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Commercial banks efficiency in Tanzania: A non parametric approach

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Abstract

This paper employs Data Envelopment analysis (DEA) to estimate the relative efficiency of selected 20 commercial banks in Tanzania from 2008 to 2011. The findings are categorized based on two groups of commercial banks operating in Tanzania i.e. small and large groups. The selection of these two groups is based on Total asset accumulation, the empirical findings indicates technical efficiency of the selected large banks in Tanzania ranges from 0.54(2008) to 0.79(2011) respectively. There were sharp decline of technical efficiency from 0.79(2008) to 0.54(2009) there after showing increasing trend of technical efficiency to 0.74(2010), generally the results shows that banks are using more resources than what they are producing. In this study this is to say selected large Banks were supposed to use 79 percent to 54 percent of resources available for them to be efficient without compromising the output level under CRS. On another hand small banks were found to be performing worse compared to large banks for example under constant return to scale, the average technical efficiency ranges from 0.70(2008) to 0.65(2011).Similarly the small banks were supposed to use 70% to 65% respectively to produce the current level of output. Under VRS both large and small banks were found to have different efficiency levels, with large banks experiencing more efficiency level compared to small banks, pure technical efficiency declined from 0.91 for large banks in the year 2008 to 0.83 by the year 2011.In this scenario large banks were supposed to reduce input resources by 9 percent 2008, 22%2009, 10 percent 2010 and 17 percent 2011 in similar vein small banks were supposed to reduce input resources by 29 percent (2008), 40 percent 2009, 24 percent (2010) as well as 31 percent 2011while maintaining the present output levels. Therefore inefficiency utilization of input resources could be one of the reasons for inefficiency of commercial banks in Tanzania. Commercial banks operating in the country still have a chance of improvement. It is observed that through make use of underutilized resources and reduce operating expenses most commercial banks will remain to be relative efficient in the production frontier.

Key words: Data Envelopment Analysis, Tanzania Commercial banks, Efficiency,

1. Introduction

The financial sector in Tanzania has undergone substantial structure change since reform and transformation in early 1990`s. financial asset have expanded rapidly, led by growth in private credit. The contribution of financial sector to the overall economy of Tanzania cannot be overemphasized for example, in recent years commercial banks, particularly in developing countries, have been called upon to help to achieve certain socio economic objectives laid down by the state, therefore banks help the state to develop trade and industry in the country, in similar vein banks encourage habits of thrift and saving, they help capital formation in the country, and they lend money to traders and manufacturers. In modern world banks are considered not merely as dealers in money but also leaders in economic development. For example in Tanzania according to Ministry of Finance report (MoF Yr 2010), Commercial banks credit extended to private sector was Tsh 6,029.4 billion compared to Tsh 4,805.8 billion as of the end of December 2009, equivalent to an increase of 25.5 percent, the increase was the above target of 19.2 percent, owing to enhance confidence by commercial bank lending to the private sector, following global economic recovery. Credits were directed to various economic activities such as personal loans (23.1 percent); business activities (17.6 percent); Manufacturing (13.6 percent); and transportation (9.0 percent). Private credit to GDP showed significant increase from (2003-2010). The ratio of private credit to GDP rose from 5 percent to 16 percent, however it remain lower behind the countries in the region, whose regional average is 44 percent. Focussing on accessibility of financial services only one in Six Tanzanians has access to financial services from formal institutions, this is to say over half

of the population of Tanzania is excluded from financial services, in which most Tanzanian about 80% are engaging in agriculture and contributing over 56% of the economy; this largest part of the population is rural areas. The reasons to why they are excluded are because of majority of banks and financial institutions are more commercial targeting commercial traders than farmers, on another hand majority of people in rural areas lack bank knowledge also poor infrastructure discourage commercial banks and financial institutions to operate in rural areas. The micro institutions operating in rural areas are not properly regulated, they are running in their own, there are no funds or returns at the end of the month s and many people perceive them as they have been formulated by a certain group of people for their own interest.

