Research Journal of Finance and Accounting
ISSN 2222-1697 (Paper) ISSN 2222-2847 (Online)
Vol.4, No.9, 2013

Modeling the Banks Efficiency in Tanzania: Panel Evidence

Dickson Pastory, Xuezhi Qin, Benson Ndiege
School of Management, Dalian University of Technology
passtory1@yahoo.co.uk and qinxuezhi@gmail.com

Abstract
The paper was aimed at evaluating the efficiency of banking system in Tanzania. The study employed panel data for the period of 2006-2011. The paper utilized data from all 45 banks in Tanzania; the paper used efficiency measures, financial ratios, parametric and non-parametric approaches. In the context of parametric approach the study employed the Trans log and cob Douglas to test the profit efficiency. The findings of the study revealed that the three models to exhibited results, each model reflects and reported its efficiency score categories and the author conclude from the empirical literature that the all the three models do exhibit different efficiency score. Furthermore the study noted that the banks within the peer group were operating at higher level of efficiency but the industry at large still operates at inefficiency level but operate at higher level of profit efficiency due higher level of interest spread, large banks have been more efficient then the medium banks followed by the Non-Banking Financial institutions and finally the medium banks.
Key words: Parametric and Non parametric Approach, Trans log, Cobb Douglass, Tanzania.

1.0 INTRODUCTION

The implementations of the financial reforms brought the substantial impact in banking system in Tanzania, such as the increase in banks numbers; interest rate freely determined by the forces of lending and deposits, and the restoration of the operational and production efficiency (Xuezhi and Dickson 2011).
Currently the banks are in the third generation of financial reforms, the first and second generations have cropped up 45 banks, cost efficient has been improved, increased in prudential guidelines and strengthen banks role in monitoring and supervision (BOT, 2011).
The rapid development in financial sectors has promised optimism for further development that will benefit the Tanzania economy and hence necessitate re-evaluating the banking efficiency in general to confirm its efficiency. World Bank report of (2007) has pointed that despite of many financial reforms in developing countries many banks still operate at high level of inefficiency. The greatest inefficiency has been associated with higher interest rate spread, greater loan losses and higher operating costs.
Banks efficiency is very crucial as it increases the profitability level and enhance banks competition, with the result of competition it will results the lower costs that are being charged to the consumer and improve product and service quality (Berger 1993). Moreover efficiency of the commercial banks does increase the domestic mobilization that enhance the competition level of the banking system accompanied with fair interest rate spread (Senbet, 1994).
In the context of Tanzania environment very few studies have been conducted to explain efficiency of banks in Tanzania, one example is that of Aikaeli (2008), this is somehow surprising given the economic importance of banks sector in Tanzania which offer products and services to the entire economy. The financial system is heavily relied on banking system because the development of stock market very low. Therefore the study focused on determining the level of technical efficiency in banks in Tanzania. The efficiency level will be established based on the third generation of the financial reforms.
The innovation point of the paper is the adoption of the DEA model, ratio analysis and SFA model to measure the efficiency level. The study adopted both models since the measurements of efficiency through parametric and non-parametric are associated with greater criticism due to lack of precise definitions of bank output and input. Using both parametric and non-parametric approach in measuring efficiency results into different outcome due to lack of global consensus which method is superior to the other.

"SFA model is associated with the statistical noise and functional form estimation which is associated with requirements of the strong assumption about the frontier design while on the other case DEA has the disadvantages of not following the functional form which is not associated with statistical noise estimation, the advantages are simpler to use with little assumption of output and input"…….. Berger and Humphrey, 1997)

In other literature scholars have pointed that all parametric and non-parametric models have greater weakness of inability to accommodate the negative data, hence necessitate using the ratio analysis to measure the efficiency of the banks, but the same financial ratio has also some weakness and heavily criticized in literature.

"Ratio analysis is based on the facts that different company operates under different environment therefore the comparison can be misleading, accounting data are subjected to various estimates and different assumptions, and meanwhile the use of different standards may hinder comparability"……..
Xuezhi and Dickson (2011).

Therefore to avoid the above ambiguity that has been posed heavily in literature, forced the author to adopt both approaches. Crucially the efficiency of banks was assessed and making separation between the poor efficiency banks and efficient banks hence it will inform the stakeholder of the financial system and government on how the efficient of banks are being reflected on the entire economy.
The rest of the paper is structured as follows: Part one indicates the overview of the commercial banks in Tanzania, Part two explains the Empirical literature review , Part three the study methodology, Part four the findings of the study and Part five the conclusion of the study.

1.1 OVERVIEW OF BANKING SYSTEM IN TANZANIA.

The evolution of the banks in Tanzania is categorized into five sections, during the Germany rule, British rule, Post-independence before Arusha declaration, post Arusha declaration, and after Arusha Declaration to present. See the evolution of banking system below

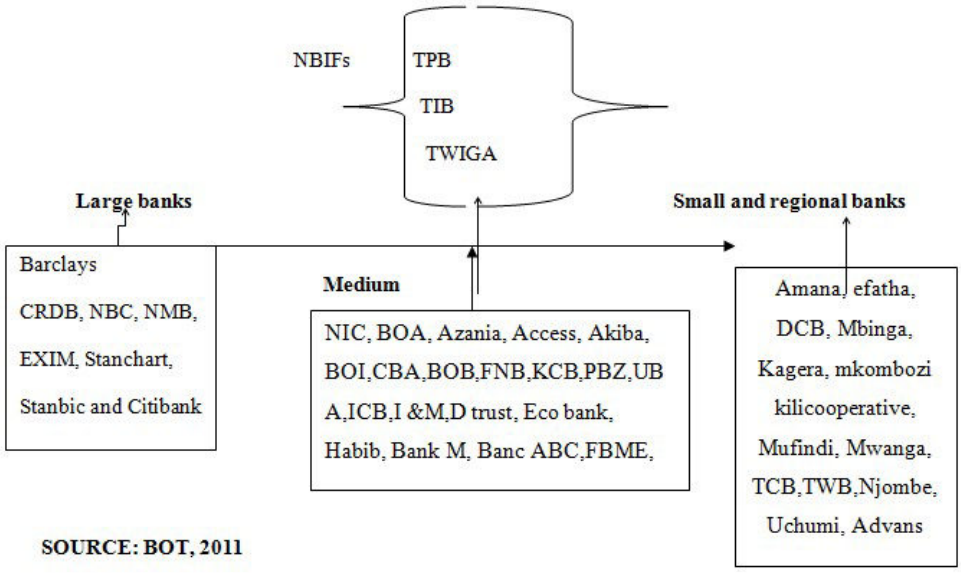
No	Year	Banks evolution	Activities and performance and Remarks
1	1905	Deutsch ostafricanische	The bank of berlin was opened in Dsm and operated as the central bank
2	1911	Handles bank	Opened Tanga with the aim of saving economic activities and mobilize savings
3	1905-1911		Germany rupees and heller was used as a means of exchange
4	1941-1949		Ending of Germany rule and collapse of the Germany banks.
5	1953-1954	National and Grind lays composed of lays,national,south Asia llyod, standard,Barclays,Anglo Egyptian, and the national bank of south Africa	Formed during the British rule
6	1958	Ottoman Bank	Operate in DSM, Mwanza, Lindi, Kigoma, moshi
7	1961	Commercial bank of Africa	Operate in DSM, Mwanza, Lindi, Kigoma, moshi
8	1961		Attainment of country independence and maintained the same policies and regulation as operated by the colonial power
9	1963		Recommendations to restructure the banking system by Dr Edwin Blumenthal
10	1964		All banks nationalised
11	1964-1965	National cooperative Bank,National Bank of commerce and People Bank of zanzibar	They were not operating properly due foreign metropolitan hence low savings mobilization, low loan issuance and low financing level
12	1966	Bank Of Tanzania	It was established to regulate the banks
13	1971-84	Tanzania cooperative bank, NBC	Operated in both Tanganyika and Zanzibar
14	1984	Tanzania cooperative bank was recategorized into rural and development bank	Cooperative was the powerful house that served the economic activities of the nation
15	1991	NBC and CRDB	Was poorly performing due the higher level of non-performing loans
16	1995	All banks	Market liberization and banking reforms
17	1996	NBC and CRDB	They were restructured and privatized , NBC split into NBC 1997,NMB and consolidating NBC 1997 holding ltd co
18	1997	NBC 1997	Sold to ABSA group of south Africa by 70%
19	2000		Adoption of second refoms by BOT
20	2000-2005	22 fully fledged banks, 5 regional banks,5 financial institutions and 102 bureau de change	Enhanced and increased competition
21	2006-2011	8 large banks,20 medium banks,3 NBIFs and 14 regional and small banks	Higher competition in the financial system and increased the saving mobilization and efficient of the financial system

Authors manipulations from various reports: (2012)

1.2 THE BANKING SYSTEM AND STRUCTURE IN GENERAL

According to Bank of Tanzania (2011), there are currently 45 banks operating in the country. The composite of it include 8 large banks, 20 medium banks, 3 NBIF and 14 small and regional banks. The banks have a total of tshs 14,281.7 billion as the main funding in 2011 of which customer deposit was 80% while core capital was 12%, deposit from other banks4% and other liabilities of 4%. Moreover the large banks dominate the market with the market share of 74%, medium banks 21%, NBIF 4% and regional and small banks by 21%.

