% and 10.6% respectively. The reverse will be the case when there is an increase in customer loans, earning assets, other overheads cost and capital. On the other hand, a 1% increase in salaries will lead to a decrease of 2.51% in total costs and 1% increase in interest and non-performing loans will decrease total cost by 1.74% and 6% respectively. The reverse will be the case when there is a decrease in salaries, interest and non-performing loans.

The maximum likelihood is \(-306.21321\). The concept of maximum likelihood estimation is underpinned by the idea that a particular sample of observations is more likely to have been generated from some distributions than from others. The maximum likelihood estimate of unknown parameter is defined to be the value of the parameter that maximises the probability (or likelihood) of randomly drawing a particular sample of observations. The likelihood ratio (LR) statistics is 321.26 and with 7 degrees of
freedom, the calculated $X^2$ is 20.2777. Therefore, the null hypothesis that there is no inefficiency component is rejected and it is concluded that there is inefficiency component in the total cost of bank operations in Nigeria.

In addition, to the coefficients, Table 2 reports estimates for several other parameters, $\text{sigma}_v^2$ (0.2586) is the estimate of $\sigma^2_v$, $\text{sigma}_u^2$ (0.2089) is the estimate of $\sigma^2_u$ gamma (0.4468) is the estimate of $\gamma = \frac{\sigma^2_u}{\sigma^2_s}$, $\text{sigm2}$ (0.4575) is the estimate of $\sigma^2_s = \sigma^2_v + \sigma^2_u$. Since $\gamma$ must be between 0 and 1, the optimization is parameterized in terms of the inverse logit of $\gamma$, and this estimate is reported as ilgtgamma (-0.2134). Since $\sigma^2_s$ must be positive, the optimization is parameterized in terms of $\ln(\sigma^2_s)$, whose estimate is reported as Insigma2 (-0.7604). Finally, $\mu$ (0.9132) is the estimate of $\mu$, the mean of the truncated normal distribution.

### Table 2

**Stochastic Frontier Analysis, Time-Invariant Inefficiency Model Result**

<table>
<thead>
<tr>
<th>Dependent Variable: Log of Total Cost (lnTC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td>Inc1 Natural log of customer loans</td>
</tr>
<tr>
<td>Inc2 Nat. log. of other earning assets</td>
</tr>
<tr>
<td>Inc3 Natural log of salaries</td>
</tr>
<tr>
<td>Inc4 Natural log of interest</td>
</tr>
<tr>
<td>Inc6 Natural log of other overheads</td>
</tr>
<tr>
<td>Inc8 Natural log. of capital</td>
</tr>
<tr>
<td>Inc10 Natural log of non-performing loans</td>
</tr>
<tr>
<td>Cons</td>
</tr>
<tr>
<td>/mu</td>
</tr>
<tr>
<td>/Insigma2</td>
</tr>
<tr>
<td>/ilgtgamma</td>
</tr>
</tbody>
</table>

| Sigma2                         | 0.4575   | 0.0753       |             |          |
| Gamma                          | 0.4468   | 0.0944       |             |          |
| Sigma_u2                       | 0.2089   | 0.0748       |             |          |
| Sigma_v2                       | 0.2586   | 0.0238       |             |          |

Log likelihood = -306.21321
Wad chin2(7) = 321.26
Prob> chin2 = 0.0000

With the models derived above and using the analysis with capital risk and assets quality the individual bank X-efficiencies are derived using STATA 10 post estimation tool. The direct output of the analysis is minus the natural log of the technical efficiency of the Banks. The natural logarithm of the derived technical efficiency values are obtained to arrival at the individual efficiency values. As earlier stated the X-efficiency values are supposed to take values between one and infinity. Therefore, the inefficiency is value by which the X-efficiency value is greater than 1 and when the in-efficiency is deducted from 1 which is the highest efficiency value each bank’s efficiency is obtained. Five of the observations that were below 1 were eliminated from the analysis.
The in-efficiency in the Nigerian banking system ranged between 0 and 19 per cent of total cost. Put differently, the efficiency of Nigerian banks ranged between 81 and 100 per cent of total cost. Yearly percentages of inefficiency ranged between 0 and 17 for 2000; 83 and 92 for 2001; 82 and 90 for 2002; 82 and 90 for 2003; and 81 and 90 for 2004. The summary is showed in Table 3.