Therefore a well regulated banking system, credit cooperatives (SACCOSS) and the stock market is very important to socio economic growth. In that regard they must be encouraged to take part on more local participation through both training and sensitizing people, the existing financial system in the country has such an obligation and is essential to boost the level of domestic savings and to channel funds into productive sector investments .However the banking system in Tanzania remain weak since reform, it is still dominated by larger domestic banks as well as larger subsidiary of international banks. The top tier caters to a small group of larger corporate which in most cases represents 70 percent of bank's loan portfolios leaving the retail market underserved, on another hand operating cost in financial institutions in Tanzania remains higher since reform, the banking system's overhead cost to total asset ratio has not significantly declined and remain high at 5.7 percent. Large banks network allow them to mobilize ample low-cost deposits at interest rate between 1 percent and 2.5 percent, while significant portion of assets is still invested in government securities which yield up to 20 percent, leading to higher interest margin, (Aikaeli 2008). The efficiency status of small and large banks is questionable this is because Small banks are unable to compete with larger banks; with very few branch networks these small banks remain concentrated in urban areas. More over the current 80 percent loan to deposit puts the smaller banks at a disadvantage. Therefore this study intends to evaluate the efficiency of commercial banks in Tanzania; special focus is relative efficiency between the two groups i.e. small and large groups of commercial banks. The study will have significant implications to different practitioners in the banking industry e.g. regulators, policy makers creditors just to mention few.

1.1. Main features of Tanzanian commercial banks

There observable features of commercial banks in developing countries and emerging economies. These features are manifestation of low level economic and social development as well as unpredictable and unsound institutional and legal frame work establishing banks and financial institutions in developing countries. The dominance of a top tier of larger domestic legacy and foreign banks with large share of banking business is one of the prominent features of the banking sector in various developing economies. Generally assets to total assets with regard to a single bank are still small. Currently 50 percent of banks assets in the country are concentrated in the three largest domestic banks. This can be traced back during socialistic era when the nature of the economy was centrally planned and few banks were operating in the country. Customer satisfaction was very poor but clients remain loyal just because they fear to undertake their transactions with small banks, Aikaeli,(2008)

Around 80 percent of the total financial system assets are concentrated in commercial banking. Commercial banks in the country can be sub divided into three major categories: Large domestic bank; subsidiaries of major international banks; and small banks including domestic and foreign banks. Subsidiaries of the major international banks hold 40 percent; small banks hold 10% of the total assets of the banking sector. By considering ownership, most commercial banks in Tanzania are foreign. Some commercial banks have taken serious initiatives in investing in microfinance institutions. The BoT (Bank of Tanzania) has put in place microfinance regulations s so as to encourage the microfinance institutions and banks to invest in this virgin area. This has increased outreach of financial services in rural areas, which has been affected by financial transformation and reforms this is due to the fact that some bank branches in rural areas were closed.

In developing and transition economies banks are faced with different risks ,with credit risk being one of the major risks facing most banks in developing countries(IMF-World Bank 2003), the 2003 Financial Sector Stability Assessment FSAP concluded that banks were generally liquid well capitalized, and resilient to most shocks. The system had a capital ratio in excess of 20 percent, and relatively low lending activity limited the extent of credit risk, while exchange rate risk was well contained. The main vulnerability stemmed from interest-rate risk, with banks holding a significant share of assets in government bonds more over its found that financial soundness indicator

(FSIs) shows a banking sector is still adequately capitalized especially in big domestic banks and foreign banks subsidiaries, however weakness is still observed in small banks. The system- average Tier I and Tier II Capital Adequacy Ratios (CARs) rose almost by 4 percent points between 2008 and 2009, to between 18 percent and 19 percent for both (compared to prudential minima of 10 percent (Tier I) and 12 percent (Tier II) 1. (IMF-World Bank 2010). Rapid private credit growth has increased credit risk in most commercial banks during the period of the study. Between 2003 and 2008 strong growth in private sector raised the share of loans in banks' portfolio from 32 percent to 54 percent, exposing the sector to increased credit risk FSAP (2010). Substantial concentration in the loan portfolio leaves the bank exposed to the failure of large borrowers. This can be noticed that the failure of the single largest exposure renders five of the largest 10 banks undercapitalized by depriving of more than 65 percent of its asset. The undercapitalized banks would require additional capital of 0.2 percent of GDP to return to the regulatory minimum capital level. The report also indicated NPLs rose to 7.8 percent in June 2009 from 6.2 percent in December 2008, but subsequently declined due to the effort of the government under rescue package for distressed bollowers.NPL varies across banks they ranged from 1.8 percent to 14.2 percent.

2. Literature review

Efficiency has been defined differently by scholars. As per Wikipedia efficiency can be described as the extent which, time, effort or cost is well used for the intend task or purpose. It is often used with specific purpose of relaying the capability of specific application of effort to produce specific outcome effectively with minimum amount or quantity of waste, or unnecessary effort. In this case efficient means reducing the amount of wasted input. And when considering input as scarce resource efficiency means maximizing output while trying to reduce the amount of scarce input resources. Therefore any change that maximizes value without compromising the other is termed as economically efficient; in this case value is seen as the basis of efficiency. By supporting this argument Vilfredo Pareto established the conditional situation on efficiency that: If there is a change which makes at least one individual better off without making the other worse off, that change is efficient (Debreu, et al 1959).This is different from Marshall Optimality where efficiency situation is characterized by the sum of gains or losses due to a change aiming at improvement, in this case if the sum is net gain there is Marshall improvement and the opposite is true. We have seen efficiency differ from one discipline to another, therefore different scholar may define efficient differently depending form the discipline they referring to, ranging from natural sciences to social sciences. The concept of efficiency was also related by cost and production function introduced by Shephard (1953, 1970). His production function considered multiple outputs different from classical production theories focusing on single output situation. This was the beginning step of measuring Total economic efficiency pioneered by Farrell (1957)

The efficiency studies in commercial banks have been studied many countries from developed countries to developing countries; some of efficiency studies yield contradicting results regarding the efficiency of large and small banks, some studies indicating large banks efficiency level is higher than the small banks while other studies indicating different results. Also some studies of efficiency were aimed at evaluating the efficiency status of domestic and foreign banks similarly contradicting results were also indicated in level of performance of the two groups, some indicating higher efficiency level in domestic banks while others indicates the opposite. For example countries in emerging economies for example Supachet,C(2008) used Data Envelopment Analysis to analyze Relative efficiency of commercial banks in Thailand, using production approach the researcher used the following netputs; the inputs were interest expenses, labor related expenses and capital related expenses where as the output were interest and dividend income, in intermediation approach they used the following inputs total deposits and total expenses while the out puts were loans and net investments ,the empirical findings of their study revealed the efficiency of Thai commercial banks via functional approach or operational Approach wa very high and stable while using different approach i.e. intermediation approach the performance was moderately high and volatile. When referring to size, large medium and small, small banks were efficient via operational approach with average efficiency of 100%. The similar study was used to compare the efficiency status of Foreign and Domestic banks in Malaysia, the study by Ong Tze San Lim Yee Theng and The Boon Heng (2011) applied Data Envelopment Analysis to compare the efficiency of Domestic and foreign banks in Malaysia, the following inputs and output were also used in their analysis using intermediation approach ,inputs were total deposit, fixed asset adopted from Chin and hen(2008) while the outputs were total loans and investments as adopted from Miller and Noulas(1996).The

empirical findings indicates that Domestic banks have higher efficiency level than foreign banks. On another hand Izah,M.T, Nor,M.A and Sudin, H (2009) using Data Envelopment analysis obtain similar results that Domestic banks were more efficient than foreign banks, more over it was found that the domestic bank inefficiency was attributed by pure technical inefficiency rather than scale inefficiency.

In recent year's researches in banking efficiency have increased, this is because most countries want to assess the level of achievement after implementing different reforms. Before reforms developing countries financial institutions were experiencing a number of problems such as poor service delivery, high-level of credit risk, poor quality of loans, limited and inadequate capitalization and operational efficiencies others were high incidence of nonperforming loans as well as high liquidity risks. Similarly few studies were conducted in Sub Saharan Africa (SSA), Tanzania is one of the countries within this part of the world. The study of commercial banks in SSA is very important because most of these countries have similar regulatory conditions and other contingency factors; the following are some of key studies on bank efficiency in SSA. The following are some literatures whose main focuses were based on cost and profit efficiency, comparison of foreign banks and domestic banks efficiency, foreign banks penetration and the economies of scale etc. The following are some few selected studied on bank efficiency and performance in Sub Saharan Africa.

Kiyota (2009) provide a comprehensive banking sector efficiency analysis of sub Saharan African countries (SSA). The study employs two stage analyses in examination of profit efficiency and cost efficiency of commercial banks: stochastic frontier approach and Tobit regression. Stochastic frontier approach was utilized to estimate profit efficiency and cost efficiency, where as Tobit regression was employed to provide cross country evidence of the influence of environmental factors on efficiency Sub Saharan African commercial banks, in similar vein the study intended to examine whether foreign banks are more efficient than domestic banks. The empirical results of the study indicated that foreign banks outperform domestic banks, which are consistent with the agency theory postulates; banks with higher leverage or lower equity are associated with higher profit efficiency. In terms of bank size, smaller banks were more profit efficiency where as medium size and larger banks are cost efficient. On another hand the findings of the study suggests that non SSA Foreign banks are more cost efficient than Sub Saharan foreign as well as domestic banks for the period of 2000-2003.