BANKING SYSTEM IN TANZANIA



2.0 EMPERICAL REVIEW

Banks efficiency is among the area that has been researched much in literature, many studies are based on international level especially in U.S.A, few in regional levels and non in local levels. See the following,

Yeh (1996) used the DEA in conjunctions with ratio analysis to measure the banking performance, the models helped to separate between the efficiency and non-efficiency firms which are very important in banking regulations and banks operational decision making. He confirmed that DEA approach is more reliable tools for efficiency evaluation and it has the ability to provide additional information compared to ratio analysis which is very subjective filled with a lot of ambiguity. Mathews Kent and Jenifer Daley (2008), in their study of the efficiency of Jamaica commercial banks by using the relationship between the accounting ratios and DEA, it was indicated that they are closely related. Also they found that DEA is an appropriate tool since it includes multiple inputs and output over the traditional ratio analysis. Tarawneh (2006) measured the performance of commercial banks in Oman; he used asset management, operational management and bank size. Its finding using DEA indicated that higher bank efficiency has tendency to increase ROA. Webb Robert and Kumbirai mabwe (2010) investigated financial performance of South African banks using DEA and Ratio analysis. Their final findings indicated that financial performance had decreased after the financial crisis. Meanwhile the profitability, liquidity and credit quality ratios were decreased. Also in the same study Samuel (2004) found that financial ratios such as credit quality, profitability and liquidity were less efficient and their liquidity levels were very low associated with higher credit risk. Salamouris and Dimitrious and Halkos George (2004) measured the efficiency of Greek commercial banks using financial ratios and DEA, they argued that financial ratios can be used as a supplementary of DEA for evaluating organizational efficiency and performance; further findings indicated that increase in efficiency has been accompanied due to the decrease in small banks due to mergers and acquisition. Celikkol Hakon and Gumus Yusuf (2011), employed both measures of financial performance and the results indicated that there is great deviations of quick ratio, Net income to sales, return on asset and return on equity among the firms under study. Also they evidenced that the ratios are significantly correlated with DEA. Athanassopoulos and Batlantine (1995) pointed that traditional ratio analysis was insufficient to evaluate the firm efficiency and suggested that the DEA was the appropriate tool for the efficiency measurements. Malik Syed and Alkhathlan Khalid (2009) in their investigated the efficiency level of Saudi Arabian bank and it has been evidenced the banks were efficiently managed with financial resources with reasonable mean value. Lapsa etaal (2008) indicated that simple ratio analysis and DEA are crucially significant in evaluating the efficiency and they are significantly related in determining the efficiency of the firm. Waleed etaal (2011) in their study on

measuring relative efficiency of Jordanian commercial banks using DEA indicated that sample banks were stable efficiency while the larger banks were more efficiency and stable compared to the small and medium banks. Sufian (2007) investigated bank merger in Singapore, he employed both parametric and financial ratios and the findings confirmed that mergers had not increased the efficiency level rather it had increased the costs after merger. Pappas etal (2008) investigated the efficiency of Islamic and conventional banks using both the financial and DEA, the financial ratio results evidenced that the Islamic banks were less cost efficient but more revenue efficient compared to the conventional banks while DEA indicated the higher gross efficient to all banks but significantly higher in the convectional banks compared to the Islamic banks. In another study Efendric (2010) investigated the efficiency of Islamic banks in Bosnia using DEA and the results indicated that Islamic banks were less efficient compared to the convectional banks. Maghayerch (2002) studied the impact of liberalization on the efficiency of commercial banks; the findings showed the impact of liberalization was positively related to the efficiency of commercial banks as it had boosted much the efficiency and productivity level. The study is consistent with that of Ben-khedhiri (2007) who confirmed the positive impact of liberalization to the Middle East commercial banks.

Other authors have analyzed efficiency level of banking system by using both parametric and non-parametric approach see the following:

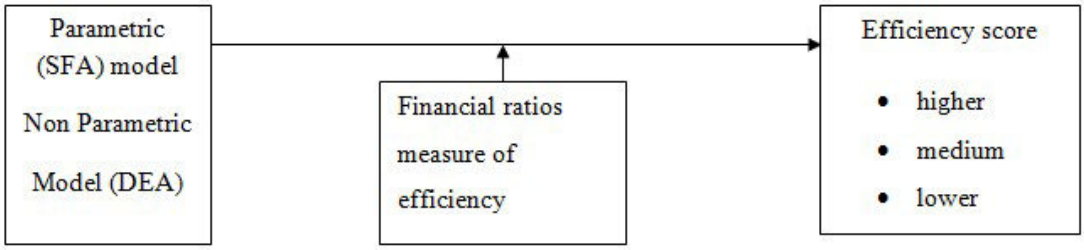
Koetter etal (2006) made study on consistency of the two competing model using the Germany banks as an example, the findings has pointed that non parametric approach are more sensitive to errors and other outliers in comparison to the SFA model . Resti (1997) investigated the cost efficiency of 270 Italian banks using both parametric and non-parametric model but was somehow surprising as it was pointed that there was no statistical significance different between the two models. Lovell (1990) found the SFA model to have higher efficiency score of 92% as compared to DEA which was having the efficiency score of 81%. On another study Baurer etal (1998) argued that SFA model has higher mean efficiency of 85% compared to DEA model which has 83%. Moreover Weill (2004) used DEA and SFA model to measure efficiency of 688 European commercial banks and the findings indicated that there was much difference in efficiency score between the two models and there is no positive correlation among the two models. Furthermore Sheldon (1994) reported that SFA model has higher efficiency scores of 92% compared to DEA which has 78%. Yizhe (2010) assessed the efficiency of Chinese banking system, using both parametric and non-parametric approach. The findings indicate that the efficiency of banks under SFA model was 91% compared to DEA which was 89%. Further analysis indicates that the state owned banks were more efficient than the foreign banks and the large banks were more efficient than the small banks. Ferrier and Lovell (1990) examined the cost structures of banking sector in US, the study employed both parametric and non-parametric approach. The findings revealed that DEA model provide higher scores than the SFA model, this argument is somehow contradicting from empirical theory and literature as it has been argued that SFA model tends to offer higher score than the DEA model. Delis and papa Nikolaou (1992) investigated the cost and profit efficiency of Greek commercial banks, the findings revealed that SFA model has higher efficiency score than the DEA model. Therefore the banks were more profit and cost efficiency under the SFA model than the DEA. Huang and Wang (2002) evaluated the economic efficiency of Taiwan banks using both DEA and SFA, the findings indicated that SFA model were having higher score than the DEA. Eisenbeis etal (1999) analyzed the cost efficiency of the US banks by using the two model, the results pointed that SFA efficiency score of 85% compared to the of DEA which was about 70%.

With the above studies higher efficiency score has been reported by SFA model compared to DEA model, this may be because SFA model has the tendency to accommodate the stochastic noise while DEA does not accommodate the stochastic noise and is more sensitive to sample selection.