Table 3
Summary Statistics of Technical Efficiency of the Individual Banks

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of banks</th>
<th>Inefficiency</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>2000</td>
<td>74</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>2001</td>
<td>73</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>2002</td>
<td>69</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>2003</td>
<td>66</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>2004</td>
<td>52</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>334</td>
<td>0</td>
<td>19</td>
</tr>
</tbody>
</table>

Source: derived from frontier analysis results

V. RECOMMENDATIONS AND CONCLUSION

The focus of this is the quantitative analysis of financial performance of Nigerian Banks. Financial performance of a banking institution is defined in terms efficiency. The specific issue examined in this study is cost efficiency. This requires knowing which banks are efficient and those that are not efficient as comparative analyses and benchmarking information can alert institutions to new paradigms and new practices resulting in significant increases in firm efficiency and effectiveness. In order to carry out the analysis of the issues raised in the study, hypotheses were raised to be tested and they include: (i) there is no inefficiency in the Nigerian banking system and (ii) there is no significant difference among individual bank's efficiency in Nigeria.

An analysis was undertaken to determine the efficiency of the banks for the period of the study, that is, 2000 – 2004. The Stochastic frontier Analysis (SFA), a parametric statistical test was applied to determine the cost efficiency of the banks. Following Girardone, et al. (2004). Capital risk and asset quality represented by capital amounts on the balance sheet and non-performing loans were added to the standard cost frontier analysis on the current study. Individual firm’s X-efficiencies for each of the five years was also derived during the course of the study.

The result of the hypotheses testing are summarised as followings:

- The variable of customer loans, other earning assets, salaries, interest, other overheads, capital and non-performing loans are capable of determining the efficiency of the banking system in Nigeria.
- The likelihood ratio test with these variables rejected the null hypothesis that there is no inefficiency in the Nigerian banking system.
- The likelihood ratio test with the above variables without non-performing loans also rejected the null hypothesis that there is no inefficiency in the Nigerian banking system.
• The likelihood ratio test with the above variables without capital also rejected the null hypothesis that there is no inefficiency in the Nigerian banking system.

• The likelihood ratio test excluding both capital and non-performing loans also rejected the null hypothesis that there is no inefficiency in the Nigerian banking system.

• That the variables used for analysing the efficiency of Nigerian banks are capable of determining the level of inefficiency and efficiency of the individual banking institution in the Nigerian economy.

• The level of inefficiency of the individual bank ranged from 0 to 19 per cent for the period.

• The level of efficiency of the individual bank ranged between 81 to 100 per cent for the period.

Another evidence from the study is that there is inefficiency in the Nigerian banking system. The implication of this is that the supervisory authorities and managers should identify the level of inefficiency of each banking institution and arrest or reduce the inefficiency in order to increase the efficiency of the institution. Failure to do this can accentuate the inefficiency and snowball into distress of the institution.

At the beginning of this study, it was stated that knowledge of the underlying factors that influence banks’ efficiency is essential not only for the managers of the banks but for other numerous stakeholders such as the Central bank, Deposit insurance corporations, Bankers Associations, Auditors, Government and other financial authorities. Based on the results of this study the following recommendations are made for the benefits of the stakeholders.

The Central bank and Deposit insurance corporations need to internalise the tools employed in this study for their own monitoring and supervisory measures of banks’ efficiency.

The auditors need to upgrade their auditing tools based on the tools of analysis in this study to enable them carry out their audit function in banking institutions more effectively so as to accurately determine the level of efficiency of the banks and blow appropriate whistle in their audit reports.

Bank managers more than ever before need to adopt scientific management and therefore require to undertake frontier analysis of banks’ ability to remain efficiency in business and to enable them carryout proper planning and execution of their activities.

The analysts like auditors need the scientific tools used in this study to analyse banking institutional performance and draw conclusions on them which they can disseminate to those they advise for them to take informed decision.

The contribution of this study to knowledge is that the scientific tool of Stochastic Frontier Analysis (SFA) which has long been in use in United States of America, Canada, Europe and India on banking data have now been applied to the Nigerian bank panel data. The study has revealed that there is inefficiency in the Nigerian banking system and that the level of inefficiency ranges between 0 and 19 per cent of total cost.
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