Using Econometrics such as cost frontier approach and operating ratios (Ikhide (2008) examined the efficiency of commercial banks in Namibia. Different from other studies the researcher integrated operating ratio and Stochastic frontier approach, in this study the following ratios were used interest margin, on interest income, gross margin operating costs, other ratios were loan loss provision total cost pre-tax income and after tax income. In addition using Trans logarithmic cost function the following inputs were used labour, capital and deposits while outputs were price labour, capital and deposit respectively similar to Musonda (2008).The empirical findings from Translog cost function established the existence of economies of scale of banking operating in Namibia which can be exploited through banks expanding their scale of operation, the paper also establish that more banks could still join the industry without compromising the industry profitability since most of the existing commercial banks are operating under the falling portion of their average cost curve.

Antony Musonda(2008); Through analyzing advantages and disadvantages of different approach the author decided to select Stochastic frontier approach (SFA), using a single stage maximum likelihood estimation procedure applied to a stochastic frontier cost function, the study applied intermediation approach, three inputs were selected namely labour ,funds and capital with corresponding price defined by labour cost, funding cost as well as capital cost on the other hand the output were defined by Net loans overdraft and interbank placement(loans) . The empirical findings observed that, Zambian banks are on average inefficient in order of 11.4% further more it was also indicated that foreign banks are more efficient than domestic banks, the reasons for inefficiency was contributed significantly by regulatory framework, more over the study recommended that institutional framework must be strengthened to revitalize the sector.

Kamau, A,W (2011), using non parametric Data Envelopment Analysis (DEA), investigate intermediation efficiency and productivity in the banking sector in the post liberalization period in Kenyan Commercial banks The results show that though the banks were not fully efficient in all aspect, they performed fairy well during the period under study. More over the commercial banks efficiency score was not less than 40% at any point. In terms of ownership and size, foreign banks were found to be more efficient than local banks, and in local category local private were

more efficient than local public, large sized banks were more efficient than medium and small sized banks.

Using Data Envelopment Analysis (DEA), Soboddu, O and Akiedo (1998) investigated bank performance and supervision in Nigeria during transition and deregulated economy on another hand it assess whether the policy package results in an improvement in the technical efficiency of the industry. The study found that banking industry intermediation efficiency declined significantly during the years immediately following the adoption of deregulation with slight improvements noticed only in recent times. The results concluded that this may be the effect of inconsistent policies to which the sector was subjected during this period. More over the study revealed private and government banks differ in their technical efficiency; the average efficiency measures were higher for private banks than for the government's banks.

Victor Murinde and Moses Tefula (2002) Using Translog Stochastic cost and profit frontier approach. Study measurement and determinant of X-Inefficiency in commercial Banks in sub Saharan Africa found the degree of cost inefficiency was exacerbated by bad loans, high capital ratio and financial liberalization. More over it was shown that the large banks were more efficient and the level of foreign bank penetration reduces x- inefficiency.

Ncube (2009) examine South African banking sector efficiency, the main focus of the paper was on cost and profit efficiency of banks in South Africa, Applying stochastic frontier model, the paper examined cost and profit efficiency of small and four large banks. Results indicated that over the period of study (2000-2005) South African banks significantly improved their cost efficiencies and no significant gains and profitability fronts. The results also indicated that there is a weak positive correlation between cost and profit efficiency of South African banks. In Addition most cost efficient banks were also most profit efficient. A regression analysis of cost efficiency in banks size suggests a negative relationship with cost efficiency declining with the increasing bank size.

Aikaeli (2008) investigate efficiency of commercial banks in Tanzania, utilizing secondary time series of the Tanzania banking sector (1998-2004), the paper examined technical, scale and cost efficiency of banks. Data Envelopment Analysis (DEA) model was applied to derive efficiency estimates of the banks. Results of the study suggest that overall bank efficiency was fair, and there was room for marked improvements on all the three aspects of efficiency examined, in his study foreign banks ranked highest in terms of technical efficiency followed by small banks and then large domestic banks.

2.2 Non-parametric Techniques

There are two linear mathematical programming techniques that have been used in many efficiency studies. Data Envelopment Analysis (DEA); and Free Disposal Hull (FDH). DEA (Data Envelopment Analysis) is the Non Parametric Mathematical Programming to frontier estimation. This is the linear programming technique where the set of best practices or frontier observations are those for which no other decision making unit or linear combination of units has as much or more of every output (given inputs or as little or less of every input (given output).The pieces –linear convex developed by Farrell (1957) was found to be very useful to number of academician. The DEA approach decomposes cost (input saving) into technical efficiency and allocative efficiency as well as scale efficiency, interested with the concept of economic efficiency.DEA does not require the explicit specification of the form of the underlying production relationship (Berger &Humphrey, 1997). Charnes and Cooper (1978) proposed a model which had an input orientation and assumed Constant Return to Scale (CRS) later on it was extended to VRS by Banker, Charnes and Cooper current researchers are considering both VRS and CRS. Scale efficiency can be well be obtained by running the data under both constant return to scale and Decreasing return to scale; scale efficiency is obtained by diving the two i.e. dividing the scores under CSR by efficiency score under VRS model, the difference between the two scales of efficiency is that VRS envelops the model more tightly than the CRS model, and the efficiency score of VRS must therefore greater than or equal to efficiency score under CRS. VRS have been reported to be used frequently in the late 1980s and the begging of 1990s and that is associated with many studies under DEA approach. One of the interesting feature of VRS in most DEA studies they report whether decision making unit is Operating under increasing return to scale or Decreasing return to scale in which according to Cooper et al (2000) Increase return to scale must apply below that level, as the slope of efficient frontier (which reflects the marginal rate of transformation of inputs to outputs)will be greater than average cost of conversion, on another hand ,decreasing return to scale must apply above the zone in which constant return to scale apply. Return to scale has been used in efficiency studied to investigate the effect of regulation and deregulation for example mergers and acquisition.

Free Disposable Hull (FDH) approach; this is the special case of DEA model where the points on lines connecting the DEA vertices are not included in the frontier. The Free Disposable Hull (FDH) production possibilities set is composed only of the DEA vertices and the free disposable hull points interior to these vertices. Because of its nature of being congruent with or interior to the DEA frontier, FDH will typically generate larger estimates of average efficiency than DEA (Berger &Humphrey, 1997).

The major weakness of these nonparametric approaches is that they generally assume that there is no random error such as no measurement error, no inaccuracies created by accounting rules that would make measured outputs and inputs deviate from economic output and inputs as well as no luck that temporarily gives a decision making unit better measured performance one year from the next (Berger &Humphrey, 1997).however it could be one of the merits of DEA do not require the input prices which are sometimes difficult to obtain but when treating inputs and outputs in DEA approach may brig biased results, usually DEA treats inputs and output as homogeneous while in fact they are heterogeneous, more over it has been known that DEA do not require any assumption above the functional form of the frontier, but it constructs an efficient non parametric frontier or a piece wise linear surface, the efficient Decision Making Unit is Measured relative to all DMUs lay on efficient frontier, irrespective whether the efficiency is based on Constant return to scale or Variable Return to scale. Despite the above demerits of DEA approach still is the most preferable method in efficiency studies some of merits associated with DEA is that it can allow jointly produced inputs and output in which parametric was found to be focused with one output at a time more over DEA approach can deal with relative few sample when compared to parametric approach which require significant numbers of observations for their regressions, which will be of limited value especially if the number of observation in the data set is not significantly greater than the number of parameter estimated. A rule of thumb commonly used in DEA suggests that the number of observation in the data set should be at least three times the sum number of inputs variables. On another hand the use of regression analysis specifically multivariate analysis according to Tabchnick and Fidel (1996) requires a sample size that meets a rule of thumb. The sample size should be $N \geq 50 + 8M$ and $N \geq 104 + M$ for individual predictors, where N is the sample size and M is the number of independent variables. But the rule of thumb as presented by Cooper (2000) does not indicate that when using large sample DEA will not produce better results. Even if DEA approach is having some of the limitations it is still regarded as the best non parametric approach in measuring efficiency, the following are some of studies using DEA approach.

The study by Tripe David (2005) showed the significance of DEA when comparing with Malmquist Productivity Index (MPI) when referring to sample size. The study measures New Zealand bank efficiency for the period of 8 Years using panel data, the results indicated that DEA approach of panel data is found to applicable more generally because it allows the use of greater number and wide range of inputs and outputs variable, on another hand DEA was found not to be constrained in the same way by relative small cross sectional set of comparable banks, the research thus suggests that DEA of Panel Data should be applied more widely to the study of bank efficiency particularly where there are difficulties in constructing sufficient cross sectional samples from single year's data.

3. Research methodology.

3.1 Model Specification

CCR Model

The mathematical illustration of the basic DEA model is traceable to Charnes Cooper and Rhodes (1978) and is referred as to as CCR model. If n banks (as DMUs) convert the same m inputs into the same S output and the jth bank uses an m-dimensional input vector, Xij(i=1, 2….,m) to produce an S-dimensional output vector,Yrj (r=1,2,…,s) and denoting the bank under evaluation by subscript o,the optimization problem solved for each bank is expressed as:

Max $$h_o = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{s} v_i x_{io}}$$

S.t

$$\frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{s} v_i x_{ij}} \leq 1;\ j = 1,2,...n \qquad (1)$$

Where

$$\frac{u_r}{\sum_{i=1}^{m} v_i x_{io}} \succ \varepsilon; r = 1.....,s \quad \text{And} \quad \frac{v_i}{\sum_{i=1}^{m} v_i x_{io}} \succ \varepsilon; i = 1.....,m, \quad \varepsilon \succ 0$$

The model measures relative performance of decision making unit (DMUs).These can be individual units (banks in this case) or a group of unit peers. There are n DMUs which are j=1, 2… n. In the model, Y rj >0 and Xij > 0 represent the observed amount of rth output and ith input of the jth DMU. DMU efficiency score is $0 \leq h0 \leq 1$ as regards the constraints. ε > 0 is a non Archimedean constant that is smaller than any positive valued real number for h0.ur and vi represent visual multipliers obtained by solving the maximization problem. In equation 1 the numerator represents a set of desired output and denominator represents a set of inputs. Visual output, $y_o = \sum u_r^{*} y_{ro}$ is summed over r =1 ,2 ,……S. Visual input, $X_0 = \sum v_i * y_{io,}$ is summed over i=1,2,……, m. The obtained $h_0^* = Y_0/X_0$, is efficiency score which satisfies $0 \leq h_0^* \leq 1$. When $h_0^* < 1$. When $h_0^* = 1$ represents full (or 100 percent) efficiency and $h0^* < 1$ represent some relatively inefficiency.

Therefore CCR- DEA model is represented as a dual problem of maximization linear programming.

Minimize

$$\Phi_0 - \varepsilon\left[\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right] \qquad 2)$$

Subject to $0 = \Phi_0 x_{io} - \sum_{j=1}^{n} x_{ij}\lambda_j - s_i^-$ and $y_{ro} = \sum_{j=1}^{n} y_{rj}\lambda_j - s_r^+$,

$$\Phi_0\ x_{io} - \sum_{j=1}^{n} x_{ij}\lambda_j - s_i^- = 0 ..$$

$$s_i^- = \Phi_0\ x_{io} - \sum_{j=1}^{n} x_{ij}\lambda_j$$

Where Φ_0 is efficiency score of a particular decision making unit (DMU0) in terms of dual solution. λj is a vector of constants while s_i^- is a vector of non negative slack associated with inputs inequalities and s_i^+ is a vector of non negative slack associated with input inequalities. Because equation (2) has finite optimal solution, from duality theory of linear programming we have

$$h_0^* = \Phi_0^* = \varepsilon\left(\sum_{i=1}^{m} s_i^{+*} + \sum_{r=1}^{s} s_r^{+*}\right) = \sum_{r=1}^{s} u_r^* y_{ro} \quad , \tag{3}$$

This is used to estimate efficiency scores. On another hand under

BCC model

The former basic model was later developed by Banker, Charnes and Cooper (1984) widened The CCR model to account for variable Return to scale (VRS) by adding the following constraints.

Minimize $\Phi_0 - \varepsilon\left[\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right]$ Subject to

$$S_t^- = \Phi_0 x_{io} - \sum_{j=1}^{n} x_{ij}\lambda_j \tag{4}$$

$y_{ro=}$ $\sum_{j=1}^{n} y_{rj}\lambda_j - s_r^+$, and $1 = \sum_{j=1}^{n} \lambda_j$.

$0 \le \lambda_j, s_i^-, s_r^+$ for i=1, 2 …m; r=1, …,.s; j=1, 2…, n we notice now that $\lambda_j s$ are restricted to sum up to one estimate the constraint in CCR that DMU must be scale efficient for it become technical efficient. Model (2) to (4) are estimated for DEA efficiency scores ranges between 0 and 1.By adding the above constraints a convex hull of intersecting planes envelop the data points more tightly than the former basic CCR model(CRS)conical hull and thus provide technical efficiency scores which are greater than or equal to those obtained using CRS model.

