Original Article

The Return to Scale Efficiencies of the Nigerian Credit Institutions Finance on the Agricultural Sector

Yahaya P. Usman, PhD

Department of Social Sciences & Humanities, Federal Polytechnic, Idah, Kogi State, Nigeria

Corresponding Author email; usmanpy9 @gmail.com

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Abstract

The study evaluated the return to scale efficiencies of the Nigerian Credit Institutions finance on the agricultural sector with the aid of data envelopment analysis (DEA). The empirical analysis was made of the credit institutions financial statistics which were sourced from Central Bank of Nigeria (CBN) Statistical Bulletin (various issues), the Nigeria Deposit Insurance Corporation (NDIC) Annual Report and Statement of Accounts (various issues) and various publications and interactions with Bank of Agriculture (BOA). Findings from the study indicated that the Deposit Money Banks operations are technically efficient in some years, for instance 1992 and 1994, the Bank of Agriculture and the Microfinance Banks activities also suggested technical efficiency in their operations in 1999 and 2002; and 1997 and 1998, respectively. The study concludes by recommending that the credit institutions should improve on their operations as attaining technical efficiency would ensure optimization of inputs deployed to the agricultural sector.

Keywords: Credit, Institutions, Efficiency, agriculture, Banks

1.1 Introduction

Attainment of technical and production efficiencies in the use of resources are a major aspiration of most economies. For instance over fifty percent of Nigerians are engage in various aspect of agricultural production (Mordi et al 2010), yet, the country is still faced with the problem of food shortages consequent upon low productivity of the sector. This is a strong indication that resources deployed to the sector have not yielded commensurate output. To raise productivity in the agriculture, therefore, requires not only added financial intervention particularly from the money market but to ensure that such funds are optimally invested. A task considered unattractive; Alegiuno (2010) stated that some impediments to poor financing of agriculture include, the predominance of small holding farmers with adverse technical and market economies of scale. This category of farmers does not have acceptable collateral to present for loans from commercial banks. This is in addition to inadequate records and data on the basis of which banks can effectively assess the creditworthiness of farmers, the inability of farmers to present bankable proposals for lending. Likewise the World Bank (2015) enumerated the challenges financial institutions face when offering financial products to agriculture are three folds:

i. The transaction costs of reaching remote rural populations.
ii. Higher perceptions of non-repayment due to sector specific risks, such as production, price and market risks.
iii. Financial institutions' lack of knowledge in how to manage transaction costs, agriculture-specific risks and how to market financial services to agricultural clients.

Furthermore government policies often prove to be ineffective and could in fact create impediments to offering financial services to agricultural sector hence policies such as concessional lending practices, interest rates caps, and loan forgiveness programmes creates disincentives for private sector lending while creating problem for government lending to agriculture. However the challenges of financing agriculture, the intermediation role of Nigerian credit institutions, that is, Bank of Agriculture (BOA), the Deposit Money Banks (DMB) and the Microfinance Banks (MFBs) on the agricultural sector is under focus in this study.

1.2 Statement of the Problem

In the light of the fact that studies on banks efficiency in Nigeria are not only few but also concentrated on deposit money banks; for instance, Obafemi (2012), Olaosebikan (2009) and Fagge *et al.* (2012). These studies extend scale efficiency investigation to the activities of Microfinance Banks and Bank of Agriculture. In doing this, the data envelopment analysis (DEA) was employed. Unlike other studies mentioned in the literature of finance/credit-growth nexus, this study will attempt to address the following research question.

i. How technically efficient are the Nigerian Credit Institutions in the use of their funds in the agricultural sector?

1.3 Objective of the Study

The broad objective of the study is to examine the efficiency of the Nigerian Credit Institutions investment on the agricultural sector.

1.4 Justification for the Study

This study is justifiable from the fact that the technical efficiency of banks agricultural credits is less investigated in the literature in Nigeria. Also, agriculture remains a major contributor to gross domestic product (GDP) of Nigeria. Furthermore, the agricultural sector in Nigeria remains the bedrock for sustainable growth. The sector needs credit to purchase machinery, adapt/adopt the mechanize operation, transportation of equipment and produce, processing and marketing of produce. Agricultural credit is an essential input for increasing productivity. Government and policy makers need to be informed about issues militating adequate financing of the sector for its sustainable growth; and that neglect of agriculture in terms of funds means the enthronement of socio-economic dislocations, such as external imbalance, price instability and unemployment.

The study examined the scale efficiencies of the Nigerian Credit Institutions credits invested on the agricultural sector in Nigeria. Thus, the study is country specific, dwelling on how the credit institutions funds impacted on the agricultural sector in Nigeria. Time series data spanning from 1992 to 2015 (24years) were employed and the Data Envelopment Analysis (DEA) was used to examine the scale efficiencies.

1.5 Brief History of the Nigerian Credit Institutions

1.5.1 Deposit Money Banks (DMBs)

Formal deposit taking banking activities began in Nigeria in 1892 when the African Banking Corporation (ABC) based in South Africa opened a branch in Lagos. This was followed by the opening of branch of Barclays Bank DCO (now Union Bank of Nigeria) in Lagos in 1917. These two expatriate commercial banks monopolized banking business in the country until 1927 when the first recorded indigenous bank, that is, Industrial and Commercial Bank Limited was established (Mordi, et al., 2010).

The dominance of expatriate banks continued until the Nigerianisation of a large proportion of the share ownership of deposit money banks in line with the Nigerian Enterprises promotion (amendment) Act of 1977, which pegged the equity shares of banks at the minimum ratio of 60:40 between indigenous and foreign interests. To extend banking services to the rural areas, the Central Bank of Nigeria began expansion programme in 1977. This led to the opening of over 600 rural branches of commercial or deposit money banks as at end December, 1990. In terms of number of deposit money banks in Nigeria as at end December, 2005, twenty five banks emerged from the consolidation exercise of the banking system in the country. Also, as at end December, 2015, the twenty five banks have 5468 branches (CBN Statistical Bulletin, 2015). Total assets of the deposit money banks stood at ₦ 10,106.4billion, as at end December, 2007. This rose to over ₦28,000.00 billion as at end December, 2015. According to Mordi et al., (2010) a large portion of the total assets of banks was in loans and advances, which constituted 37.8 percent of total assets in 1998, 36.5percent in 2005 and 44.9 percent in 2007. As at end December, 2015 the portion of loans and advances to total assets of DMBs was a little over 70 percent.

1.5.2 Microfinance Banks

The early 1990s witnessed some innovations in financial institutions with the establishment of Peoples Bank of Nigeria and the Community Banks. The Peoples Bank was established in October 1990 to provide specialised services for both the rural and the urban micro-enterprises which found it difficult to access credit in the formal financial market due mainly to their inability to provide collateral security. The community banks on the other hand are owned and managed by the community or a group of communities for providing deposit, credit and other financial services to its customers on the basis of self-recognition and credit worthiness.

However, in 2005 the government introduced a new microfinance bank (MFB) policy. This policy was designed to provide diversified, affordable and dependable financial services to enable the economically active poor have access to investment financing, thus In December 2005, the Central Bank of Nigeria (CBN) issued new regulations mandating Community Banks to convert to Microfinance Banks (MFBs) latest by December, 2007. The regulation among others required the Community banks to increase minimum shareholders from ₦5.0 million to ₦ 20.0million, for those converting to state MFBs. At the end of the exercise a total of 709 MFBs emerged of which 603 converted from the existing 757 community banks. The total assets of the MFBs at end December 2007 stood at ₦ 55.6billion with a shareholder's fund of ₦ 9.8 billion. At end December 2015 the number of MFBs in Nigeria stood at 948 with a total asset of ₦343.9 billion.

1.5.3 Bank of Agriculture (BOA)

The Bank of Agriculture (BOA) was established to enhance the affordability of credit to the agricultural sector. The bank has put into place various schemes of lending in order to solve the credit need of small and large scale farmers. The BOA's activity in this area involves the direct making of loans and strengthening of Micro-Finance banks, which deliver credit at the local community level. The bank embarked on various initiatives to strengthen the cooperative credit structure at local and state government levels as well as rural micro-finance banks. In order to reinforce its credit function and to make credit more productive, BOA operates a number of development and promotional activities, which include;

i. Work with cooperative groups at the state and local government levels to prepare development action plans for themselves.
ii. Enter into collaborative or on-lending memorandum of understanding (MOU) with state governments, cooperative associations and Micro-Finance Banks specifying their respective obligations to improve the affairs of the groups and banks within a stipulated time frame.
iii. Monitor implementation of Development Action Plans (DAP) of cooperative associations and Micro-Finance banks and fulfillment of obligations under MOUs.
iv. Provide financial assistance to cooperatives and Micro-Finance banks for establishment of technical, monitoring and evaluation cells.
v. Provide organization development intervention through reputable training institutes like Federal Cooperative Colleges, Universities of Agriculture and department of agriculture of various Universities in Nigeria.
vi. Provide financial support for cooperative studies in universities and polytechnics.

vii. Provide training for senior and middle level executive of local commercial bank branches, Microfinance banks and cooperative associations.
viii. Create awareness among the borrowers on ethics of repayment through local debt collectors and cooperative marshals that enforce timely repayment and prompt remittance of same to the lending institutions.
ix. Provide financial assistance to Microfinance banks for building improved management information system, computerization of operations and development of human resources (BOA, Brochure, 2010

The BOA's credit policies are activated at the level of direct lending, on-lending, collaboration and monitoring credit. The direct lending scheme was devised to assist individual farmers and organizations against adequate collateral security. On the other hand, the on-lending scheme is an indirect lending. It involves lending to establish organizations mainly state governments and Microfinance Banks against repayment guarantees for on-lending to small scale farmers in their respective areas.