3.0 METODOLOGY OF THE STUDY

The efficiency model of banking system

Models



The paper used the Data Envelopment Analysis (DEA), Stochastic Frontier analysis (SFA) and Ratio analysis to measure efficiency of the banking system. DEA is a non-parametric, linear programming methodology for

determining relatively efficient production frontier, based on the empirical data on chosen inputs and outputs of a number of entities, called Decision Making Units (DMUs).The best DMU is the one that lies on the frontier, the one which lies below the frontier is said to be inefficient. The DEA frontier is formed as linear combinations that connect the set of best practice of DMU and yield the convex production possibility curve (Cooper etal 2004). DEA analyze each vector (DMU) separately, producing individual efficiency measures relative to the entire set under evaluation. The paper uses the modified model of CCR to include the variable return to scale of BCC. Commercial banks provide a wide range of services to the economy hence the application of SFA becomes complex and difficult and also the regulation of commercial banks by the Bank of Tanzania and other market imperfection such as spread on interest price (most deposit are priced below the market price) (Berger, 2000), make the adoption of SFA model difficult phenomenon which is accompanied by estimation of function form and random error. According to Berger (1997) SFA which is specified has poor approximation of banking efficiency since the banks data are not near to the mean mix and the frontier forces to have u shaped in logs and does not take the heterogeneity of the banks which can result into bias.

The advantage of DEA is that it is simple to use, it can employ multiple input and output, it less restrictive parametric form and does not require the formulation of the function form and its weakness is the lack of estimation of stochastic error which may overstate the level of efficiency (Luka, 2007). Also does not require the access of data for the longer period.

Charnes, Cooper and Rhodes were the first persons to introduce the linear programming model for measuring efficiency for each DMU. It is obtained by taking the ratio of output and input. In each of the two cases, they are assigned weight**.** The efficiency measure for the DMU is obtained by solving the following mathematical programming problem:

$$\max_{u,v} h_0(u,v) = \frac{\sum_{r=1}^{s} u_r y_{r0}}{\sum_{i=1}^{m} v_i x_{i0}} \quad \text{(i)}$$

Subject to

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \le 1 \text{ , } j=1,2,\ldots,j_0,\ldots,n \quad \text{(ii)}$$

$$u_r \ge 0, \quad r = 1,2,...,s \quad \text{(iii)}$$

$$v_i \ge 0, i = 1,2,...,m, \quad \text{(iv)}$$

where x_{ij}= the observed amount of input of the ith type of the jth DMU (x_{ij}>0, i=1,2,...,n, j=1,2,...,n) and y_{rj}= the observed amount of output of the r_{th} type for the j_{th} DMU (y_{rj}>0, r=1,2,...,s, j=1,2,...,n).

The variables u_r and v_i are the vector of the output and input respectively. But the above problem has an infinite solution; we assign vx equal to one.

$$\sum_{i=1}^{m} v_i x_{i0} = 1 \quad \text{(v)}$$

In order to obtain a linear programming problem that is equivalent to the linear fractional programming problem (i)-(iv). Thus, denominator in the above efficiency measure h_0 is set to equal one and the transformed linear problem for DMU_0 can be written:

$$\max_{u} z_0 = \sum_{r=1}^{s} u_r y_{r0} \quad \text{(vi)}$$

subject to

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \text{ , } j = 1,2,...,n \quad \text{(vii)}$$

$$\sum_{i=1}^{m} v_i x_{i0} = 1 \quad \text{(viii)}$$

$$u_r \ge 0, \ r = 1,2,...,s \quad \text{(ix)}$$

$$v_i \geq 0, i = 1,2,...,m. \quad \text{(x)}$$

For the above linear programming problem, the dual can be written (for the given DMU0) as:

$$\min_{\lambda} z_0 = \Theta_0 \quad \text{(xi)}$$

Subject to

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}\ ,\ r = 1,2,...,s \quad \text{(xii)}$$

$$\Theta_0 x_{i0} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0\ ,\ i = 1,2,...,m \quad \text{(xii)}$$

$$\lambda_j \geq 0\ ,\ j = 1,2,...,n \quad \text{(xiii)}$$

Since there are no constraints for the weights λ_j, other than the positivity conditions in the problem (xi)-(xiv), it implies constant returns-to-scale. For allowing variable returns to scale, it is necessary to add the convexity condition for the weights λ_j,

$$\sum_{j=1}^{n} \lambda_j = 1 \quad \text{(xiv)}$$

With the above analysis we have modified CCR model to include the variable return to scale as adopted by Banker, Charnes and cooper (1984). The input-oriented BCC-model for the DMU0 can be written as:

$$\min_{\lambda} z_0 = \Theta_0 \quad \text{(xv)}$$

Subject to

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{r0}\ ,\ r = 1,2,...,s \quad \text{(xvi)}$$

$$\Theta_0 x_{i0} - \sum_{j=1}^{n} \lambda_j x_{ij} \geq 0 \quad i = 1,2,...,m \quad \text{(xvii)}$$

$$\sum_{j=1}^{n} \lambda_j = 1 \quad \text{(xviii)}$$

$$\lambda_j \geq 0, \quad j = 1,2,...,n \quad \text{(xix)}$$

The above equations incorporate the CCR model to includes the variable return to scale under the BCC model, the pure efficiency of CCR indicates the variable return to scale while the scale efficiency indicate the result under the CCR model. The values which are closely to one are being considered as efficient DMU (Cooper et al, 2000). In this study I adopted constant return to scale. And since manager has less control over banking input I adopted the output oriented DEA.

3.1 Specification of the model of the input and output as adopted by DEA.

The measurement of banks output and input is very difficult because there is disagreement on which components of output bank produces and which component of input it uses (Berger, 1992).There are basically two popular approach that are being used; these are intermediation approach and production approach. On the intermediation approach banks loans and other assets are considered as output since they are used to produce revenue of the banks. Deposit and other liabilities are considered as the inputs, it considers bank primary motive as to borrow funds from the depositors and lends those funds hence loans are considered as the output of the bank and the input includes interest expenses, labour costs, capital costs, operating costs and interest costs expenses. Production approach considers whether the asset and liabilities contribute to the output of the bank. It entails the commercial banks as the institution that uses labour and capital to produce various deposit accounts and loans. The inputs in this category are labour, capital and operating costs.

Models classification

	Input 1	**Input 2**	**Input 3**	**output1**	**Output 2**
Model 1	**Employee number**	**deposits**	**Operational costs**		**loans**
Model 2	**Employee number**	**Operational costs**		**deposit**	**loans**

Model 1: indicate the intermediation approach
Model 2: indicate the production approach

3.2 The SFA model of banking efficiency

On the context SFA model, it is a frontier that specifies the functional form for the variables to be evaluated such as profit, cost and revenue. The functional form tends to allow the stochastic error (random error) in the equation to take into account for unobservable variables. It tends to decompose into efficiency and inefficiency. The non-inefficiency tends to follow half normal distribution, and Berger (1997) pointed that inefficiency must be truncated and it can't be negative.

In this study, the translog output function is used for the case of outputs M and inputs K, which is specified as follows:

$$\ln D_{oi} = \alpha_0 + \sum_{m=1}^{M} \alpha_m \ln y_{mi} + \frac{1}{2}\sum_{m=1}^{M}\sum_{n=1}^{N} \alpha_{mn} \ln y_{mi} \ln y_{ni} + \sum_{k=1}^{K} \beta_k \ln x_{ki} + \frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{K} \beta_{kl} \ln x_{ki} \ln x_{li}$$

$$+ \sum_{k=1}^{K}\sum_{m=1}^{M} \delta_{km} \ln x_{ki} \ln y_{mi}$$

$$i = 1, 2, \ldots, N. \qquad (1)$$

The restrictions required for homogeneity of degree +1 in outputs are

$$\sum_{m=1}^{M} \alpha_m = 1 ; \sum_{m=1}^{M} \alpha_{mn} = 0 , \; m = 1, 2, \ldots, M ;$$

$$\sum_{m=1}^{M} \delta_{km} = 0 , \; k = 1, 2 \ldots K \qquad (2)$$

The trans log input distance function can be conducted using the same method. As discussed by Battese & Coelli (l995), a random disturbance term is added, while ln D is assumed to be independently distributed as truncations at zero of the N (mit, δ^2, μ) the distribution. The time-varying model is included to appropriately reflect the changing of technology and other time-dependent variables (Coelli, et al., 2005). The bank efficiency is estimated by using FRONTIER 4.1. The approach applies maximum likelihood estimation of Tran slog estimation which used multiple output and input. This approach is generated by using output oriented models. In this case the technical inefficiency is identified where there is a reduction of the output with regard to the increase in input.