3.2 Inputs and output variables dimensions

DEA model has input and Output, the input orientation aimed at reducing the input resources while maintaining the present output level. While on another hand output orientation is aiming at maximizing the output levels while maintaining input recourses or without further increasing input resources Cooper et al (2000). Coelli et al when referring to the choice of inputs and output orientation they argued that the choice of orientation depends on controlling capacity of the manager i.e. the choice of inputs or outputs depends on which quantities the managers have most control over. In banking and financial institutions usually input orientation is most preferred than output orientation when determining cost and profit efficiency this is because the management have most control over inputs than output resources.

Banks produce various ranges of products, unlike manufacturing firms that produce physical goods. Measures of bank output and inputs have been identified in various empirical studies in bank efficiency .A few measures of bank

outputs, such as assets, liabilities and revenue, have been employed in current studies both developed countries and developing countries. The number of deposits and loans accounts has been suggested as bank output because financial services are provided to owners of these accounts directly. More over the dollar in each account has also been recommended as the bank output since the dollar amount in each account is a substantial source of profits, which generates usable funds and services (Berger and Humphrey, 1992).

The production approach addresses physical inputs, such as capital and labour and treats bank as firms producing different deposits and loan accounts. Banks deal with transactions and document for its customers who own these accounts. The number of accounts and transactions are regarded as the best measures of the bank output; to some extent this is not practical. In practice, the number of deposit and loan account is usually used as the measure of bank output rather than the detailed on transaction and documents (Ferrier and Lovell, 1990)

The other approach is intermediation approach (Sealy and Lindley (1997),treats banks as financial intermediaries that channels funds between depositors and creditors in the bank production process, the value of bank loans and investment is thought as output, while labor, deposits, and capital are treated as inputs. This approach is distinguished from the production approach by adding deposits to inputs, which result in consideration of both operating and interest costs, one of the limitations of this approach is that for smaller banks this method fail to account for transaction services delivered by liability holder to their deposited (debtors) and therefore under estimate the overall value added of banking activities. By carefully examining the literature above we have decided to follow intermediation approach, commonly used by many authors. We used different combination of input and output such as Deposit, interest expenses, operating expenses, loan, investment, interest income and no interest income. The first three were treated as inputs while the last four were treated as output. The selection of the above input and output was also supported by Miller and Noulas 1996, Hassan, et al 2009, Singh, et al 2008, Siems, 1992, Yue, 1992 and Barr, R.S., L.M.Seiford and T.F Siems, 1993. We used Input orientation when running DEA model under both Constant Return to Scale (CRS) and Variable Return to Scale (VRS) assumptions, Technical efficiency and pure technical efficiency scores were obtained which was used to compute Scale efficiency by dividing technical efficiency by pure technical efficiency

4. Results

The following section discusses the empirical findings of both CCR and BCC model. The findings are categorized based on two groups of commercial banks operating in Tanzania i.e. small and large groups both tables are attached to the appendix. Average Technical efficiency of the selected large banks in Tanzania ranges from year 2008-2011 ranges from 0.54(2008) to 0.79(2011). There were sharp decline of technical efficiency from 0.79(2008) to 0.54(2009) there after showing increasing trend of technical efficiency to 0.74(2010).Generally the results shows that banks are using more resources than what they are producing. Selected large Banks were supposed to use 79 percent to 54 percent of resources available for them to be efficient without compromising the output level under CRS. On another hand were found to be performing worse compared to large banks under constant return to scale, the average technical efficiency ranges from 0.70(2008) to 0.65(2011).

Under VRS both large and small banks were found to have different efficiency levels, with large banks experiencing more efficiency level compared to small banks, pure technical efficiency ranges from 0.91 for large banks in the year 2008 to 0.83 by the year 2011,we see also declining trend of efficiency. Therefore large banks were supposed to reduce input resources by 9percent 2008, 22%percent2009, 10percent 2010 and 17percent 2011 on another hand small banks were supposed to reduce input resources by 29 percent (2008), 40 percent2009, 24 percent (2010) as well as 31 percent 2011.

5. Concluding remarks

This paper employs Data Envelopment analysis (DEA) to estimate the relative efficiency of selected 20commercial banks operating Tanzania 2008 to 2011. The classification of banks into large and small banks categories were based on Total assets accumulation. Generally the results are not bad, most commercial banks still have a chance of improvement. In terms of size large banks have shown better performance compared to the counterpart small banks, these findings are similar to Victor Murinde and Moses Tefula (2002), Kamau, A.W (2011) Worthington, A.C (1999).

We recommend commercial banks should minimize the use of input resources while maintaining the same level of output. By improved handling of operating expenses, advances, capital and by boosting banking investment operation, the less efficient banks can successfully endorse resource utilization efficiency. However the results of this analysis have important implications for management of the banks, policy makers and bank regulators in Tanzania

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Appendix

Table 1. Constant Return to Scale Results (CRS)

			Input- oriented CRS Efficiency			
DMU no	SIZE	BANK name	2008	2009	2010	2011
1		BARCLAYS	0.441504	0.433671	0.567144	0.23351
2		CITIBANK	0.917062	0.96292	1	1
3		CRDB	0.689765	0.404598	0.643133	0.728436
4		EXIM	0.564614	0.47829	0.644501	0.529435
5		NBC	1	0.501186	0.665033	0.56326
6		NMB	1	0.557592	0.795054	0.895177
7	large	STANBIC	0.977033	0.442615	0.865355	0.593428
			0.798568	**0.540125**	**0.740031**	**0.649035**
8		BOA	0.470483	0.359408	0.550561	0.469433
9		TZ ACB	0.527014	0.446761	0.711342	0.784151
10		TZ ACCESS	0.880552	0.411121	0.526029	0.37634
11		AZANIA	0.452473	0.449215	0.501678	0.310182
12		BANK M	0.535591	0.54035	0.721335	0.65279
13		BOB	0.804444	0.356278	0.614174	0.832533
14		CBA	0.761686	0.584688	0.65038	0.486357
15		FBME	0.514324	0.382593	0.418152	0.373929

16		I&M	0.674695	0.431588	0.761848	0.991528
17		ICB	1	0.484438	1	1
18		KCB	0.544443	0.503263	0.502526	0.605231
19		NIC	1	1	0.741881	0.690798
20	small	PBZ	1	0.435425	0.65251	1
			0.705054	**0.491164**	**0.642494**	**0.659482**

Table 2. Variable Return to Scale Scores (VRS)

			Input- oriented VRS Efficiency			
DMU no	SIZE	BANK name	2008	2009	2010	2011
1		BARCLAYS	0.662812	0.740465	0.851094	0.325659
2		CITIBANK	0.955959	1	1	1
3		CRDB	1	1	0.775774	1
4		EXIM	0.801904	0.751872	0.782256	0.808563
5		NBC	1	0.969556	0.95655	0.895377
6		NMB	1	1	1	1
7	large	STANBIC	1	0.717983	1	0.829821
			0.917239	**0.882839**	**0.909382**	**0.83706**
8		BOA	0.475068	0.414391	0.603852	0.498503
9		ACB	0.527517	0.509647	0.914842	0.854039
10		ACCESS	0.902488	0.430776	0.861247	0.389674
11		AZANIA	0.454204	0.863039	0.797841	0.310654
12		BANK M	0.537932	0.798171	0.823395	0.704241
13		BOB	0.839978	0.372114	0.615163	0.84878
14		CBA	0.768199	0.627663	0.796315	0.580162
15		FBME	0.518724	0.657503	0.445084	0.385008
16		I&M	0.683753	0.518556	0.880654	1
17		ICB	1	0.485944	1	1
18		KCB	0.544565	0.701513	0.625337	0.730901
19		NIC	1	1	0.74945	0.690899
20	small	PBZ	1	0.435968	0.736744	1
			0.711725	**0.601176**	**0.757686**	**0.691759**

Table 3:Average efficient results

	2008			2009			2010			2011			
EAC count	CRS	VRS	S E	CRS	VRS	SE	CRS	VRS	SE	CRS	VRS	SE	**TOT**
LR (Avg)	0.799	0.917	0.857	0.54	0.883	0.611	0.74	0.909	0.811	0.649	0.837	0.763	
Eff DMU	2	4	2	0	3	0	1	3	1	1	3	1	**21**
SM(Avg)	0.705	0.712	0.991	0.491	0.601	0.839	0.642	0.758	0.854	0.659	0.692	0.951	
Eff DMU	3	3	2	1	1	1	1	1	1	2	3	2	**21**

ABBREVIATION

BOB=Bank of Baroda, ACB=Akiba Commercial banks,NMB=National Microfinance Bank, BOA=Bank of Africa,PBZ=Peoples Bank of Zanzibar.ICB=International Commercial bank,KCB=Kenya Commercial bank, LR(Avg)=Large Bank Average,SM(Avg)=Small Bank Average, CRS,VRS,SE=Constant Return to Scale, Variable Return to Scale and Scale Efficiency respectively.

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