Section two dwells on the review of related literature. Section three deals on research method and theoretical framework, section four deals with the trends, data presentation, analysis and discussion of results; while section five is the summary, conclusion and recommendations.

2. Conceptual Issues

The word credit comes from the Latin word 'credo' which means 'I believe'. Hence, credit is based upon belief, confidence, trust and faith. Pandey (2012) states that credit means ability to command the other's capital in return for a promise to repay at some specified time in future. There are four 'Cs' of credit, namely, character, capacity, capital and condition that must be considered in lending. Credit is a contractual agreement in which a borrower receives something of value now and agrees to repay the lender at some later date generally with interest. The Oxford Advanced Learner's Dictionary (2012) defines credit as money that you borrow from a bank, that is, a loan.

Also, Pandey (2012) defines agricultural finance as dealing with the financial aspects of the farm business. It includes both macro and micro finance aspects of an agricultural economy. Agricultural finance, therefore, is the economic study of the acquisition and use of capital in agriculture. It deals with the supply and demand for funds in the agricultural sector of the economy. Credit to the agricultural sector remains not only costly but inequitably distributed particularly to the small-scale farmers.

Agricultural credit enhances productivity and promotes standard of living among farmers. According to Zuberi (2008) agricultural output was low in developing countries. Using Pakistan as a case study, he attributed this to small holdings, traditional methods of farming, poor irrigation facilities, low or misuse of modern farm technology, among others. He argued that access to credit therefore, was expected to stimulate farm investment, boosting the use of modern inputs, and augmenting farm production. Similarly, Audu et al (2007) stressed the need for agricultural finance, arguing that capital in the form of finance is needed to modernise agriculture because new technologies have to be purchased before they can be used on the farms. Therefore, any system of financial intermediation that would leave a pool of money for investment among farmers would catalyze agricultural production and growth.

Also, IFAD (2010) further adds that agriculture credit refers to all those financial services that focus on on-farm activities and agricultural businesses without necessarily targeting poor people. Similarly, International Financial Corporation (IFC) (2014) states that access to financial services while not a mean to an end, is critical to provide funds for farm investments in productivity, improved post harvest practices, smooth household cash flow, enable better access to markets and promote better management of risks.

The concept of agriculture originated from the Latin word 'Agricultura' which is equally made of Latin words 'ager' which means field and 'cultura' which means cultivation or growing. To practice agriculture, therefore, means to use natural resources to produce commodities which maintain life, including food, fibre, forest products, horticultural crops, and their related services. Thus, Rubenstein (2003) defined agriculture as the deliberate effort to modify a portion of earth's surface through the cultivation of crops and raising of livestock for sustenance gain. Similarly, Wikipedia defined agriculture as the cultivation of animals, plants and fungi for food, fibre, bio-fuel, medicinal plants and other products used to sustain and enhance human life. Agriculture has two main division plant or crop production and animal or livestock production; the ultimate purpose of agricultural practice is for food production and meeting other human needs such as clothing, medicines, tools, artistic display and dwelling or economic gain.

2.2 Theoretical Literature

2.2.1 Pagano's Theory of Financial Markets and Economic Growth

The link between financial development and economic growth stems mainly from the insights and techniques of endogenous growth models, which have shown that there can be self-sustaining growth without exogenous technical progress and that the growth rate can be related to preferences, technology, income distribution and institutional arrangements. Pagano (1993) therefore reviewed the ground covered by earlier theoretical and empirical front and points to some still unresolved issues.

To capture the potential effects of financial development on growth, the theory considers the simplest endogenous growth model, that is, the 'AK' model, where aggregate capital stock is given as;

$$Y_t = AK_t \quad \text{..... 1}$$

Pagano stated that this production function can be seen as a reduced form resulting from one of two underlying frameworks. One is a competitive economy with external economies where each firm faces a technology with constant returns to scale but productivity is an increasing function of the aggregate capital stock K_t. Alternatively, the AK model can be derived assuming that K_t is a composite of physical and human capital, the two types of capital being reproducible with identical technologies.

Pagano assumes that the population is stationary and that the economy produces a single good that can be invested or consumed; and if invested, depreciates at the rate ϭ per period. Thus, gross investment then equals

$$I_t = K_{t+1} - (1\text{-}б)k_t \quad \text{.....2}$$

Where *(1-б)* is the flow of saving that is lost during financial intermediation.

In a close economy with no government, Capital market equilibrium requires that gross savings S_t equal gross investment I_t.

$$ΘS_t = I_t \quad \text{.....3}$$

From equation (1) the growth rate at time t+1 is

$$g_{t+1} = \frac{Y_{t+1}}{Y_{t+1}} - 1 = {K_{t+1}}/{K_t} - 1 \quad \text{.....4}$$

Using equation (2) and dropping that time indices, the steady-state growth rate can be written as:

$$g = A\frac{1}{Y} - б = AΘ_s - б \quad \text{..... 5}$$

Where $\frac{S}{Y} = S$ that is the gross saving rate.

Equation (5) reveals how financial development can affect growth in the following ways:

i. It can raise Θ the proportion of saving funnelled to investment, financial markets can help to increase the growth rate of g. In the process of transforming savings into investment, financial intermediaries absorb resources, so that a naira saved by households generate less than one naira worth of investment – the fraction Θ in equation (3). The remaining fraction 1-Θ goes to banks as the spread between lending and borrowing rates, and to security brokers and dealers as commissions, fees and, so on
ii. It may increase *A*, the social marginal productivity of capital; financial markets improve the allocation of capital thereby promoting growth. This can be done in two ways, one collecting information to evaluate alternative investment projects; and two inducing individuals to invest in riskier but more productive technologies by providing risk sharing.
iii. It can influence the private saving rate. In this instance the sign of the relationship is ambiguous, in that financial development may also reduce saving, and thereby growth. As capital markets develop, households gain better insurance against endowment stocks and better diversification of rate of return risk, while consumer credit becomes more readily and cheaply available.

2.3 Related Empirical Literature

There is few literature on bank scale efficiency in Nigeria, for instance Olaosebikan (2009) studied the efficiency of the Nigerian banking system 1999 and 2005. Bank efficiency was examined using data envelopment analysis (DEA) and the main determinants were identified using a Tobit model. The results indicated that efficiency fluctuated during the first part of the period and improved during the recent years, a period associated with increase in minimum capital requirement. The study also found that differences in bank efficiency were explained by problematic loans and bank size.

Similarly, Obafemi (2012) applied the data envelopment analysis (DEA) approach to examine the technical efficiency of Nigerian banks from 1984 to 2004. The result showed that on the average, banks in Nigeria were not efficient within the study period. However, it showed that liberalization improved the efficiency of banks in Nigeria, though the improvement did not last as the efficiency of some of the banks waned with continued liberalization. On the hand, Fagge et al (2012) investigated how banks efficiency has changed overtime in Nigeria. The study applied data envelopment analysis (DEA). The results suggest mixed developments in terms of technical, pure technical and scale efficiencies of banks during the assessment period. Average pure technical efficiency at 39.8 percent is higher than the scale and technical efficiencies at 30 and 24.5 percent, respectively, while average technical and efficiency change index were at 1.2 and 2.3 points, respectively.

3. Theoretical Framework

Model

The model is designed to investigate the technical efficiency of the Nigerian Credit Institutions, namely, Bank of Agriculture (BOA) Deposit Money Banks (DMBs) and Microfinance Banks (MFBs), which are involved in agricultural financing. This study adopts the Data Envelopment Approach (DEA) in evaluating the scale efficiencies. The DEA is a non-parametric approach that allows the assessment of banks' performance as homogenous Decision-Making Units (DMUs). The approach does not require any specification of a functional form of the production function. Similarly, in his contribution, Tahir *et al.* (2009) revealed that this technique identifies an efficiency frontier from which we can measure the distance of each DMU from the frontier. Efficient DMUs form the frontier, while less efficient ones are located inside the frontier. Efficiency score is measured as the ratio of the weighted sum of outputs to the weighted sum of inputs.