3.3 Testing profit efficiency using Cobb Douglas and Tran's long functional form

In the second case the study tested the difference between Cobb Douglas and Trans long, since all of them are used to find the efficiency of the banks. The variables used are as follows:

variable	notation	mean
Output	Q_1	Total loans
Output	Q_2	Total Deposit
Output	Q_3	Non-interest income
Input Price	P_1	Interest expense/total deposit
Input Price	P_2	Non-interest expense/depreciation expense
Input Price	P_3	Labor cost/total assets

3.3.1 Cobb-Douglas Function Form

The functional form of the Cobb Douglas is as follows:

$$\ln\left(\frac{\text{Prof}_{kt}}{P_3} + \left|\left(\frac{\text{Prof}_{kt}}{P_3}\right)^{\min}\right| + 1\right) = \alpha_0 + \sum_{i=1}^{3} \alpha_i \ln (Q_{ikt}) + \sum_{i=1}^{2} \beta_i \ln (\frac{P_{ikt}}{P_{3kt}}) + (\nu_{kt} - \mu_{kt})$$

Where Prof_{kt} is profit of bank k in period t (t=1, 2, 3… T). Q_{ikt} represents the Q_i (i=1, 2, 3) of bank k in period t; P_{ikt} corresponds to the P_i (i=1, 2, 3) of bank k in period t. We impose linear homogeneity restrictions by normalizing the dependent variable and all input prices byP_3. Since a number of banks in the sample exhibit negative profits, we use $\ln\left(\frac{\text{Prof}}{P_3} + \left|\left(\frac{\text{Prof}}{P_3}\right)^{\min}\right| + 1\right)$ rather than ln $\frac{\text{Prof}}{P_3}$ to be the dependent variable. $\left|(\frac{\text{Prof}}{P_3})^{\min}\right|$ Is the minimum absolute value of Profit Over all banks in the sample. With this transformation, there is no bank with negative profits in the sample. ν_{kt} are random errors assumed to be iid with $N(0, \sigma_\nu{}^2)$ distribution; μ_{kt} being non-negative random variables accounting for profit inefficiency and assumed to be iid with truncations at zero on the $N(\mu, \sigma_\mu{}^2)$ distribution, where μ is an unknown scalar parameter. Also, we have$\mu_{kt} = (\mu_k e^{(-\eta(t-T))})$, where η is an unknown scalar parameter; and α_0, α_i, β_i are the parameters to be estimated.

3.3.2 **Trans log Function Form**

$$\ln\left(\frac{\text{Prof}_{kt}}{P_{3kt}}+\left|\left(\frac{\text{Prof}_{kt}}{P_{3kt}}\right)^{\min}\right|+1\right)=\alpha_0+\sum_{i=1}^{3}\alpha_i\ln(Q_{ikt})+\frac{1}{2}\sum_{i=1}^{3}\sum_{j=1}^{3}\alpha_{ij}\ln Q_{ikt}\ln Q_{jkt}+\sum_{i=1}^{2}\beta_i\ln\left(\frac{P_{ikt}}{P_3}\right)$$
$$+\frac{1}{2}\sum_{i=1}^{2}\sum_{j=1}^{2}\beta_{ij}\ln\left(\frac{P_{ikt}}{P_{3kt}}\right)\ln\left(\frac{P_{jkt}}{P_{3kt}}\right)+\sum_{i=1}^{3}\sum_{j=1}^{2}\gamma_{ij}\ln Q_{ikt}\ln\left(\frac{P_{jkt}}{P_{3kt}}\right)+(\nu_{kt}-\mu_{kt})$$

In the case of the translog form, the variable notation is just as same as Cobb-Douglas form.

3.3 Financial ratio

This is the widely tool for evaluating the performance of the banks and they have been used by the bank regulators globally to point the strength and weakness of the banks by relating the items of the balance sheet and income statement (Xuezhi, 2011). Bank regulators used as the CAMELS model where they used the ratio of capital adequacy, profitability (earnings), liquidity and market sensitivity to judge the performance of the banks. Baisi (2005) pointed the following strength and weakness of the financial ratios. The strength is based on the facts that it simplifies and summarize financial statements, it is useful for benchmarking and comparison of company of different size and it is useful in trend analysis by comparing overtime. The weakness is based on the facts that different companies operate under different environment, accounting data are subjected to various estimates and different assumptions, and meanwhile the use of different standards may hinder comparability. They are based on the past information and not future oriented.

The ratios that are used to measure efficiency are:

I. Return on asset (ROA), measure the returns on the asset employed. It is a ratio of net income of the bank divide by total asset
II. Return on equity (ROE), measures the return to the shareholders, it is computed as net income of the bank divide by total equity
III. Portfolio yield: this measures the earning of the bank, it is actually what the bank has earned.
IV. Loan and advances to total asset, this measure the efficiency of the bank with regard to loan issued in accordance to the total asset.
V. Total expenses to total interest income, it reflects how the expenses have been covered by the total interest income.
VI. Rate paid on Funds, it is a ratio of interest expenses to customer deposit. It measure the mean interest rate paid to customers.
VII. Liquid asset to deposit liabilities, this measures the ability of liquid assets to cover the liabilities.
VIII. Non-performing Loan to Gross loan, this measure the ability of the bank to manage loan
IX. Gross loan to total deposit, this measure the percentage of loan that has been issued with regard to deposit.
X. Government securities to Earning assets. This shows how the assets have been invested in government securities.
XI. Liquid asset to total asset, this measure the proportional of liquid asset on the total asset.

4.0 Findings

4.1 Ratio analysis Results

Table 1: Portfolio Yield

Year	2006	2007	2008	2009	2010	2011	Average
Regional small	16%	20.2%	12.7%	16.9%	17.1%	19.1%	17%
NBIF	22.6%	20.9%	12.1%	12.1%	13.8%	15.1%	16.10%
Medium	11%	12%	17.5%	18.5%	11.0%	11.3%	13.5%
Large	13.4%	15%	23.9%	16.9%	11.2%	11%	15.23%

With the analysis of table 1 it is indicated that in 2006 and 2007 NBIF had higher portfolio yield compared to the other banks, the reason might be higher loan return it had received with respect to the long term loan and medium bank was having a lower portfolio yield on the same periods. Small and regional banks were ranked as the number two category in this case and it was having great ability to generate revenue which covers financial and operating expenses during the same period compared to medium and large banks. In 2008 and 2009 large banks maintained higher average portfolio yield followed by the medium banks was having higher average efficiency compared to the NBIF and regional banks and small banks. In 2010 and 2011 the regional and small

banks were having higher portfolio yield because of their ability to extend into the outreach levels and the increase in community banks. The NBIFs were ranked second institution followed by the medium banks and the last was the large banks. On average Regional banks have higher portfolio yield, followed by NBIF, then large banks and the lastly the medium banks.

Table 2: Return on asset (ROA)

Year	2006	2007	2008	2009	2010	2011	average
Regional small	1.5%	3.1%	2.2%	0.7%	0.4%	0.5%	1.40%
NBIF	2.1%	1.5%	1.5%	1.0%	1.1%	2.1%	1.55%
Medium	1.2%	2.3%	1.7%	0.9%	1.1%	0.5%	1.28%
Large	2.7%	3.7%	3%	2.8%	2.0%	2.1%	2.72%

With analysis of table 2, The large banks have maintained higher percentage of ROA compared to the other banks, this is because higher average earnings compared to the other banks associated with greater investments in loans and other securities, and the NBIF was ranked second followed by the medium banks and lastly the Regional and small banks. This aspect is very important as it measures the efficiency of the management in utilizing the assets of the banks in generating revenue and the greater the ratio the better. The lower percentage in the other banks has been attributed to the increase in non-interest expenses which is not matched with the increase to in income and the increase in loan loss provision. On average the large banks recorded the higher efficiency level, followed by the NBIF, then the regional and small banks and the last was the medium banks.

Table 3: Return on equity (ROE)

Year	2006	2007	2008	2009	2010	2011	average
Regional small	11.4%	22.2%	12.5%	3.4%	1.9%	2.1%	8.92%
NBIF	10.4%	8.3%	8.6%	5%	4.3%	7.6%	7.37%
Medium	9.3%	16.8%	13.0%	7.3%	9%	3.9%	9.88%
Large	29.35	37.0%	27.3%	23.7%	16.9%	18.5%	25.46%

With analysis of table 3, large banks maintained higher ROE compared to the other banks and this has the advantage of attracting potential shareholders as their return are well capitalized and maintained, medium banks were ranked the second , regional and small banks were the third one and the last one was NBIF. This ratio shows how the equity investors are earning from their investments. The large banks have substantially maintained their equity income compared to their banks and it was fairly stable. On average the large banks have higher Return on equity, followed by the medium banks, then the regional and small banks and the last was the NBIF.

Table 4: efficiency per employee

Year	2006	2007	2008	2009	2010	2011	average
Regional small	10.2%	14.3%	10.3%	4.3%	3.7%	2.1%	7.48%
NBIF	10.4%	8.1%	9.1%	6.5%	9.3%	14.4%	9.63%
Medium	13.2%	16.6%	15.8%	9.2%	13.3%	9.5%	12.93%
Large	36.7%	46.95	40.8%	40.2%	32.3%	37.6%	39.09%

Generally in all years large banks maintained the highest level of staff efficiency compared to the other banks followed by the medium banks, the highest level has been attributed due higher average earning they receive compared to the other banks. The least bank was the regional and small banks which recorded the lowest staff efficiency due to the lower earnings associated with great loan loss. Large banks on average recorded the highest efficiency level, followed by medium banks, then the NBIF and the last was regional and small banks.

Table 5: Rate Paid on fund

Year	2006	2007	2008	2009	2010	2011	average
Regional small	5.6%	5.7%	5.3%	5.4%	5.3%	5.5%	5.47%
NBIF	3.1%	3.5%	3.8%	3.6%	2.8%	2.4%	3.20%
Medium	3.5%	4%	3.7%	4.1%	3.1%	3.5%	3.65%
Large	2.2%	2.6%	1.9%	2.1%	1.6%	1.4%	1.97%

This shows the average interest paid by the bank on customer deposit, the regional and small banks was ranked the firsts as they paid higher interest on deposit, this is particularly made in order to attract deposits due to the lower equity investments. The NBIF was the second, followed by the medium bank and the last was the large

bank. That's why the large bank has maintained higher earnings due to the greatest interest spread, hence inefficiency. The large banks showed the lower rate paid on funds by customer, followed by the NBIF, then the medium banks. Small and regional banks had shown the great rate paid by customers

Table 6: Portfolio Yield to operating efficiency

Year	2006	2007	2008	2009	2010	2011	average
Regional small	1.8%	3.8%	4.2%	0.8%	-0.2%	0.7%	1.85%
NBIF	-2.8%	-3.7%	-2.0%	-1.0%	-2.5%	-0.1%	-2.02%
Medium	-0.7%	-0.3%	-0.8%	-1.3%	-1.8%	-1.8%	-1.12%
Large	3%	3.2%	2.0%	1.9%	0.0%	0.1%	1.70%

With analysis of table 6: The large banks have maintained the highest ratio, followed by the regional and small banks, medium banks were ranked the third one and the last was NBIF which indicates that the ratio of operating efficiency was higher compared to the portfolio yield. Moreover the large banks have been able to maintain stable ratio because of greater reliance on corporate customers, compared to small and medium banks which rely on small customers who are very risk on defaulting. The small and regional banks on average was efficiency followed by the large banks then medium banks and the last was the NBIF

Table7: Government securities to earning assets

Year	2006	2007	2008	2009	2010	2011	average
Regional small	4.9%	6.2%	10.7%	7.6%	8.1%	9.5%	7.83%
NBIF	49%	51.3%	29.3%	35.7%	31.2%	30.8%	37.88%
Medium	13.6%	15.2%	20.5%	16.8%	18.3%	13.5%	16.32%
Large	28.1%	29.2%	22.9%	22.8%	26.2%	18.9%	24.68%

With analysis of table 7, The NBIF was having higher earnings ratio on government securities due greater equity investments which prefer long term investment on government securities due higher return and lower portfolio risk. Medium bank was ranked the second one and then followed by the regional and small banks. The lower the value is due to the lower equity and hence little investment on government securities. The NBIFs were efficient in this category on average, followed by the large banks, then the medium banks and the last one was the regional and small banks.

Table 8: loan and advances to total assets

Year	2006	2007	2008	2009	2010	2011	average
Regional small	62%	60%	60%	50%	51%	47%	55%
NBIF	34%	34%	54%	46%	47%	56%	45%
Medium	43%	43%	49%	50%	44%	53%	47%
Large	42%	41%	50%	45%	44%	48%	45%

With analysis of Table 8: it has been indicated that regional and small banks have maintained the largest percentage of loans as percentage of total asset because most of them have lower assets compared to the liabilities they have. The large banks were ranked the second followed by the medium banks and the last was the NBIF. The higher average rate has been to the regional and small banks, followed by the NBIF and then the medium banks and the last was the large banks

Table 9: Non-interest expenses to interest income

Year	2006	2007	2008	2009	2010	2011	average
Regional small	53%	53%	60%	65%	69%	75%	63%
NBIF	92%	92%	86%	85%	101%	85%	90%
Medium	72%	65%	68%	69%	81%	81%	73%
Large	56%	55%	66%	66%	82%	84%	68%

With analysis of table 9, the NBIF has maintained the highest ratio, medium bank was the second one followed by large banks and the last was the regional bank with the lowest ratio. In this case the lowest the ratio is the better. NBIF was having higher ratio hence it is the least bank because the higher expenses was not covered by the interest income particularly in 2010. In this category the bank is assessed due to its ability to cover its non-interest expenses as the operational expenses. It has been higher to the NBIF on average, followed by the medium banks, then the large banks and the last was the regional banks.

Table10: Gross Loan to deposit

Year	2006	2007	2008	2009	2010	2011	average
Regional small	75%	77%	81%	71%	66%	78%	75%
NBIF	51%	53%	75%	70%	79%	89%	70%
Medium	57%	62%	66%	65%	61%	72%	64%
Large	53%	55%	66%	57%	56%	61%	58%

With analysis of table 10, it has been indicated that regional and small banks have higher ratio, NBIF was the second, followed by the Medium banks and the last was the large banks. In this case the banks need to strike balance between the loan and deposit. By conventional wisdom 80% percent is much preferred and excess of that it means the bank might face withdrawal problem once customer demand them. Because NBIF is not a depository institution and is not subjected to withdrawal on demand based level therefore the ratio can exceed 80%. All in all the banks have not reached the level required by the BOT regulations which is supposed to be 80% to the banks. Higher level has been to the regional and small banks, followed by the NBIF, then the medium banks and finally the large banks.

Table 11: Total expenses to total interest income

Year	2006	2007	2008	2009	2010	2011	average
Regional small	90%	83%	83%	93%	103%	106%	93%
NBIF	115%	122%	111%	110%	123%	103%	114%
Medium	107%	104%	107%	112%	118%	118%	111%
Large	79%	80%	86%	88%	102%	101%	89%

With this it shows how the bank is able to cover the interest expenses with the available interest income. NBIF and Medium banks are able to cover interest expenses by more than 100% of their interest income, while large and small banks have the lower ratio compared to the two. The higher level in average has been recorded by the NBIF, then the medium banks, followed by the regional and small banks and the last was the large banks.

Table 12: Non-Performing Loan to gross loan

Year	2006	2007	2008	2009	2010	2011	average
Regional small	0.8%	2.9%	0.8%	1.2%	2.9%	8.5%	2.85%
NBIF	3.9%	-7.9%	0.0%	16.7%	8.4%	15.1%	6.03%
Medium	2.3%	-4.4%	1.5%	2.2%	4.3%	5.9%	1.97%
Large	5.8%	6.4%	5.0%	7.0%	9.6%	6.5%	6.72%

With analysis of table 11, the small and regional banks have lower rate compared to the other banks hence indicate the great efficiency of the banking system due to lower default rate compared large banks which have recorded the highest non-perfuming loan ratio compared to all banks hence indicate the inefficiency level. The higher rate has been attributed due to higher loan issuance to the customer. The NBIF has been ranked the third. Small banks are able to make close monitoring to their customers hence the risk of default is lowered. The good performance in this case on average has been recorded by the medium banks, then the regional and small banks, NBIF ranked the second one and the last was the large banks

Table: 12 liquid assets to total assets

Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**average**
Regional small	36%	37%	36%	44%	47%	39%	40%
NBIF	58%	59%	40%	44%	47%	39%	48%
Medium	53%	53%	46%	45%	51%	42%	48%
Large	54%	54%	44%	49%	50%	46%	50%

This show the liquid asset of the banks in comparison to the total asset. Medium banks have the highest ratio due increase in number banks, the largest banks were ranked in the second position followed by the NBIF and the last were Regional and Small banks**.** The higher the ratio the better as it indicates the ability of the banks to meet its daily working capital requirements. Large banks have recoded higher average score, followed by the medium and NBIF and the last was the regional and small banks.