The concept of efficiency measurement can be divided into technical efficiency (TE) and allocative efficiency (AE) (Farrell, 1957). Technical efficiency is the firm's ability to obtain maximum output from a given set of input. While allocative efficiency refers to the firm's ability to use input in optimal proportions, given their respective prices and production technology.

Writing on efficiency measurement in the banking sector Tahir *et al.* (2009) revealed that the main objective of DEA is to determine which firms are operating on their efficient frontier and which firms are not. The researchers considered a general framework where n DMUs exist and each consumes the same m input to produce S output. They state that DMUj uses X_{ij} (I = 1, 2, 3, ..., m) of input ***i*** to produce Y_{rj} (r = 1,2,3,...,**s**) of output ***r*** assuming that $X_{ij}>0$ and $Y_{rj}>0$.

Flowing from the foregoing, the Nigerian Agricultural Credit Institutions would be treated as homogenous decision making units. These decision making units are Bank of Agriculture, Deposit money banks and Microfinance banks. They would be evaluated by solving the following optimization problem:

$$\max ho = \sum_{r=1}^{s} U_r Y_{ro} / \sum_{i=1}^{m} V_r X_{io} \quad \text{.....3.5}$$

Subject to the constraints

$$\sum_{r=1}^{s} U_r Y_{rj} / \sum_{i=1}^{m} V_i X_{ij} \leq 1,\ U_r \geq 0,\ V_i \geq 0.$$

For ***i*** = 1, 2, ..., m; ***r*** = 1, 2, ..., s; ***j*** = 1, 2, ...,n where h_o is the ratio of virtual outputs to virtual inputs, the U_{rjs} and V_{jjs} are the variables and the Y_{rojs} and X_{jojs} are the observed output and input values of the homogenous decision making units (DMUs) to be evaluated.

Apriori Expectations

A set of normalising constraints guarantees that no DMU can obtain an efficiency score that exceeds unity. If the efficiency score h0 = 1, DMU_0 satisfies the necessary condition to be data envelopment analysis (DEA) efficient; otherwise it is DEA inefficient.

3.2 Description of Variables and Measurement

3.2.1 Total Operating Income (TOI)

This refers to income resulting from a firm's primary business operations, excluding extraordinary income and expenses. It is also called earnings before interest and taxes. Total operating income gives a more accurate picture of a firm's profitability than gross income. TOI was computed from CBN and NDIC publications (various issues).

3.2.2 Non-Performing Loan (NPL)

This is when loan scheduled payment of interest and principal is past due date by 90 days or more, or at least 90 days of interest payments have been capitalized. When loan is refinanced or delayed by agreement or payment is less than 90 days overdue, but there are other good reasons to doubt that payments will be made in full. NPL was computed from CBN and NDIC publications (various issues).

3.2.3 Capital Adequacy Ratio (CAR)

Capital adequacy ratio (CAR) is expressed as a percentage of a bank's risk weighted credit exposures. It is used to protect depositors and promote the stability and efficiency of the banking system. CAR is the ratio of a bank's capital to its risk. It indicates the ability of a bank to absorb a reasonable amount of loss in compliance with statutory capital requirements. The CBN (2014) defined CAR as basically the proportion of the bank's tier 1 and tier 2 equity as a proportion of the banks risk weighted assets that is, loans. CAR helps regulators protect depositors from banks who lend aggressively and doing so; may not get back most of the money lent. The CAR data was computed from NDIC Publications (various issues).

3.2.4 Total Assets (TAS)

Total assets (TAS) are the sum of all current and non- current assets that a bank owns. They are reported on the banks balance sheet. The total assets figure is based on the purchase price of the listed assets. And not the fair market value. TAS is made up of the banks liabilities plus stockholders equity. The TAS data was computed from NDIC Publications (various issues).

3.2.5 Liquidity Ratio (LRA)

Liquidity ratio has to do with the ability of a bank to meet its financial obligations as they come due. It is a computation that is used to measure a bank's ability to pay its short-term debts. There are three common calculations that fall under the category of liquidity ratios. T he current ratio is the most liberal of the three. It is followed by the acid ratio, and the cash ratio. The current ratio indicates a bank's ability to pay its liabilities from its current assets. This ratio is the one used to quickly measure the liquidity of a bank. It is defined as current assets divided by current liabilities. On the other hand acid ratio also called quick ratio measures how well a bank can meet its short-term obligations with its most liquid assets. Acid ratio equals a summation of cash and cash equivalents plus short term investment plus account receivable all over current liabilities.LRA figures were computed from CBN and NDIC Publications (various issues).

3.2.6 Loan- to- Deposit Ratio (LDR)

This ratio is used to calculate a lending institutions ability to cover withdrawals made by its customers. A bank that accepts deposits must have certain measure of liquidity to maintain its normal daily operations. Loans given to its customers are mostly not considered liquid, that is, they are investments over the given loan period of time. LDR is a ratio between the banks total loans and its total deposits. If the ratio is lower than one (LDR>1); the bank borrows money which it re-loans at higher rates, rather than relying entirely on its own deposits. Banks may not be earning an optimal return if the ratio is too low. If the ratio is too high the bank might not have enough liquidity to cover any unforeseen funding requirements or economic crises.

3.3 Sources of Data

The data for the study were obtained mainly from secondary sources, such as the Nigeria Deposit Insurance Corporation (NDIC) Annual Report and Statement of Accounts (Various issues) and Bank of Agriculture (BOA) publications.

3.4 Method of Data Analysis

There are two ways of measuring bank outputs, namely production approach and the intermediation approach. The production approach highlights banks' activities such as creation of accounts, procession of deposits and loans and acquisition of operating costs. While under the Intermediation approach, banks are treated as financial intermediaries that combine deposits, labour and capital to produce loans and investments. The values of loans and investments are treated as output measures; labour, deposits and capital are inputs; and operating costs and financial expenses comprises total cost (Fagge, et al. 2012). In line with the intermediation roles of Nigerian agricultural credit institutions to farming individuals and enterprises, this study would use the intermediation approach to define banks input and output. Accordingly, three inputs; (X), and three outputs (Y) would be used. These are Total Assets (X_1), Capital Adequacy Ratio (X_2) and Liquidity Ratio (X_3); Total Operating Income (Y_1), Non-performing Loans (Y_2) and Loan-to-Deposit Ratio (Y_3).

Data envelopment analysis would be employed to ascertain the efficiency of the credit institutions. It provides an efficiency rating that is generally denominated between zero and 1, which will inter-changeably be referred to as an efficiency percentage between the range of zero and 100%. The upper limit is set as 1 or 100% to reflect the view that a decision-making unit (DMU) cannot be more than 100% efficient.

4. Analysis of Results

The Data Envelopment Analysis (DEA) was used to analyse the efficiency status of the inputs deployed by the Agricultural Credit Institutions. It is instructive to know that the DEA is a veritable means for ensuring efficiency of the Decision Making Units (DMUs) using linear programming techniques to envelope observed inputs- outputs vectors as tightly as possible. Our proposed measure of efficiency of any decision making units is obtained as the maximum of a ratio of weighted outputs to weighted inputs subject to the condition that the similar ratio for every DMU's is less than one.

Next, we proceed to evaluate the rank of the decision making unit regarding its activity for each of the year under study. The study used the inter-mediation approach to define bank input and output. Accordingly, three inputs and three outputs are used. The inputs are Total Assets (X_1), Capital Adequacy Ratio (X_2), and Liquidity Ratio (X_3), while the outputs are Total Operating Income (Y_1), Non-Performing Loan (Y_2) and Loan to Deposit Ratio (Y_3). Data Envelopment Analysis (DEA) provides an efficiency rating that is generally denominated between 0 and 1, which will interchangeably be referred to as an efficiency percentage between the range of zero and one hundred percent. The upper limit is set as 1 or 100% to reflect the view that a decision making units cannot be more than 100% efficient. Statistical/Data Analysis (STATA) special edition was used to perform all computations.

4.1 Data Envelopment for Deposit Money Banks (DMBs)

Table 4.1 presents the variable returns to scale (VRS) outputs of the Nigerian credit institutions, that is the Deposit Money Banks (DMBs), Microfinance Banks (MFBs), and Bank of Agriculture (BOA). These are the decision making unit (DMUs) used in the study. For ease of reference the discussion of results take each DMU separately.