Table 13: liquid assets to total deposit liabilities

Year	2006	2007	2008	2009	2010	2011	average
Regional small	43%	45%	53%	58%	59%	55%	52%
NBIF	76%	76%	56%	54%	60%	50%	62%
Medium	64%	67%	52%	66%	71%	55%	63%
Large	62%	64%	47%	60%	55%	63%	59%

The NBIF was having higher ratio, medium bank was the second followed by the large banks and the last was the Regional and small banks. The ratio indicates the ability of the liquid assets to cover the customer deposit. The higher the ratio indicates the efficiency of the banks and the lower the ratio indicates the inefficiency of the bank. The medium bank has recorded the higher average ratios, followed by the NBIF, then the large banks and the last was the regional and small banks.

Table 14: summary ranking of the overall efficiency score of the banks

Ratios indicators	Reg&small bank	NBIF	Medium	Large
Portfolio Yield	1	2	3	4
Return on asset (ROA)	3	2	4	1
Return on equity (ROE)	3	4	2	1
efficiency per employee	4	3	2	1
Rate paid on Funds	4	2	3	1
Portfolio Yield to operating efficiency	1	4	3	2
Government securities to earning assets	4	1	3	2
loan and advances to total assets	1	4	2	3
Non-interest expenses to interest income	4	1	2	3
Gross Loan to deposit	1	2	3	4
Total expenses to total interest income	3	1	2	4
Non-Performing Loan to gross loan	1	3	2	4
liquid assets to total assets	4	3	2	1
Total efficiency score ranking	**3**	**32**	**33**	**31**

Author's calculation (2012)

Note; 1st, 2nd, 3rd, and 4th indicate the ranking perspectives. With analysis of table 14 large banks have been noted to have higher efficiency score compared to the other banks, the large banks under the category include 8 banks, the second efficiency banks was NBIF which is composed of 3 banks, then the medium banks which is composed of 23 banks and the least efficient banks is the small and regional banks which is composed of 14 banks

4.2 RESULTS BY DEA MODEL

4.2.1 The use of DEA through application of efficiency ratios

The specification of input and output under the ratio category is explained below

Table 15

Item	Specification	Measurement
Y1	ROA	output
Y2	ROE	output
X1	Portfolio yield	input
X2	Loan and advances to total asset	input
X3	Total expenses to total interest income	input
X4	Rate paid on Funds	input
X5	Liquid asset to total asset	input
X6	Non-performing Loan to Gross loan	input
X7	Gross loan to total deposit	input
X8	Government securities to Earning assets	input
X9	Efficiency per employee	input
X10	Non-interest expenses to interest income	input
X11	Liquid asset to deposit liabilities	input

The analysis of DEA efficient score followed six steps, the first instance the efficiency score was analyzed in terms of classification of large, medium, small and regional banks, then the efficiency measured between the

individual peer group, and there after the efficiency score was measured within the whole banks sector for the 44 banks. The performance in terms of efficiency was analyzed comparatively among the banks under study

4.2.2 Analysis of the efficiency of the banks based on the bank size

On the classification between large, small, medium and NBIF , large banks have been evaluated to be more efficient with efficient score of 1, followed by small banks with efficient score of 0.9, then the NBIF with the efficient score of 0.8 and lastly the medium banks with efficient score of 0.5. The average efficiency to all banks score was 0.87.The efficiency level of large banks has been facilitated by the increase in investment portfolio and wide spread of income sources. In this category the only DMU was large, small, medium and NBIF. When the DEA approach with the actual inputs and output was used , the results behaved differently compared to the ratios used by the DEA as the score differs but the results remained to be similar as to when the efficiency measured by the ratios. The large banks were exhibited the higher efficiency score, followed by the small and regional banks and then the NBIFs and the final banks were the medium banks. Moreover the results have been different from the financial ratios adoption as the measure of performance, as the ratios indicated the large banks tends to be efficient, followed by NBIFs, then the medium banks and last was the small and medium banks which is contradictory from the use of both DEA ratios and actual inputs and output. When applying the SFA model the average efficiency score indicates that NBIF was more efficient followed by the small and regional banks then the large banks and the last was the medium banks. The sector exhibited the mean technical efficient of 0.93. The results have been different with that of DEA which showed the average efficiency of 0.88.

Table 16

Banks	**Efficiency by using ratios on DEA Model**	**Mean efficiency score by CCR model**	**Mean efficiency by BCC model**	**Mean efficient By SFA model**
Large banks	1	0.924342667	0.93565	0.87665112
Small and regional	0.9	0.875431167	0.9073	0.93670650
NBIFs	0.8	0.858429167	0.8741	0.97178469
Medium banks	0.5	0.794869833	0.80372	0.89633527
Average efficiency	**0.87**	**0.863268208**	**0.88019**	**0.9280399**

4.2.3 Analysis of the efficiency of the large banks

On the other peer group within the banks all eight large banks recorded an average score of 0.88, Citibank was the highest efficient score of 1, NMB recorded efficient score of 0.98, CRDB recorded efficiency level of 0.94, standard chartered recorded efficiency level of 0.91 followed by Exim bank with the score of 0.87 and the NBC with the efficiency level of 0.85, Stanbic recorded efficiency score of 0.81 and the last was Barclays bank which recorded efficiency level of 0.52. The higher efficiency level of Citibank has been facilitated by exclusively dealing with corporate clients and increase in international transactions especially corporate bonds. The large banks exhibited the average score of 0.779272 using the BCC model while 0.677037 with the CCR Model which was good score efficiency and Citibank had the most efficient score, followed by CRDB, then the NBC and the last was Exim bank. The two models reveal different efficient scores. On the analysis of SFA model for the eight large banks they exhibited the mean score of 0.75, The results show that Stan chart bank, Barclays bank, CRDB, NBC and Exim bank are the most efficient banks as they recoded the higher efficient scores while Citibank and NMB was the least efficient banks with the average score of 0.5.

Table 17

Banks	**Mean score by CCR**	**Mean score by BCC**	**Results by SFA model**
Barclay	**0.7644**	**0.77713**	**0.86366609**
Citibank	**0.8009**	**0.89025**	**0.56437933**
CRDB	**0.7698**	**0.85781**	**0.84047780**
Exim	**0.6603**	**0.74667**	**0.78933214**
NBC	**0.6455**	**0.83321**	**0.82646006**
NMB	**0.4728**	**0.65175**	**0.50603311**
Stan Chart	**0.65566**	**0.78714**	**0.90350476**
Stanbic	**0.64151**	**0.69022**	**0.70546954**
Average score	**0.677037**	**0.779272**	**0.74991535**

4.2.4 Analysis of the medium banks efficiency

With analysis of 18 medium banks within the peer group themselves they recorded the average efficiency of

0.49. FNB, Acess, Akiba, Diamond trust , Habibu , BOA and BOI was the most efficient medium banks with the efficient score of 1,1,0.83,0.89,0.79,0.69 and 0.69 respectively. The other medium bank had inefficient average score with mean average efficiency below 0.5 and PBZ was the least bank with average efficient score of 0.1 using DEA with ratios. Using the DEA model it was revealed that with the different of the two approaches, they tend to give different results through the analysis of 20 medium banks. On other case access bank and bank M recorded the higher efficiency score compared to the other medium banks: The other banks recorded the worst score while the other indicated the average score with similar level of inputs and output. On the other case the SFA Model recorded the higher efficiency average score of 0.52, the most efficient being the bank M and access banks, Barclays and I &M. The other banks recoded the moderate performance with the exceptional of NIC and ICB which recorded the inefficiency level.

Table 1

	CCR	BCC	CCR	BCC	CCR	BCC	CCR	BCC	CCR	BCC CCR	BCC
access		akiba		azania		banc abc		bank M		boa	
0.8	0.9	0.7	0.75	0.8	0.9	0.7	0.8	0.8	0.9	0.50	0.54
BOB		BOI		CBA		kcb		nic		uba	
0.5	0.57	0.5	0.7	0.6	0.7	0.6	0.7	0.7	0.74	0.2	0.22
pbz		icb		I&m		Habib		eco		dtrust	
0.3	0.34	0.39	0.4	0.7	0.78	0.7	0.73	0.2	0.5	0.7	0.8

4.2.5 Analysis of the NBIF efficiency

Using DEA financial ratios of NBIF indicates the average mean efficiency of 0.9, with the highest score recorded by the TIB, then followed by TPB and the last score recorded by the Twiga bank. Moreover when DEA actual outputs and inputs were used the banking sector revealed the mean efficiency score of 0.91 by CCR model while the BCC model indicated the efficiency score of 0.918. When the SFA model was used it indicated the mean efficiency score of 0.99 which is approximately to 1. The higher efficiency level being recorded by TIB, then TPB and the last score made by Twiga bank. Between the two models the SFA Model has indicated the highest mean score compared to the other.

Table 19

Banks	Efficiency by DEA ratios	CCR-mean efficiency	BCC-mean efficiency	SFA model
TIB	0.921	0.92	0.923	0.99998491
TPB	0.9	0.91	0.9211	0.99998491
TWIGA	0.89	0.90	0.9100	0.99998491
Average efficiency	**0.9**	**0.91**	**0.918033**	**0.99998491**

4.2.6 Analysis of the small and regional banks efficiency.

Using DEA financial ratios the results indicate that the banks were more efficient over BCC model compared to the CCR model. The banks recorded average mean efficiency of 0.7 for the 14 banks. The highest efficiency average score was recorded by Amana, Advans, DCB, TWB, Kagera, Mkombozi, kili and UCC with an average score efficient of 1, 0.9, 0.86, 0.6,0.9,0.69, 0.85 respectively. The lowest efficient score was mwanga and Mbinga community banks which were below 0.5 average mean efficient meanwhile the average score was above 50% to all banks using the actual inputs and output. They efficiently utilised the input to produce the output, with the exceptional to other small banks such as mwanga and mbinga banks which recorded the efficient score below 50%. The results point out the small banks had used much input to produce output which doesn't correspond to the input usage. On the context of the SFA model the average efficiency level was 0.99, with all banks performing above 0.9 they indicated that the input were efficiently utilised in producing the output.

4.2.7 Analysis of the all 45 banks

The last efficient analysis score was pooling all together 45 banks using DEA and SFA model. The mean efficient by DEA financial ratios indicates the scores of 0.44, but the CCR and BCC model indicated the efficiency of 0.4589 and 0.5 respectively which are the inefficient score level for the industry as whole. Therefore when all banks are pooled together they indicate the average inefficiency level in the industry. The new emerging regional community and small banks indicates the highest score level of efficient because they have operated in few years and probably they have pocketed few overhead costs. This includes AMANA, FNB,

MKOMBOZI and TWB recorded the highest efficient level. CITIBANK recorded the highest mean average score of 0.9 followed by NMB 0.87 while the other large banks recorded average efficiency score and other worst score. With medium banks the highest efficient average score was 1 recoded by the FNB and ADV banks. The lowest score in this medium bank was recorded by PBZ. The results by SFA model indicated the mean efficiency of 0.6 which was different do the DEA model.

Table 20

All Banks	**Acc**	**FNB**	**Adv**	**Akiba**	**Azania**	**Bankabc**	**Bank M**	**Barclays**
0.447456	0.263174	1	1	0.149956	0.12695	0.103204	0.369338	0.100634
ECOBANK	**Efatha**	**Exim**	**Habibu**	**I&M**	**ICB**	**Kagera**	**Kil**	**Mwanga**
0.916716	1	0.284804	0.264424	0.437967	0.102644	1	1	1
NMB	**CBA**	**CITIBANK**	**CRDB**	**DCB**	**DIAMND**	**Njombe**	**UCC**	**PBZ**
0.640707	0.245414	0.916716	0.297416	1	0.254005	1	1	0.386596
TIB	**TPB**	**TWB**	**TWIGA**	**UBA**	**BOI**	**NIC**	**TCB**	**Njombe**
0.221679	0.622707	1	0.28092	0.632988	0.188908	0.170357	1	1
BOA	**BOB**	**TCB**	**Mfindi**	**NBC**	**Standardc**	**Stanbic**	**KCB**	MKOMB
0.080788	0.258766	1	1	0.282977	0.272755	0.175627	0.055982	1

4.4 The use of production approach of DEA using actual inputs and actual outputs.

With the adoption of production approach the results was different with that of intermediation approach, the small banks and regional banks exhibited the greater efficiency score , followed by the NBIF, then the medium banks and the last was the large banks. In this it entails that the small banks do utilize the input efficiently to produce output under the production context while the large banks was not good as the small and regional banks. It brings sense by saying the large banks do efficiently operate under intermediation purposes and the small and regional banks are efficiently in processing and making customer accounts. Meanwhile the results were not different when the BCC model was adopted but the efficient score was increased to small dimensions as compared to CCR but it didn't change the ranking category. The small and regional banks maintained the highest level of efficient and the large banks were the least as compared to the other banks. Moreover similar procedure was adopted to test the efficient of 8 large banks, 20 medium banks, 3 NBIF and 14 small and regional banks. The findings didn't change, the efficient score revealed to be higher in production approach as compared to intermediation approach.

Table 21

Banks	Mean efficiency score by CCR	Mean efficiency score by BCC
Large banks	0.8903	0.9605
Small and regional	0.963084	0.98525
NBIFs	0.943	0.96533
Medium banks	0.9407	0.94977
Average efficiency	0.933194	0.96521

4.5 The results by the Cobb Douglas and Tran slog profit efficiency

The mean profit efficiency measures given by Cobb-Douglas function form are higher than the mean efficiency given by the trans log function are reported in the table below: The mean profit efficiency has been increased over the years in banking sector. The mean profit efficiency was lower in 2006 for both Tran slog and Cobb Douglas but they picked up in every year which showed the improvements level. Generally the overall average mean efficiency for the both year has been indicated to be 0.699387 and 0.677744 for the Cobb Douglas and Trans log respectively.

year	mean profit efficiency by cobb Douglas	Mean efficiency by Tran slog
2006	0.35697508	0.25507778
2007	0.5392378	0.46831019
2008	0.69941715	0.67829692
2009	0.81300878	0.82479022
2010	0.88879968	0.91323246
2011	0.89888188	0.92675669

4.5.1 Statistical analysis of the profit efficiency by Cobb Douglas and Tran slog

The results has been statistically significance although gamma has been too low, but in most empirical studies it has been witnessed that for the profit efficiency in case of gamma tends to be small as compared to the other form of efficiency.

	Cobb Douglas		Trans log	
	coefficient	**t-statistics**	**coefficient**	**t-statistics**
Sigma squared	4.7299126*	5.3724834	8.8746361*	8.629237
Gamma	0.37418174*	6.5980871	0.046115928	1.3369817
Mu	-2.6607119*	-2.900406	-0.12794719	-1.5706488
Eta	0.71118043*	10.417806	0.87675537*	6.7836884
LR test	48.033863*		39.399438**	

*statistically significant at 1% level

4.5 Summarization of efficiency model used in the study

In this DEA approach the assessment was made first by adopting the efficiency ratios. The findings indicated that the large banks were the most efficient banks having the score of 1 followed by the small and regional banks, then the medium banks and lastly the NBIF. But when all 44 banks were pooled together the sector indicated the inefficiency level in average for about 44% efficient score, meaning that there was any input waste of 56%. This trend may be because there some many inefficient banks so once pooled together they tend to eat up the efficient for the other banks. Moreover the findings from both models do differ. DEA model with intermediation approach and production approach indicates different results, the higher score being recorded by production approach. Similarly SFA model has indicated different results with that of DEA. The SFA results are much higher than the DEA model. The average efficiency level of all banks has been indicated to be 0.567 which is average efficiency of the banking sectors. The results is similar to that of koetter (2006) and Resti (2000) who pointed that DEA efficiency score are lower than the SFA scores. The results is contradicting may be because of few inputs and output chosen, larger input and output choice may influence the results. Higher input choice and output may decrease the efficiency scores, several empirical literature have pinpointed that DEA is too sensitive to input and output choice. The study adopted only three inputs which are employee number, operational and deposit and the output chosen was loans. On another case the test of profit efficiency by Cobb Douglas and Tran slog revealed the difference and the results showed that the banks are operating at the higher level of profit efficiency.

5.0 Conclusions

The author intended to measure the efficiency level of banking sector in Tanzania, using three measures: financial ratios, DEA and SFA model. The results were somehow contradicting because of differences in efficiency scores among the chosen models. Therefore it proves from the empirical literature that there is no consensus among the efficiency measurements. The results may be also have been influenced by the nature of input and output chosen. Generally the industry as whole is inefficiency by DEA model with average efficiency of 46% , meaning that there is 56% input wastes. Using SFA model the sector as whole indicated the average efficiency level of 0.567. Moreover the assessment of efficiency via intermediation and production approach indicated that banks are more efficient over production approach than the intermediation approach this proves that it is very hard for people to get loans in banking sector.