Table 4.1: VRS-Output Oriented DEA Efficiency Results for DMBs, MFBs and BOAs

Year	DMBs		MFBS		BOAs	
	Rank	Theta	Rank	Theta	Rank	Theta
1992	1	1	19	0.82	1	1
1993	1	1	24	0.61	24	0.82
1994	1	1	22	0.71	21	0.87
1995	1	1	21	0.72	14	1
1996	10	0.99	15	0.91	15	1
1997	1	1	1	1	16	1
1998	11	0.96	1	1	20	0.89
1999	22	0.68	1	1	22	0.86
2000	24	0.62	1	1	18	0.95
2001	18	0.81	18	0.82	23	0.85
2002	20	0.77	1	1	1	1
2003	19	0.79	1	1	1	1
2004	17	0.82	1	1	1	1
2005	16	0.84	1	1	1	1
2006	12	0.96	14	0.91	1	1
2007	1	1	20	0.78	1	1
2008	1	1	17	0.87	1	1
2009	1	1	11	0.66	1	1
2010	23	0.66	23	0.66	1	1
2011	13	0.94	1	1	1	1
2012	15	0.86	13	1	1	1
2013	14	0.87	12	1	1	1
2014	1	1	16	0.87	0.87	0.89
2015	1	1	1	1	17	0.98

Source: Author's Computation Using STATA Output

The evaluatiosn of rank of the Decision making unit 1,that is, (DMBs) revealed that for the years 1992, 1994, 1995, 1997, 2007, 2008 and 2009 have the same rank of 1 which implies that DMBs operated on efficiency levels in these years, Also, 1996 is ranked

10 while 1998 is ranked 11. In addition, year 2006 is ranked 12; 2011 is ranked 13; 2013 is ranked 14. In other ranking, year 2012 is ranked 15 while 2005, 2004, 2001, and 2003 occupies the 16th, 17th, 18th and 19th position respectively. The year 2002 is ranked 20; 1993 is ranked 21, 1999 is ranked 22; 2010 is ranked 23 and year 2000 is ranked 24.

The technical efficiency measure (theta) on which the ranking is based was examined and it was discovered that inputs deployed by the DMBs in year 1992, 1994, 1995, 1997, 2007, 2008, 2009, 2014 and 2015 are technically efficient. The reason behind this is that the aforementioned years have a unit value for their theta. It was further observed that all the inputs deployed are strongly efficient because they have no slack at the input and the output level.

A referent is an inefficient DMU which targets efficient DMU as a fastest step to get to an optimum. This was examined and the result revealed that 1992, 1994, 1995, 1996, 2007, 2008, 2009, 2014 and 2015 are referents. This implies that all the inefficient DMBs used them as targets and fastest step to attain position of optimality. Consequently, the result showed that there are nine corresponding reference years in this study.

The study revealed the technical efficiency score for the DMBs for 1993, 1996, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2010, 2011, 2012 and 2013 to be 69, 99, 96, 68, 62, 81, 77, 79, 82, 84, 96, 66, 94, 86 and 87 percent respectively and implies that 31, 0.04, 4, 32, 38, 19, 23, 21, 18, 16, 4, 34, 6, 14 and 13 percent reduction in their respective inputs would get them back to the position implied by the weights of 1992, 1994, 1995, 1997, 2007, 2008, 2009, 2014 and 2015 respectively. Operations in the DMBs in 1993 and 2006 need to reduce input by 57 and 70 percent respectively to get to the optimal efficiency position implied by activities in1992 and 1996 activity needs to reduce input employed by 95 percent to get to the optimal efficiency position implied in 1994. While 2006 activity needs to reduce input by 76, 26, 100, 98 and 90 percent respectively to get to the optimal efficiency position implied by 1995. On the other hand, the DMBs Operations in 1998, 1999, 2000, 2001, 2002, 2003, 2004 and 2005 need to reduce their input by 11, 57, 75, 59, 69, 92, 79 and 79 percent respectively to get to the optimal efficiency position implied by 1997. While operations in 2010 and 2011 need to reduce input by 52 and 93 percent respectively to get to the optimal efficiency position implied by 2009.

The result indicates that 1992 is the reference for the inefficient 1993 and 2006; 1994 is the reference for the inefficient year 1996; 1995 is the reference for the inefficient 1993, 1996, 2003, 2005 and 2006; 1997 is the reference for the inefficient 1996, 1998, 1999, 2000, 2001, 2002, 2003, 2004 and 2005; 2007 is the reference for the inefficient 1993, 2006, 2011, 2012 and 2013; 2008 is the reference for the inefficient 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2011 and 2013; 2009 is the reference for the inefficient 1992, 2003, 2010 and 2011; 2014 is the reference for the inefficient 2011 and 2013 and 2015 is the reference for the inefficient 1996, 2010, 2012 and 2013.

The reference output weights (lambdas) indicated percentage reduction in inputs that would improve the performance of the identified DMBs whatever other changes the DMBs make. The other possible changes are indicated by the slacks. Thus, activity in 1993 has a positive slack: 0.0027 on total asset, 8.0746 on liquidity ratio and 0.6376 on total operating income. Furthermore, 1996 activity has a positive slack: 0.0002 on total asset and 7.6815 on liquidity ratio. Similarly activities in 1998 have a positive slack: 27.929 on total asset, 6.0422 on liquidity and 6.0891 on total operating income. Like in other years, the DMBs activity in 2009 has a positive slack: 0.0013 on total asset, 2.3786 on capital adequacy ratio, 13.2255 on liquidity ratio, 8.4451 on total operating income and 38.9361 on non performing loans. While activity of DMBs in 2000 have a high positive slack 1115.08 on total asset, a small positive slack 7.1472 on liquidity ratio, 6.0639 on total operating income and 100.213 on non performing loans. Year 2001 operation has a high positive slack 9770.33 on total asset, a small positive slack 8.6917 on liquidity ratio, 0.1555 on total operating income and 89.6023 on non performing loan. 2002 operation has a high positive slack 12292.8 on total asset, has a small positive slack 20.4101 on liquidity ratio, 3.4881 on total operating income and 92.067 on non performing loans. In addition, DMBs operation in 2003 has a high positive slack 13045.7 on total asset, a small positive slack 8.3741 on liquidity ratio, 24.1785 on total operating income and 17.9548 on non performing loans. Also, 2004 operation has a high positive slack 17913.2 on total asset, has a small positive slack 6.0422 on liquidity ratio and 5.4655 on total operating income. 2005 has a high positive slack 24589.2 on total asset, has a small positive slack 4.8484 on liquidity ratio, 19.2264 on total operating income and 13.5261 on non performing loan for the DMBs operation. On the other hand,. 2006 has a small positive slack 5.1758 on capital adequacy ratio, 14.177 on liquidity ratio and 31.9008 on total operating income. 2010 operations have a positive slack on 80.7026 on total asset, 2.3556 on capital adequacy ratio, 79.343 on non performing loans and 26.7981 on loan to deposit ratio. 2011 operations have a positive slack 1.1608 on liquidity ratio and 17.7052 on loan to deposit ratio. 2012 operations have a positive slack 1.6995 on total asset, 1.8867 on capital adequacy ratio, 9.5609 on liquidity ratio and 4.3256 on loan to total deposit. Also, 2013 operations have a high positive slack 2035.69 on total asset and has a small positive slack 19.9278 on liquidity ratio.

The performance of DMBs in 1993 can be improved by reducing input through total asset and liquidity ratio by 0.0027 and 8.0746 respectively and subtracting a further 99.36 percent from total operating income after having reduced all inputs by 31 percent without putting any other input or output in a worse position. Also, 1996 performance of the DMBs can be improved by reducing input through total asset and liquidity ratio by 0.0002 and 7.6815 respectively and subtracting a further 98.5 percent from non performing loan after having reduced all inputs by 0.04 percent without putting any other input or output in a worse position. The performance of DMBS in 1999 can be improved by reducing input through total asset, capital adequacy ratio and liquidity ratio by 0.0013, 2.3786 and 13.2255 respectively and subtracting a further 92 and 51 percent from total operating income and non performing loans respectively, after having reduced all inputs by 32 percent without putting any other input or output in a worse position. In like manner, the performance of DMBs in 2000 can be improved by reducing input through total asset and liquidity ratio by 1115.08 and 7.1472 respectively and subtracting additional 94 and -0.213 percent from total operating income and non performing loans after having reduced all inputs by 38 percent. DMBs 2001 performance can be improved by reducing input through total asset and liquidity ratio by 9770.33 and 8.6917 and subtracting additional 84 and 10 percent respectively from total operating income and non performing loans after having reduced all inputs by 19 percent.

The performance of the DMBs in 2002 can be improved by reducing the input of total asset and liquidity ratio by 12292.8 and 20.4101 and subtracting additional 96.5 and 8 percent respectively from total operating income and non performing loans after having reduced all inputs by 23 percent. 2003 performance can be improved by reducing the input of total asset and liquidity ratio by 13045.7 and 8.3741 and subtracting additional 75 and 82 percent respectively from total operating income and non performing loans after having reduced all inputs by 21 percent. 2004 performance of the DMBs can be improved by reducing input through total asset and liquidity ratio by 17913.2 and 6.04224 and subtracting additional 94.5 and from total operating income, after having reduced all inputs by 18 percent. The performance of the banks in 2005 can be enhanced by reducing the input of total asset and liquidity ratio by 24589.2 and 4.8484 and subtracting further 81 and 86 percent respectively from total operating income and non performing loans after having reduced all inputs by 16 percent. 2006 performance of the DMBs can be improved by reducing the input of the capital adequacy ratio and liquidity ratio by 5.1758 and 14.177 and subtracting further 68 percent from the total operating income after having reduced all inputs by 4 percent. The performance of DMBs in 2010 can be improved by reducing the input of the total asset and liquidity ratio by 80.7026 and 2.3556 and subtracting additional 29 and 73 percent respectively from non performing loans and loan to deposit ratio after having reduced all inputs by 34 percent. 2011 performance of the DMBs can be enhanced by reducing input through liquidity ratio by 1.1608 and subtracting further 82 percent from the loan to deposit ratio after having reduced all inputs by 6 percent. The performance of DMBs can be improved by reducing the input of the total asset, capital adequacy and liquidity ratio by 1.6995, 1.8867 and 9.5609 respectively and subtracting further 95.7 percent from loan to deposit ratio after having reduced all inputs by 14 percent. 2013 performance can be improved by reducing input through total asset and liquidity ratio by 2035.69 and 19.9278 respectively after having reduced all inputs by 13 percent. All these performance analysis were done without putting any other input or output in a worse position.

4.1.2 Scale Efficiency Measure of DMBs

The section deals with the technical efficiency measurement of the Deposit Money Banks (DMBs). This is evaluated using the technical, pure technical and scale efficiency. The analysis for each year is presented in table 4.14 below:

Table 4.2 Variable Return to Scale (VRS) Frontier for DMB

Code: VRS Frontier(-1:drs, 0:crs, 1:irs)					
	2	3	4	5	6
DMU:DBM	CRS_TE	VRS_TE	NIRS_TE	SCALE	RTS
1992	1.000	1.000	1.000	1.000	0.000
1993	0.684	0.692	1.000	0.989	1.000
1994	1.000	1.000	1.000	1.000	0.000
1995	1.000	1.000	1.000	1.000	0.000
1996	0.993	0.996	1.000	0.997	-1.000
1997	1.000	1.000	1.000	1.000	0.000
1998	0.904	0.962	1.000	0.940	1.000
1999	0.453	0.683	1.000	0.663	1.000
2000	0.437	0.621	0.782	0.703	1.000
2001	0.550	0.809	1.000	0.679	1.000
2002	0.486	0.766	1.000	0.635	1.000
2003	0.613	0.785	1.000	0.781	-1.000
2004	0.567	0.823	0.961	0.689	1.000
2005	0.621	0.838	1.000	0.740	1.000
2006	0.924	0.961	1.000	0.962	-1.000
2007	1.000	1.000	1.000	1.000	0.000
2008	1.000	1.000	1.000	1.000	0.000
2009	1.000	1.000	1.000	1.000	0.000
2010	0.660	0.660	1.000	1.000	0.000
2011	0.938	0.943	1.000	0.994	1.000
2012	0.857	0.858	1.000	0.999	1.000
2013	0.816	0.869	1.000	0.938	1.000
2014	1.000	1.000	1.000	1.000	0.000
2015	1.000	1.000	1.000	1.000	0.000

Source: Author's Computation output.

Table 4.2 represents the Variable Return to Scale (VRS) frontier for the first decision making units, the Deposits Money Banks (DMBs). If a constant return to scale (CRS) is assumed, the technical efficiency score is reported in column 2. Column 3 shows the technical efficiency score if Variable Returns to Scale (VRS) is assumed while Column 4 reports the technical efficiency score if non-increasing returns to scale is assumed. Column 6 reports whether the DMU operates on the increasing returns segment of the frontier, on the constant returns segment, or on the decreasing returns segment. It is suffice to mention at this juncture that the Non-increasing returns would be either constant returns to scale or decreasing returns to scale. In addition, decreasing returns to scale exist when an increase in all inputs at a fixed rate causes output to fall. Column 5 reports the scale efficiency score of decision-making units for the various years.

The DMBs in the year 1992 operated on the constant returns to scale segment of the variable return to scale frontier and has a scale

efficiency of 1. For analytical purposes, scale efficiency is simply measured as the ratio of the constant returns technical efficiency to variable returns to scale efficiency. Generally speaking, in a constant return to scale, doubling the factor inputs will naturally leads to a double in the level of initial output. Thus, an increase in the level of the total assets, capital adequacy ratio and the liquidity ratio of the deposits money banks by 50 percent would increase the Total operating income, Non performing loans and loan to deposit ratio by 100 percent. The other years where the deposit money banks in Nigeria operated on the constant return to scale frontiers are year 1993, 1994, 2007, 2008, 2009, 2010, 2014 and 2015.

The DBMs however operated on the increasing returns to scale frontiers and had a scale efficiency of 99 percent, 94 percent, 66 percent, 70 percent, 68 percent, 78 percent, 69 percent and 74 percent in 1993, 1998, 1999, 2000, 2001, 2002, 2003, 2004 and 2005 respectively. This implies that the deposit money banks can effectively reduce their inputs for the aforementioned years by 1 percent, 6 percent, 44 percent, 30 percent, 22 percent, 32 percent and 26 percent in order to move to a constant return to scale frontier. In addition, in the year 2011, 2012 and 2013, the DMBs also operated on the increasing return to scale segment of the frontier. For instance, the scale efficiency for the year 2011 and 2012 stood at 99 percent each while that of 2013 stood at 93 percent. This suggests that the DMBs can reduce their inputs by 7 percent or less in 2013 to be able to efficiently deploy all their available input resources to achieve maximum output.

Furthermore, the DMBs operated on the decreasing return to scale segment of the frontier on three different years in the study period. Their scale efficiency in the year 1996, 2003 and 2006 stood at 99 percent, 78 percent and 96 percent respectively. It is instructive to note that since they are on the decreasing return to scale segment of the VRS frontier, they can improve their efficiency by reducing both their inputs and output until they can operate with the level of resources obtainable in the years where constant return to scale is possible.

4.2 Data Envelopment Analysis of Microfinance Banks (MFBs)

The evaluation of rank of the DMBs reveals that activities of the banks in 1997, 1998, 1999, 2000, 2002, 2003, 2004, 2005, 2011 and 2015 have the same rank of 1. Also, 2009 is ranked 11, 2013 is ranked 12, 2012 is ranked 13, 2006 is ranked 14, 2016 is ranked 15, 2014 is ranked 16, 2008 is ranked 17, 2001 is ranked 18, 1992 is ranked 19, 2007 is ranked 20, 1995 is ranked 21, 1994 is ranked 22, 2010 is ranked 23 and 1993 is ranked 24.

The technical efficiency measure (theta) on which the ranking is based was examined and it was discovered that MFBs operations in 1997, 1998, 1999, 2000, 2002, 2003, 2004, 2005, 2009, 2011 and 2015 are technically efficient. The reason behind this is that the aforementioned MFBs have a unit value for their theta. It was further observed that all the MFBs are strongly efficient because they have no slack at the input and the output level.

A referent is an inefficient MFB which targets efficient MFB as a fastest step to get to an optimum. This was examined and the result revealed that MFBs operations in 1997, 1998, 1999, 2002, 2003, 2004, 2010, and 2013 are referents. This implies that all the inefficient MFBs used them as targets and fastest step to attain position of optimality. Consequently, the result showed that there are eight corresponding reference MFBs in this study.

The study revealed the technical efficiency score for the MFBs in 1992, 1993, 1994, 1995, 1996, 2001, 2006, 2007, 2008, 2010 and 2014 to be 82 percent, 61 percent, 71 percent, 72 percent, 91 percent, 82 percent, 91 percent, 79 percent, 87 percent, 66 percent and 87 percent respectively. The result indicates that activity in 1997 is the reference for the inefficient activity in year 1995 and 1996. 1998 is the reference for the inefficient 1995 activity; 1999 is the reference for the inefficient 1995 and 1996. 2000 is the reference for the inefficient 1992 and 1993; 2003 is the reference for the inefficient activity in 1993, 1994, 1995 and 1996. 2004 is the reference for the inefficient activity 2001. While 2005 is the reference for the inefficient year 2001. The year 2015 is the reference for the inefficient 2008, 2010, 2012 and 2014.

Activities in Year 1992, 1993, 1994, 1995, 1996, 2001, 2006, 2007, 2008, 2012 and 2014 and is given as 82, 61 percent, 71 percent, 72 percent, 91 percent, 82 percent, 91 percent, 79 percent, 87 percent, 66 percent and 87 percent respectively. This implies that 18, 39, 29, 9, 18, 9, 21, 13, 34 and 13 percent reduction in their respective input would get them back to the position implied by the weights of 1997, 1998, 1999, 2000, 2003, 2004, 2005, 2009 and 2015 respectively.

The reference output weights (lambdas) discussed for the MFBs showed percentage reduction in inputs that would improve the performance of the identified MFBs whatever other changes the MFBs makes. The other possible changes are indicated by the slacks. Thus, activities of the MFBs in year 1992 has a positive slack: 0.64 on capital adequacy ratio, 20.37 on liquidity ratio, 66.17 on total operating income and 7.7 on loan to deposit ratio. Year 1993 operations have a positive slack: 12.72 on liquidity ratio and 268.805 on total operating income. The same applies to 1994 operations which have a positive slack: 1.36 on liquidity ratio, 273.84 on total operating income and 7.37 on non performing loan. In addition, operations in 1995 have a positive slack: 142.27 on total operating income and 6.73 on non performing loan. Year 1996 operations have a positive slack: 197.93 on total operating income and 8.15 on non performing loan while activities in 2001 have a positive slack: 0.37 on capital adequacy ratio, 338.91 on total operating income and 4.68 on loan to deposit ratio. In the same vein, year 2006 operations have a positive slack: 17.45 on liquidity ratio, 501.95 on total operating income and 2.85 on loan to deposit ratio while 2007 operations have a positive slack: 10.90 on liquidity ratio and 85.18 on total operating income. Also, activities in 2008 have a positive slack: 0.94 on capital adequacy ratio and 8.89 on non performing loan. It was also discovered that operations in 2010 have a positive slack: 4.59 on liquidity ratio, 164.81 on total operating income and 5.12 on non performing loan. 2012 operations of the MFBs have a positive slack: 13.11 on total asset and 2871.81 on total operating income. The year operations 2013 have a positive slack: 16.32 on total asset, 1087.23 on total operating income and 11.69 on non performing loan. Finally, activities in 2014 by the MFBs have a positive slack: 33.62 on total asset and 1277.83 on total operating income.

The performance of the MFBs in 1992 can be improved by reducing input through capital adequacy ratio and liquidity ratio by 0.64 and 20.37 respectively and subtracting a further 34 and 92 percent from total operating income and loan to deposit ratio after having reduced all inputs by 18 percent without putting any other input or output in a worse position. It must be noted that performance of 1993 can be improved by reducing input through liquidity ratio by 13 and subtracting a further -169 percent from

total operating income after having reduced all inputs by 39 percent without putting any other input or output in a worse position. In the same vein, the performance of 2001 can be improved by reducing input through capital adequacy ratio by 0.37 and subtracting a further -239 and 95 percent from total operating income and loan to deposit ratio respectively, after having reduced all inputs by 29 percent without putting any other input or output in a worse position. The performance of the MFBs in 2008 can be improved by reducing input through capital adequacy ratio by 0.94 and subtracting additional 91 percent from non performing loans after having reduced all inputs by 14 percent. Finally, 2014 performance can be improved by reducing input through total asset by 34 and subtracting additional -1178 percent from total operating income after having reduced all inputs by 13 percent.

4.2.1 Scale Efficiency for Micro Finance Banks:

This section deals with the technical efficiency measurement of the Microfinance Banks (MFBs) as decision making units. The evaluation is done using the technical, pure technical and scale efficiency. The analysis for each year is presented hereunder.

Table 4.2.1: VRS Frontier Table of Microfinance Banks

Code: VRS Frontier(-1:drs, 0:crs, 1:irs)					
	2	3	4	5	6
DMU:MFB	CRS_TE	VRS_TE	NIRS_TE	SCALE	RTS
1992	0.816	0.816	1.000	1.000	0.000
1993	0.612	0.613	1.000	0.998	1.000
1994	0.701	0.708	1.000	0.990	1.000
1995	0.703	0.715	1.000	0.983	1.000
1996	0.907	0.911	1.000	0.995	1.000
1997	1.000	1.000	1.000	1.000	0.000
1998	1.000	1.000	1.000	1.000	0.000
1999	0.888	1.000	1.000	0.888	-1.000
2000	1.000	1.000	1.000	1.000	0.000
2001	0.813	0.818	1.000	0.993	1.000
2002	1.000	1.000	1.000	1.000	0.000
2003	1.000	1.000	1.000	1.000	0.000
2004	1.000	1.000	1.000	1.000	0.000
2005	1.000	1.000	1.000	1.000	0.000
2006	0.883	0.913	1.000	0.968	1.000
2007	0.723	0.786	1.000	0.919	1.000
2008	0.743	0.865	1.000	0.858	-1.000
2009	1.000	1.000	1.000	1.000	0.000
2010	0.565	0.659	1.000	0.857	1.000
2011	0.975	1.000	1.000	0.975	-1.000
2012	1.000	1.000	1.000	1.000	0.000
2013	0.950	1.000	1.000	0.950	1.000
2014	0.864	0.865	1.000	0.998	1.000
2015	1.000	1.000	1.000	1.000	0.000

Source: Author's Computation.

The result of the Variable Returns to Scale (VRS) frontier shows that the MFBs operated on the constant return to scale portion of the production frontier for 11 years. For instance, in 1992, 1997, 1998 and 2000, the scale efficiency is equal to unity. The same situation was observed between year 2002 and 2005. It was discovered that an increase in the output of the Microfinance Banks in the study periods yielded a corresponding increases in the output of such banks in the same proportion. Also, the Microfinance Banks operated on the increasing return to scale, for instance, 1993and 1996. The scale efficiency for the year 1993, 1994, 1995 and 1996 are 99 percent, 99 percent, 98 percent and 99 percent respectively. This means that the MFBs can reduce their inputs use by 1 percent in 1993, 1994 and 1996 and 2 percent in 1995 in order to move to the constant returns to scale. This further means that by scaling up inputs of the Microfinance Banks, output rate can increase faster than its inputs.

Finally, there was a decreasing return to scale in the MFBs operation in 1999, 2008 and 2011. If the Microfinance Banks can adopt the resource mix of 1992, they would be able to operate on the constant return to scale. This is possible if the total assets, capital adequacy ratio and liquidity ratio of the Microfinance Banks are reduced by 12 percent (1999), 15 percent (2008) and 3 percent (2011) respectively.

4.3 Data Envelopment Analysis of Bank of Agriculture (BOA)

The evaluation of rank of the BOA reveal that 1992, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012 and 2013 have the same rank of 1. Also, 1995 is ranked 14, 1996 is ranked 15, 1997 is ranked 16, 2015 is ranked 17, 2000 is ranked 18, 2014 is ranked 19, 1998 is ranked 20, 1994 is ranked 21, 1999 is ranked 22, 2001 is ranked 23 and 1992 is ranked 24.

The technical efficiency measure (theta) on which the ranking is based was examined and it was discovered that BOA operations in 1992, 1995, 1996, 1997, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012 and 2013 are technically efficient. The reason behind this is that the aforementioned BOA operations have value of theta equal one. It was further observed that all the BOA activities except in 1995 and 1996 are strongly efficient because they have no slack at the input and the output level.

In addition, the results also revealed that the operations of BOA in year 1992, 2002, 2003, 2004, 2005, 2006, 2007, 2008 and 2009 are referents. This implies that all the inefficient units used them as targets and fastest step to attain position of optimality. Consequently, the result showed that there are nine corresponding reference DMUs in this study. The study revealed the technical efficiency score for 1993, 1994, 1998, 1999, 2000 2001, 2014 and 2015 to be 82, 87, 89, 86, 95, 85, 89 and 98 percent respectively.

It was also noted that operations in 1993, 1994, 1998, 1999, 2000, 2001, 2014 and 2015 have a technical efficiency score of 82, 87, 89, 86, 95, 85, 89 and 98 percent respectively, this implies that 18, 13, 11, 14, 5, 15, 11 and 2 percent reduction in respective input would get back to the position implied by the weights of 1992, 2002 and 2004 respectively.

The reference (output) weights (lambdas) was considered for the BOA units and it was discovered that score for 1993, 1994, 1995, 1996, 1997, 1998 and 2000 are 0.69, 0.69, 0.71, 0.84, 0.65, 0.55, 0.06 and 0.39 respectively. These reveal that 31, 31, 29, 16, 35, 45, 94 and 61 percent reduction in inputs would improve the performance of identified BOA units. The other possible changes that are indicated are the slacks. Thus, operations in 1993 have a high positive slack 5585.15 on total and a small positive 0.4316 on capital adequacy ratio, 1994 operations have a high positive slack 1274.76 on total asset and positive slack 14.0504 on liquidity ratio; 1995 operations have a high positive slack 1945.4 on total asset and a small positive slack 0.6492 on capital adequacy and 1996 activities have a high positive slack 5179.78 on total asset and a small positive slack 2.0678 on capital adequacy ratio.

The performance of BOA units in 1993 can be improved by reducing input through total asset and capital adequacy ratio by 5585.15 and 0.4316 respectively, after having reduced all inputs by 31 percent. 1994 performance can be improved by reducing input through total asset by 1274.76 and subtracting a further 86 percent from liquidity ratio after having reduced all inputs by 31 percent. The performance of 1995 can be improved by reducing input through total asset and capital adequacy ratio by 1945.4 and 0.6492 respectively, after having reduced all inputs by 29 percent. The performance of 1996 can be improved by reducing input through total asset and capital adequacy ratio by 5179.78 and 2.0678 respectively, after having reduced all inputs by 16 percent. All these performance analysis were done without putting any other input or output in a worse position. It must be noted in this study that all entries such as "." mean that the value is virtually zero or too small to mention.

4.3.1 Scale Efficiency Measurement of Bank of Agriculture (BOA)

The section deals with the technical efficiency measurement of the Bank of Agriculture (BOA). This is evaluated using the technical, pure technical and scale efficiency. The analysis for each year is presented in the table 4.13 below.

Table 4.3.1: Scale Efficiency for Bank of Agriculture (BOA)

Code: VRS Frontier(-1:drs, 0:crs, 1:irs)					
1	2	3	4	5	6
DMU:BOA	CRS_TE	VRS_TE	NIRS_TE	SCALE	RTS
1992	1.000	1.000	1.000	1.000	0.000
1993	0.800	0.819	0.863	0.977	1.000
1994	0.783	0.868	1.000	0.902	1.000
1995	0.893	1.000	1.000	0.893	1.000
1996	1.000	1.000	1.000	1.000	0.000
1997	1.000	1.000	1.000	1.000	0.000
1998	0.884	0.890	0.886	0.993	1.000
1999	0.854	0.855	1.000	0.998	1.000
2000	0.933	0.951	0.933	0.980	1.000
2001	0.852	0.852	1.000	1.000	0.000
2002	1.000	1.000	1.000	1.000	0.000
2003	1.000	1.000	1.000	1.000	0.000
2004	1.000	1.000	1.000	1.000	0.000
2005	0.976	1.000	1.000	0.976	-1.000
2006	1.000	1.000	1.000	1.000	0.000
2007	1.000	1.000	1.000	1.000	0.000
2008	1.000	1.000	1.000	1.000	0.000
2009	1.000	1.000	1.000	1.000	0.000
2010	1.000	1.000	1.000	1.000	0.000
2011	1.000	1.000	1.000	1.000	0.000
2012	1.000	1.000	1.000	1.000	0.000
2013	1.000	1.000	1.000	1.000	0.000
2014	0.872	0.891	1.000	0.979	1.000
2015	0.960	0.984	1.000	0.975	1.000

Source: Author's Computation.

The result shows that constant return to scale was observed and operated on by the Banks of Agriculture (BOA) in 1992, 1996 and 1997. In all these years, the scale efficiency was unity. This implies that by doubling the resources inputs like total assets, output will be doubled. In addition, it was that the BOA units operated on the increasing return to scale segment of the frontier and had a scale efficiency of 98 percent, 90 percent and 89 percent in the year 1993, 1994 and 1995 respectively. The implication of this is that

BOA can reduce her inputs use by about 2 percent, 10 percent and 11 percent for the year 1993, 1994 and 1995 respectively. This is a must if BOA must move on the matrix of constant return to scale frontier. This result further shows that the BOA can increase her output rate, that is, total operating income, Non performing loan and loan to deposit ratio, faster than inputs rates by scaling up both inputs and outputs along the frontier to the same point where constant returns to scale is obtainable.

4.4 Comparison of Technical Efficiency of the Credit Institutions

Table 4.4.1 Scale and Returns-to-Scale Efficiencies of the Credit Institutions

Year	DMBs(1)		MFBS(2)		BOAs (3)	
	Scales	RTS	Scales	RTS	Scales	RTS
1992	1.000	0.000	1.000	0.000	1.000	0.000
1993	0.989	1.000	0.998	1.000	0.977	1.000
1994	1.000	0.000	0.990	1.000	0.902	1.000
1995	1.000	0.000	0.983	1.000	0.893	1.000
1996	0.997	-1.000	0.995	1.000	1.000	0.000
1997	1.000	0.000	1.000	0.000	1.000	0.000
1998	0.940	1.000	1.000	0.000	0.993	1.000
1999	0.663	1.000	0.888	-1.000	0.998	1.000
2000	0.703	1.000	1.000	0.000	0.980	1.000
2001	0.679	1.000	0.993	1.000	1.000	0.000
2002	0.635	1.000	1.000	0.000	1.000	0.000
2003	0.781	-1.000	1.000	0.000	1.000	0.000
2004	0.689	1.000	1.000	0.000	1.000	0.000
2005	0.740	1.000	1.000	0.000	0.976	-1.000
2006	0.962	-1.000	0.968	1.000	1.000	0.000
2007	1.000	0.000	0.919	1.000	1.000	0.000
2008	1.000	0.000	0.858	-1.000	1.000	0.000
2009	1.000	0.000	1.000	0.000	1.000	0.000
2010	1.000	0.000	0.857	1.000	1.000	0.000
2011	0.994	1.000	0.975	-1.000	1.000	0.000
2012	0.999	1.000	1.000	0.000	1.000	0.000
2013	0.938	1.000	0.950	1.000	1.000	0.000
2014	1.000	0.000	0.998	1.000	0.979	1.000
2015	1.000	0.000	1.000	0.000	0.975	1.000

Source: Author's Computation

Table 4.4.1 presents the scale efficiencies of the Nigerian credit institutions. The comparison of the scale efficiency of the Nigerian Credit Institutions is anchored on the assumption that inputs are resources employed in producing the outputs. Then our objective is to observe among like units the ones having the greatest amount of output for the amount of resources used. According to Bessent and Bessent (1979) a DMU is not efficient in producing its output (from given amounts of input) if it can be shown that some redistribution of resources will result in the same amount of this output with less of some resource and no more of any other resource. Conversely a firm is efficient if this is not possible. This study employed the scale efficiency to compare the relative effectiveness of the Credit Institutions in the investment of their resources in the Nigerian agricultural sector. The choice of this variable is predicated on the presumption that a firm or a decision making unit operating on increasing returns to scale means that by doubling its inputs, outputs will also doubled. From the scale efficiency scores of the Credit Institutions (Table 4.14) above it revealed that the Deposit Money Banks (DMBs) exhibited scale efficiency in 1992, 1994, 1995, 1997, 2007, 2008, 2009, 2010, 2014 and 2015 respectively.

On the other hand, the Microfinance Banks (MFBs) indicated scale efficiency in 1992, 1997, 1998, 2000, 2002, 2003, 2004, 2005, 2009, 2012 and 2015. Similarly the Bank of Agriculture (B0A) showed scale efficiency in 1992, 1996, 1997, 2001, 2002, 2003, 2004, 2006, 2007, 2008, 2009, 2010, 2011, 2012 and 2013.

The implication of the foregoing is that since the scale efficiency scores are more pronounced with the Bank of Agriculture (BOA), that is, 15 times; this implies that the BOA ranked highest in resource or input use. This is followed by the Microfinance Banks (MFBs), 11 times. The Deposit Money Banks (DMBs) had score of 10, thus, coming last in resource use on the scale efficiency ratings.

The allocative efficiency measures a decision making unit's success in choosing an optimal set of inputs, it then means that the Bank of Agriculture (BOA) had optimum utilisation in input, followed by the Microfinance Banks (MFBs) and lastly the Deposit Money Banks (DMBs). BOA being a specialised agricultural development financial institution must have developed sector-specific financing schemes which maximises input/fund utilisation. In corollary Microfinance Banks have as their mandate the financing of small and medium enterprises (SMEs) of which agribusiness in Nigeria is an integral component. The Nigeria agriculture is dominated by smallholder farmers which needs for credits are curtailed by their low output. Hence the micro credit schemes of the MFBs were designed to maximise the lending bank's resources.

The low position of the Deposit Money Banks (DMBs) on scale efficiency rating in financing agriculture in Nigeria conformed to the challenges and impediments faced in agribusiness which made it unattractive to commercial banks (Allegiuno, 2010, WorldBank ,2014 and Gyabea, 2015). It follows therefore, that DMBs should

learn from the other institutional financiers in the agricultural sectors in Nigeria.

5. Summary

The model was designed to examine the efficiency of the Nigerian Credit Institutions in their role in the agricultural sector. The Data Envelopment Analysis (DEA) approach was employed to analyse the technical efficiency of the Nigerian Credit Financing Institutions.

The results of the data envelopment analysis suggested mixed developments in term of technical and scale efficiencies of the credit institutions. The DMBs operated on decreasing return to scale on three different years in the research. The banks' scale efficient for year 1996, 2003 and 2006 stood at 99 percent, 78 percent and 96 percent respectively. The Bank of Agriculture (BOA) operated on constant return to scale in year 1992, 1996 and 1997 respectively. Also the scale of efficiency for the BOA was unity. In case of Microfinance Banks, there was decreasing return to scale in 1999, 2008 and 2011. The result shows that if MFBs can adopt the resource mix of 1992, the banks would be able to operate on constant return to scale. This would be possible if the total assets, capital adequacy ratio and liquidity ratio are reduced by 12 percent (1999), 15 percent (2008) and 3 percent (2011) respectively.

Generally, the study indicated increasing trends of efficiency in the credit institutions except for three years in the case of commercials banks and microfinance banks.

6. Conclusion and Recommendation

This research investigated the return to scale efficiency of the Nigerian Credit Institutions, Data Envelopment Analysis (DEA) techniques were employed to distinguish between technical and scale efficiencies in the operation of the Credit Institutions.

The Data Envelopment Analysis suggested mixed result in terms of technical and scale efficiencies of the Nigerian Credit Institutions. For instance, while Deposit Money Banks are technically efficient in some years, for example 1992 and 1994; the Bank of Agriculture and Microfinance Banks exhibited technical efficiency in 1999 and 2000, and 1997 and 1998 respectively, to mention just a few.

The study therefore, recommends the following:

i. The activities of the of the Credit Institutions, that is, Deposit Money Banks, Bank of Agriculture and Microfinance Banks should be sustained with more credit to the agricultural sector. The government should design a more favourable credit delivery scheme to enable banks to make more credit available to agricultural sector as this will lead to spurt in agricultural production and invariably the economy.

ii. To realise sustainable agricultural development the Credit Institutions must improve on operations. An improvement in their technical efficiency would ensure optimization of inputs deployed to the agricultural sector and the output.

iii. Measures such as extension services and literacy programmes should form part of loan packages to ensure optimal utilisation of non monetary credits.

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APPENDIX C: DEPOSITS MONEY BANKS (DMB)

FOR MODEL II

Year	Total assets (X_1)	Capital adequacy Ratio (X_2)	Liquidity Ratio (X_3)	Total operating income (Y_1)	Non-performing loans (Y_2)	Loan-to-deposit Ratio (Y_3)
1992	591.9	11.8	29.1	4.91	18.5	55.2
1993	2261.6	12.2	42.2	8.8	22.6	42.9
1994	2950.3	10.8	48.5	14.1	27.7	60.9
1995	3851.1	13.1	33.1	20.2	32.9	73.3
1996	4587.8	12.8	43.1	26.7	33.9	72.9
1997	5843.8	11.9	40.2	24.1	25.6	76.6
1998	6946.2	12.7	46.8	22.2	19.4	74.4
1999	10700.1	19.0	61.0	24.4	25.6	54.6
2000	15688.3	17.9	54.1	33.6	89.6	51.0
2001	24491.0	16.8	52.9	45.6	102.3	65.6
2002	29805.0	17.8	69.2	44.9	199.6	62.8
2003	33652.0	14.8	47.4	49.2	260.2	61.9
2004	37533.1	19.3	50.5	54.7	274.3	68.6
2005	45151.0	20.5	50.2	39.9	306.2	70.8
2006	8140.2	22.6	55.7	40.9	225.1	63.6
2007	13011.6	20.9	48.8	124.3	388.0	70.8
2008	19261.0	21.9	44.2	90.3	463.5	85.7
2009	17522.9	10.2	30.7	109.9	292.2	74.2
2010	18661.3	14.3	30.4	105.8	107.8	44.8
2011	21891.6	17.7	42.0	214.3	360.1	42.3
2012	24.584.7	18.1	49.7	283.3	286.1	38.0
2013	28,789.1	17.2	63.2	286.2	321.7	58.0
2014	26,233.0	15.9	38.3	335.4	354.8	68.1
2015	28,312.4	16.2	39.6	388.8	348.2	68.6

APPENDIX D: MICROFINANACE BANKS (MFB)

FOR MODEL II

Year	Total assets (X_1)	Capital adequacy Ratio (X_2)	Liquidity Ratio (X_3)	Total operating income (Y_1)	Non-performing loans (Y_2)	Loan-to-deposit Ratio (Y_3)
1992	9.8	12.3	75.1	2.1	33.4	25.5
1993	32.5	10.2	74.0	10.1	27.6	32.5
1994	48.3	9.7	57.9	12.3	19.8	42.4
1995	41.9	10.1	55.7	7.9	22.7	42.6
1996	45.6	11.1	47.8	18.4	25.1	53.1
1997	48.3	12.2	42.2	31.8	35.1	57.8
1998	65.3	9.5	49.8	78.7	42.6	60.1
1999	89.4	13.3	79.6	79.3	48.0	77.3
2000	12.0	14.1	61.4	102.4	50.1	49.8
2001	48.8	12.1	59.3	36.6	44.4	42.0
2002	15.5	11.0	63.1	110.3	38.7	46.7
2003	28.7	9.8	54.5	268.7	39.9	57.0
2004	34.2	11.3	56.4	312.4	51.3	55.0
2005	82.8	11.7	63.9	796.3	60.3	62.2
2006	55.1	10.9	75.9	41.8	46.7	48.0
2007	75.5	12.0	83.3	58.3	37.1	55.0
2008	122.6	14.3	72.3	284.6	29.8	67.2

2009	166.6	11.0	64.9	3837	19.6	73.8
2010	170.6	12.7	75.1	420.5	21.7	53.0
2011	190.7	10.8	58.7	392.9	18.6	79.2
2012	222.8	6.2	59.9	420.8	21.3	77.4
2013	270.9	11.1	44.9	400.0	15.8	74.5
2014	327.5	10.7	50.0	645.5	21.3	72.3
2015	343.8	13.8	45.8	977.9	36.7	90.3

APPENDIX E: BANKS OF AGRICULTURE (BOA)

FOR MODEL II

Year	**Total Assets (X_1)**	**Capital Adequacy Ratio (X_2)**	**Liquidity Ratio (X_3)**	**Total Operating Income (Y_1)**	**Loan-to-Deposit Ratio (Y_2)**	**Non-Performing Loans (Y_3)**
1992	2555.9	16.3	67.1	2668.3	57.8	22.8
1993	13,496.0	16.1	63.4	3465.9	45.2	32.1
1994	11,770.1	14.8	75.1	5144.5	34.4	24.8
1995	11,376.3	13.9	52.7	5393.1	41.6	30.1
1996	10,894.3	17.0	60.8	3836.3	59.1	33.6
1997	12,168.1	20.1	59.8	3328.7	65.2	44.1
1998	12,368.3	19.0	57.1	3277.1	54.3	40.3
1999	13,011.4	18.3	58.0	2121.3	51.7	39.6
2000	13,411.0	17.6	59.0	3436.8	54.4	60.1
2001	13,071.4	16.8	71.0	3566.5	36.7	101.3
2002	11,795.9	16.7	72.1	3992.6	57.8	114.1
2003	29,707.0	18.1	66.4	2397.6	51.7	209.1
2004	34,614.1	15.8	65.0	3306.9	45.8	236.0
2005	37,571.6	20.3	70.1	2011.8	54.1	227.1
2006	54,440.3	19.5	69.2	2547.8	44.2	300.0
2007	65,904.7	19.4	71.0	4668.3	58.1	299.1
2008	134,291.3	17.9	67.1	5050.5	60.1	286.4
2009	118,247.3	22.3	58.9	3497.4	61.3	320.1
2010	113,892.7	19.8	63.1	4020.7	58.6	333.4
2011	114,730.6	21.0	66.0	38,004.3	66.7	297.6
2012	98,408.4	22.1	72.0	42,457.5	62.0	347.1
2013	103,163.3	22.6	68.0	47,377.4	61.5	350.0
2014	119,690.5	20.7	67.0	27,212.9	34.4	288.7
2015	120,468.2	19.7	69.1	21,112.5	47.8	307.1