The banks are efficiency within their peer group themselves and they indicated a higher efficiency level, it entails that in the context of Tanzania environment the banking system still had the chance to increase their performance level because the whole industry has been characterized by the inefficiency level hence the banking can increase their performance level by increasing productions using similar input, alternatively the banks can reduce the input ratio to maintain the same output.

While the industry at large and broadly has indicated the inefficiency score level, the findings noted a clear chance of making improvements since the peer group themselves had shown the higher efficiency level. The mean profit efficiency tested by both Cobb Douglas and Trans log has shown higher level of profit efficiency and has increased over the subsequent years. It's a clear demarcation that the banks are operating at the higher level of profit efficiency due to the higher interest charged to the customers as compared to the deposit rate (higher interest spread).

Finally the author observed that the reforms and liberalization that has been taking place have increased the performance within the peer groups but the industry as whole still inefficiency. The bank regulators need to redesign and recast their efficiency criteria to increase the efficiency level. Nevertheless the limitation of the study can be limited by the variables chosen: employee number, deposit, operational costs and loan. Since the evaluation was limited to relative efficiency of banks it is possible for the results to be different once the other variables are chosen, however these findings remain to be remarkable evidence of efficiency of banking system

in Tanzania and provide overview picture of the entire industry.

REFRENCE.

Aikaeli J (2008) "Commercial banks efficiency in Tanzania" a paper presented in a CSAE conference on economic development in Africa Catherine's college oxford 16-18 march 2008

Athanassopoulos, A. D. and Ballantine, J. A. (1995). "Ratio and frontier analysis for assessing corporate performance: evidence from the grocery industry in the UK", *Journal of Operational Research Society*, Vol. 46, pp: 427 – 440

Alkhathlan k and Malik S (2010), "are Saudi Banks efficient" *international journal of economics and finance vol 2 2010*

Bauer P. W, Berger A and Humphrey D (1998), "Consistency conditions for regulatory analysis of the financial institutions: A comparison of frontier efficiency methods: journal of business and economics vol 50, 85-114

Bank of Tanzania (2011), "Directorate of banking supervision ", *Annual report*

Bank of Tanzania (2010), "Bank of Tanzania conferences on financial institutions" *Arusha conference Centre*

Berger A and De young R (1993) "Problem loans and Cost efficiency in commercial banks" *Journal of banking and Finance*

Berger A. and D. Humphrey, Efficiency of Financial Institutions: International Survey and Directions for Future Research, *European Journal of Operational Research*, 98, (1997), 175-212.

Brownbridge, M (1998), "The causes of financial distress in local banks in Africa and implications for prudential policy", UNCTAD discussion paper no 132.

Charnes, A., Cooper, W, and Rhodes, E. (1978). "Measuring efficiency of decision making units", *European Journal of Operational Research*, Vol. 2, pp: 429 – 444.

Cooper W, Seiford and Zhu J (2004), "Handbook on data envelops analysis, Kluwer academic publisher, Boston.

Delis M and Papanikolaou N (2009) "Determinant of Bank efficiency: evidence from parametric methodology: *managerial finance*, vol 35 no 3 pp 260-275.

Eisenbeis R and Ferrier G (1999) " the information of stochastic frontier and programming frontier efficiency scores: cost efficiency and other measures of Bank holding company performance, working paper no 99, federal reserve bank of Atlanta.

Fischer B(1993), " Success and Pitfalls with financial reforms in developing countries" *saving and development journal vol 17 no 2*

Fry M (1995), Money, interest and banking in economic development, southern Hophins University, Baltimore

Halkos, G. E. and Salamouris, D. S. (2004). "Efficiency measurement of the Greek commercial banks with the use of financial ratios: a data envelopment analysis approach", *Management Accounting Research*, Vol. 15, pp: 201 – 224.

Huang T and Wang M (2002) "comparison of economic efficiency estimations methods" parametric and non-parametric techniques; Manchester school, vol 7,pp 682-709.

Koettler M, Karmann A and Fiorentino E (2006) "The cost efficiency of Germany Banks": Discussion paper series 2, Banking and Financial studies; No 10.

Mathew K and Daley J (2009) "measuring bank efficiency: a traditional or sophistication" Cardiff business school, ISS 1749-6101. Cardiff University

Mckinnon, R (1973), *Money and finance in economic development*, Brooking institution, Washington.

Nyangetera B.M (1977),"financial repression in Tanzania, its impact on savings, investment, credit and growth", University of Dar es salaam Thesis.

Pappas V, izzeldin M and Johannes J (2012) "A comparison of performance of Islamic and convectional banks" available at www.ssrn.com visited on 12/11/2012

Resti . A (2000)"Evaluating the cost efficiency of the Italian banking system, what can be learned from the joint application of parametric and non-parametric techniques "Journal of banking and finance, vol 21 no 2, pp 221-250.

Senbet W (1994). "The perspectives on financial regulation and liberalization in Africa under incentives problems and asymmetric information" paper presented at the AERC research workshop, Nairobi.

Sufian, F. and Majid, M. Z. A. (2007). "Deregulation, consolidation and banks' efficiency in Singapore: evidence from event study window approach and Tobit analysis*", International Review of Economics,* Vol. 54, pp: 261 – 283.

Webb R and Kumbirai M (2010) "A financial ratio analysis of commercial bank performance in south Africa" *African review of economics and Finance, vol 2*

Yeh, Q-J. (1996). "The application of data envelopment analysis in conjunction with financial ratios for bank performance evaluation", *Journal of the Operational Research Society*, Vol. 47, pp: 980 – 988.

Yizhe D (2010) " cost efficiency in the Chinese banking sector" A parametric and Non-parametric approach

methodologies, online on www. Google. Co.uk, visited on 18th Nov 2012
Weill L (2004) "Measuring the cost efficiency of the European Banking: A comparison of Frontier Techniques". Journal of productivity analysis vol 21.pp 133-132

Appendix 1

Cob-Douglas

	coefficient	t-ratio
Constant	24.354474*	24.365139
Q1	-1.0258747	-1.4196710
Q2	0.93965243	1.2619119
Q3	0.17007939	0.40566545
P1/P3	0.2365308	0.51641873
P2/P3	0.33292569	0.90643909
Sigma-squared	4.7299126*	5.3724834
gamma	0.37418174*	6.5980871
Mu	-2.6607119*	-2.900406
Eta	0.71118043*	10.417806
LR	48.033863*	

*statistically significant at 1% level

Translog

	coefficient	t-ratio
Constant	133.03062*	133.15729
Q1	10.254320*	12.485162
Q2	-16.369596*	-20.163675
Q3	-0.79239336	-0.90941503
P1/P3	-0.86470252	-0.86458743
P2/P3	-3.8603722*	-3.926628
Q1*Q1	0.60397815	1.1329918
Q1*Q2	-1.3921603	-1.6858503
Q1*Q3	-0.29442881	-0.37069326
Q1*P1/p3	-0.61164363	-0.79122784
Q1*P2/P3	0.28920736	0.37391676
Q2*Q2	0.88076715	1.70642
Q2*Q3	0.079299554	0.099697689
Q2*P1	0.66705888	0.8865308
Q2*P2	0.40445977	0.55484186
Q3*Q3	0.24534177	0.44699576
Q3*P1	0.048833703	0.07400416
Q3*P2	-0.51534174	-0.73326044
P1*P1	0.15976403	0.35909157
P1*P2	-0.23808283	-0.28172822
P2*P2	-0.13174028	-0.28012601
Sigma-squared	8.8746361*	8.629237
gamma	0.046115928	1.3369817
mu	-0.12794719	-1.5706488
Eta	0.87675537*	6.7836884
LR	39.399438**	

*statistically significant at 1% level

This academic article was published by The International Institute for Science, Technology and Education (IISTE). The IISTE is a pioneer in the Open Access Publishing service based in the U.S. and Europe. The aim of the institute is Accelerating Global Knowledge Sharing.

More information about the publisher can be found in the IISTE's homepage: http://www.iiste.org

CALL FOR PAPERS

The IISTE is currently hosting more than 30 peer-reviewed academic journals and collaborating with academic institutions around the world. There's no deadline for submission. **Prospective authors of IISTE journals can find the submission instruction on the following page:** http://www.iiste.org/Journals/

The IISTE editorial team promises to the review and publish all the qualified submissions in a **fast** manner. All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Printed version of the journals is also available upon request of readers and authors.

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar