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Commercial Banks Competition in Tanzania: Application of the Modified Panzar-Rosse Model

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Abstract
This study aims at examining the competition trend in the banking sector in Tanzania. In general, the competition is self-satisfactory as it depicts monopolistic competition though a large share of assets still is dominated by the large banks. This study adopts the Panzar-Rosse model where: the sum of H-statistics is 0.8, i.e., greater than zero but less than one, and, (DEA) efficiency scores is imputed through a regression model to see if there is a relationship between competition and efficiency. In general, the scores indicate a negative relationship between efficiency and competition. The implemented reform programmes have largely improved competition among the banks in the country.
Keywords: Competition, DEA, Regression, Panzar-Rosse

1. Introduction

Commercial banks play a significant and crucial role to the economy, the role which lies in between customer saving and lending process. The banks act as the risk insulators against all sources of risks such as financial, economic, and political risks. These banks play a role in economic development by acting as an intermediary for the nation's growth and development, the intermediary action are channelled to different individuals and with this it act as the economic infrastructure upon which financial system depends on it for further growth and development**.** With the above pivotal roles of the commercial banks, it is necessary for the government and policy makers to adopt various reforms to boost competition and efficiency (Xuezhi and Dickson, 2011).

The period in the 1990s was a major milestone for the policies and regulations which shaped the financial system in Tanzania. Empirical evidences from existing literature indicate that, implementation of the reforms has had a huge impact in the financial system. The reforms were part of the structural adjustment programme which focussed on enhancing the growth and competition of the banking system (Sanyaand Gaertner, 2012).World Bank report of 1994 indicates that among the measures taken to foster competition and growth of banking system was deregulation of exchange system and interest rate, as well as monetary control by the central bank. Furthermore, to increase financial capability on the financial system, the central bank of Tanzania adopted reforms into three phases. All the phases were meant to increase the level of competition in the country (BOT, 2011).

The reforms in the banking system provide level playing field to the players in the market and at the same time leading to an increase in thrift institutions (Xuezhi and Dickson 2011). The banking system is comprised of 45 banking institutions that offer services in the country (BOT, 2011). While there is a rise in the number of banking institution in Tanzania, this has not exactly matched with the demand for financial services. Only 3% of the overall population of more than 45 million people uses bank services (BOT, 2011). The number of bank customers has not increased much, and as a result it has caused an enormous pressure on commercial banks and strong competition.

Competition in the banking sector has been a focus of policy debates and a prominent agenda in many financial system centres, as it boosts competition for market share in the banking industry (Beck, 2008). Sound competition tends to increase product innovation, improve the quality of the products and ultimately lower bank rates (Berger et al., 2004). Meanwhile, the increase in competition among commercial banks tends to speed-up the intermediation process and foster rapid economic growth. The rapid rise in the number of commercial banks and increase in competition can trigger optimism for further saving and investment (Matutes and Vives, 2000). The statistical figures on commercial banks in Tanzania indicate that there is a yearly growth in banking profit. However, the study by Vickers et al (1997) indicates that competition do increase the banking profit through product innovations, research and development. It is possible for the bank to channel its activities through

innovation with the essence of increasing the banking profit. On other hand competition is detrimental to efficiency as it increases the costs of operations and bank failures.

In response to the negative impact of competition, several measures are in place to (minimize the impact), for instance, currently the bank of Tanzania has increased the capital adequacy for all commercial banks to up to TSh.15billion from TSh.5 billion so as to absorb the potential losses in the event of winding-up. Also, due to business pressure, some commercial banks have been acquired by other banks/financial firms, for instance, an acquisition of CF Union bank by I&M (BOT, 2011).

Competition and efficiency in banking cannot easily be noticed because of the lack of detailed information about costs and prices (Bikker and Spierdijk ,2007), therefore this paper seeks to review the financial structure in terms of competition and efficiency to know the nature of market structure the banking system being exposed.

The nature of market structure is assessed by using the Panzar-Rosse model, which is used to determine the competitive status of the commercial banks in Tanzania. The results of H statistic were assessed in both interest revenue and total revenue. These have an implication that in current era the non-interest-revenue has significantly increased as the commercial banks have responded to the increase in competition by increasing the share of non-interest-revenue through fees and other charges.

Therefore, the market test is very important for the survival of the commercial banks.

The topic is crucial due to the following:

- As Tanzania is an example of emerging market, hence the study of commercial banks competition earmarks the development trend
- The financial system in Tanzania went through significant changes through the liberalization of market forces so as to enhance competition; hence the study attempts to confirm if the results have been achieved.
- The pivotal roles of commercial banks in the economy make the issue of banks competition very crucial.

To our best knowledge, this study is among the research works which adds empirical literature to the study of competition of commercial banks in Tanzania, and, in addition, it's a comprehensive paper that ventures on the analysis of data in the period 1998-2011.The structure of the paper is as follows: section two provides an overview of commercial banks in Tanzania, while section three provides the theoretical review as well as empirical review of the model of the study. Section four discusses the methodology of the study and last but not least, section five discusses the findings of the study as well as the main conclusions drawn by the study.

2.0 Theoretical review of competition

Competition in commercial bank is measured by both structural and non-structural conduct performances based on industrial organization. Structural conduct performance is an analytical framework used to study how the structure of the market and behaviour of sellers of different products and services affect the market. In this case, the highly concentrated market increases the collusive behaviour of the firms and decreases output while raising price. This is an example of inefficient market in which they make profits from the collusive action. The structure critically determines nature of performance depending on the firm's concentration (Bikker and Haaf, 2002).Structure; conduct and performance are three interrelated items. Structure influences conduct and conduct influences firms behaviour, hence performance (Daly et al., 2010). It is structure which affects performance and the bank's pricing strategy. Bos (2004) indicates that the structure can be measured by HHI statistics, which is the measure of the degree of concentration. However this is regarded as the poor measure of competition as it is based on market concentration (Claessens and Leavens, 2004). In more clarified words, structure refers to the market structure defined by concentration of the market share, while conduct indicates the firms behaviour, i.e., competition or collusive, and finally, performance indicates the status of efficiency.

The main weakness of the structural conduct performance is: it treats the market structure as an exogenous variable, but in real world market structure is also affected by the firms conduct, hence performance. This is because the entry and exit of the banks is being responded by how the collusive or competitive the market is? And what kind of entry barrier do (the banks/markets) they create? The entry and exit of the banks affect the market concentration. On the other hand, non-structural conduct model was developed to avoid the linearity in the determinants of the banking competition, and this method is widely applied in the related studies. It is based on the real world where the level of competition is based on exit and entry of banks, which actually can foster

non linearity instead of linear relationship. Pranckeviciute et al (2007) identifies three measures of competition of the commercial banks which include; the Iwata model, Bresnahan model and Panzer-Rosse model.

Iwata Model, derived by Iwata measures banking competition based on oligopoly market structure by assuming that firms are supplying homogeneous products. The model uses the demand and supply functions to estimate the conjectural variation, hence sometimes it is known as the conjectural variation model. However the only limitation of the model is the difficulty in estimating market demand and supply functions in less developed countries, such as Tanzania, due to the lack of reliable data.

Bresnahan Model estimates market structure depending on loan concentration, but it has widely been criticized as it involves the running of simultaneous equations which is a tedious task. It takes commercial banks as a single entity and measures each segment market as a loan demand (Bikker and Haaf, 2002). With this, it is widely affected by multicolinearity.

Panzar-Rosse Model investigates the extent to which changes in factor prices are reflected in the equilibrium industry (Thakor and Boot, 2008; Goddard and Wilson, 2006; Gischer and stiele, 2004). It is the new industrial organization methodology used to test the level of competition based on H-statistics either scaled or unscaled revenue. The model is based on the macro economic theory of the firm equilibrium condition. It employs different pricing strategies in response to changes in output prices (Bikker and Haaf, 2002).

The method is popular and widely used to estimate the level of competition of the commercial banks (Nathan and Neave, 1989). The method is simple to use and tends to use only variables from the income statement and balance sheet and doesn't need to use the market structure. Also the Panzer-Rosse model can be predicated and assumed, and there is no need to specify the geographical market. On this basis, this paper adopted the method with the extension of the model to incorporate the DEA efficiency scores on the model to determine if the competition has significant impact on efficiency.

2.1 How Competition affects Efficiency

Over the years, various theories on how banks' competition affects efficiency and profitability have been presented. However, there have been disagreements on the relationship between bank competition and efficiency as some argue that the two are positively related while others argue that they are negatively related.

2.1.1 Competition enhances efficiency in banks

To a large extent inefficiencies which occur within firms such as, banks, are minimized by the degree of competition in product markets. Leibenstein (1966) explains that inefficiencies are a result of imperfections that exist in the internal organization of those firms and those imperfections affect the level of information asymmetries between owners and managers of the firms. If the owners would possess tools to control firm's performance, then the discretionary share of the effort would not be the source of any problems. However this may not be easy due to the fact that the production function is not entirely known. So, firms' owners cannot check or monitor the level of effort exerted by managers. Thus, the main way to reduce these inefficiencies is by increasing competition in the industry.

Leibenstein provides two reasons for this theory: first, competition provides incentives to managers to increase their efforts as they are fully aware of the increase in competition otherwise they will be out of business. Therefore managers are motivated by their will to avoid the personal costs of bankruptcy. Second, having a large number of firms in the market can provide an opportunity for owners to assess the performance of their firm in relation to other firms. Through competition, owners acquire a better knowledge about the production function of the firm which enables them to make a better assessment of managerial performance and consequently proceed to apply necessary changes in management if any. This theory by Leibenstein is known as "the X-efficiency theory" and is supported by the studies Scharfstein (1988) and Hart (1983).

The efficient structure hypothesis by (Demsetz, 1973) narrates that increase in competition precipitates an increase in profit efficiency. This is due to the fact that competition pressures the banks to minimize costs, offer services at lower and competitive prices, and eventually forces them to increase profits through shifts in outputs. Reininger et al (2002) depicts that competition in the banking market is expected to provide welfare gains by reducing monopoly rents and cost inefficiencies. This is due to the fact that the higher degree of competition in the banking industry may result in a lower monopoly power of banks, hence a decrease in banking prices. This

would increase the level of investment and economic growth as investments are very reactive to changes in commercial interest rates. So, the reduction of monopoly rents is expected to positively impact the investment and economic growth. Increased competition also encourages banks to reduce their operating costs by minimizing their inefficiencies.

Berger and Hannan (1998) supports the Structure-Conduct-Performance (SCP) paradigm which holds that, concentration weakens competition by fostering collusive behavior among firms. They narrate that market structure has an impact on banks' efficiency due to four reasons, namely: first, high degree of market concentration may allow banks to charge higher prices than those charged in the competitive levels, also it allows managers to benefit from higher prices not from higher profits but as "quiet life". Second, market power may allow managers to pursue objectives other than firm profits. Third, the management may use resources to obtain and maintain market power. And, last but not least, the higher prices charged when exploiting market power allow inefficient managers to persevere, hence negatively affecting cost efficiency.

Hicks (1935) narrates that, banking markets which are not competitive, i.e., monopoly power, allow bank managers to enjoy a 'quiet life', free from competition without pressure or fear of losing customers, and as a result, costs are not kept under control leading to higher levels of inefficiency. This hypothesis is also supported by Pagano (1993). Efficiency is closely related to optimal competitive structure and a strong and resilient banking system should support economic efficiency and stability (Northcott, 2004). Competition and restructuring in the banking industry would stimulate the firms operating inefficiently to shift to the frontier. Those banks which do not allocate their resources efficiently would eventually go out of business unless they strive to become more efficient than their competitors by producing more output with existing inputs.

Banks that are exposed to stiff competition have more sophisticated screening and monitoring procedures, whereas banks in concentrated markets do not spend much on monitoring (Petersen and Rajan, 1995). More competitive banks have better screening and monitoring procedures in place and are therefore less likely to suffer from non-performing loans. Banks that maintain efficient monitoring and screening procedures have the benefit of avoiding additional costs that arise in inefficient banks due to resource-intensive monitoring of delinquent borrowers and better analysis of workout arrangements. In more efficient banks, seizing and disposing of collateral do not pose major problems.

The competition-stability view argues that competition in the banking market usually solves the problems of information asymmetry and enhances inter-bank liquidity, and as a result, it may enhance financial stability in these banks. Boyd and De Nicolo (2005) shows that, because market power, i.e., monopoly power, induces banks to charge above market interest rates, and because of adverse selection and moral hazard problems, the riskiness of bank loan portfolios may increase.

2.1.2 Competition does not "necessarily" enhance efficiency in banks

In any country's banking sector, the issue of the relationship between market concentration, prices, and market power is a critical one. The structure-conduct-performance paradigm proposes that there exists a positive relationship between market concentration which is an opposite of market competition and prices. Highly concentrated markets, i.e., those with minimum competition, would result in some form of collusion among banks, which would enable them to exploit their market power through wide interest rate spreads, consequently gaining supernormal profits. So due to the fact that one way to measure efficiency is through profits, these highly concentrated banks are said to be efficient. This is contrary to the other theories which propose contrary to this paradigm. It is argued that in a competitive environment those banks which are efficient, for instance, those with superior management and production technologies which translates into higher profits, will increase in size and market share at the expense of less efficient banks. This will likely result to higher market concentration, hence monopoly power by a few large banks, thus inefficiency (Vennet, 2002).

Diamond (2004) in the "bank specificities hypothesis", argues that the specificities of competition in the banking industry may result into a negative impact of competition on efficiency. This is because of the information asymmetries between bank and borrower caused by imperfect competition in the banking industry. This forces the banks to enforce some mechanisms to resolve the resulting problems such as maintaining good customer relationship and long-term repeated relationship, to gain better knowledge on the borrower and reduce the information asymmetries. Banks usually possess a comparative advantage in the ex post monitoring of their borrowers, compared to investors due to the existence of economies of scale resulting from their role of delegated monitor.

With this notion in mind, competition in the banking markets may make it less possible to enjoy these economies of scale. As a result, competition may rise monitoring costs and potentially reduce length of the bank-customer relationship, as well as further decrease cost efficiency of banks. Therefore, this theory depicts that the specificities of the banking market result in a negative relationship between competition and cost efficiency. However this hypothesis is said to be more appropriate in transition economies than in developed market economies.

The increased competition in the banking industry results in a decline in the bank efficiency. Boot and Schmeits (2005) explain that, higher competition is likely to be associated with less stable and shorter relationships between banks and customers as customers are more likely to switch to other banks in the market where there is a competitive environment. This situation will magnify information asymmetries hence requiring extra resources for screening and monitoring borrowers. Chan et al (1986) depicts that, due to the fact that these banks expect shorter relationships with customers in a competitive environment, they are more likely to reduce relationship-building activities. This means, banks incur more expenses in retaining old and attracting new customers through new information systems and aggressive marketing efforts.

The study (Allen and Gale, 2004) examines if there exists a trade-off between competition and stability. They support the competition instability view which argues that the increase in competition encourages excessive risk-taking behavior by commercial banks, which results in increased financial instability, hence inefficiency. This is because banks will be striving to attract customers using more risky methods, e.g., less strict lending procedures which may lead to non-performing loans.

2.2 Empirical Literature Review

There exist a number of studies investigating competition and efficiency in the banking markets. The empirical results from the studies conducted in Africa and other places are discussed in this part.

2.2.1 Bank competition and efficiency in Africa

Several studies related to competition and efficiency in the banking industry in Africa have been conducted by various authors in and out of the continent. Mlambo and Mcude (2011) assesses competition and efficiency of the banking industry in South Africa. The study uses firm-level data for the period (1999–2008) and employs a three-step estimation approach. The study measures efficiency using the data envelopment analysis (DEA), and then use the Panzar–Rosse approach to derive the H-statistic for competitive conditions in banking. Finally, the study takes into account the role of managerial ability in competition by re-estimating the Panzar–Rosse model, with the DEA efficiency scores as an explanatory variable. The results from this analysis reveal that, although average efficiency was growing upwards over the period evaluated, the number of efficient banks was declining. The study further discovered that during (1999–2008), the South African banking industry was characterized by monopolistic competition. This is because of the domination by five large banks, which collectively account for over 85 percent of total banking assets in South Africa. These findings reflect the fact that bank concentration may increase efficiency in the banking sector.

Frimpong (2010) investigates the efficiency of Ghanaian banks for the year 2007 using non parametric approach, and the results show that, only 4 out of 22 commercial banks in Ghana were efficient. The remaining 18 banks were inefficient and they had their efficiency levels ranging from 33-89 percent. The study also discovered that the average technical efficiency for the banking sector was 74 percent. The most efficient banks were the domestic private banks with the average efficiency level of 87%, followed by foreign banks with an average efficiency level of 72 percent and lastly, the state-owned banks with an average efficiency of 51 percent. The author uses a dataset by Ghana Banking Survey (2008) and employs the input oriented intermediation-based approach to establish the average efficiencies of Ghana banks for 2007, both overall and by group, as determined by ownership and size. The study has one shortcoming: it studies only the efficiency of the Ghanaian banks and excludes bank competition and concentration in relation to efficiency.

In addition, another study conducted in Ghana, (Buchs and Mathisen, 2005) uses a different approach to study competition and efficiency in Ghanaian banks. The authors observe at first that the very high profitability ratios and high cost structure might indicate that the Ghanaian banking structure is of a monopolistic nature. Using panel data in the period 1998-2003, the study discovers that the Ghanaian banking market is non-competitive, hence hampers financial intermediation. It was further advocated that the bank market structure and other market characteristics constitute an indirect barrier to entry thereby shielding the large profits in the Ghanaian banking system. The study employs the Panzar-Rosse model to assess the aspects of competition and efficiency in the banking sector of Ghana.

Moreover, Hauner and Peiris (2005) assesses bank efficiency and competition in low income countries using Uganda as a case and finds that the there is a significant increase in the level of competition which is associated with a rise in efficiency. The study uses data from Ugandan banks in 2003 and employs the Panzar-Rosse model, also shows that, on average, larger banks and foreign-owned banks have become more efficient, while smaller banks have become less efficient in the face of increased competition pressures.

Furthermore, a study by Nzongang & Atemnkeng (2000), which uses panel evidence for the period 1987-1999, examines the impact of concentration to the profitability of Cameroonian commercial banks and finds that, market concentration power is very important in the determination of banks' profitability and efficiency. The high degrees of banks concentration are associated with high levels of profits at the cost of efficiency and effectiveness of the financial market due to the decrease in competition. They take a different approach from other studies by employing the Herfindahl-Hirschman index to measure market concentration. Mathuli et al. (2009) measures the level of competition and efficiency in South Africa. The study proves that the South African banking system is dominated by monopolistic competition. Bisheng (2008) studies the competitiveness and efficiency of banking sector in Egypt for the period 1992-2007. The study shows that state owned banks are less competitive compared to private banks, and foreign banks are less competitive compared to domestic bank.

Also, Simpasa (2010) evaluates competitiveness of commercial banks in Tanzania, and the findings reveal that there exist monopolistic conditions with little competition among the commercial banks. Mwega (2008) analyses competition and efficiency of commercial banks in Kenya, and the findings indicate that small banks are less competitive, followed by large and medium banks. In addition to above, Biekpe (2008) also investigates the competition of commercial banks in Ghana and the findings reveal that commercial banks are being dominated by monopolistic competition which fostered intermediation process.

2.2.2 Bank competition and efficiency outside Africa

Many authors around the world have done various researches on the subject with various results. First, Podpiera et al (2007) evaluates bank competition and efficiency in the banking industry of Czech. The study measures the level and the evolution of banking competition in Czech using panel data for the period 1994–2005. The study employs Lerner index to measure competition in the loan market by using data on loan prices. The results show that there was no improvement in banking competition during that period. The authors further study the relationship and the causality between competition and efficiency by conducting a Granger-causality-type analysis which supports that a negative causality only runs from competition to efficiency. The results of this study reject the 'quiet life' hypothesis and indicates a negative relationship between competition and efficiency in banking.

Also, Abbasoglu et al (2007) explores concentration, competition, efficiency and profitability of the banking sector in Turkey in the post-crises period (2001-2005). During this period, the Turkish banking market experienced bank concentration due to mergers and acquisition, as well as liquidation of some insolvent banks. The degree of concentration and degree of competition are analyzed using Panzar-Rosse approach. The study also explores an existence of the relationship between bank efficiency and profitability by considering internationalization of banking. The results suggest no existence of the relationship between concentration and competition in Turkish banks.

Moreover, Schaek and Cihak (2007) investigates how competition affects efficiency and soundness in banks using a sample of banks from USA and UK in the period 1995-2005 and finds that competition increases bank efficiency. In addition to that, the study reveals that competition robustly increases bank soundness through efficiency channel, and Granger-Causality test was used to examine the relationship between competition and efficiency. Another study on the subject, Casu and Girardone (2006), explores bank competition, concentration and efficiency in the European banks. It studies the impact of increased consolidation on the competitive conditions of the EU banking markets by employing both structural (concentration ratios) and non-structural (Panzar–Rosse statistic) concentration measures using data from balance sheets of major EU banks in the period 1997–2003 and then analyzes factors that may influence the competitive conditions. The results of the study show that the degree of concentration is not necessarily related to the degree of competition. Also, a little evidence shows that more efficient banking systems are also more competitive. A further discovery in the study shows that, the relationship between competition and efficiency is not a straightforward -- increased competition has forced banks to become more efficient but increased efficiency does not seem to be fostering more competitive EU banking systems.

Furthermore, a study conducted by Claessens and Laeven (2004) explores the aspects of competition and concentration using panel evidence from 50 banking sectors in both developed and developing economies. The results show that banking systems characterized by greater foreign bank entry and fewer entry and activity restrictions tend to be more competitive. The study also reveals that there is no empirical evidence that the competitiveness measure relates negatively to the banking system concentration while using Panzar-Rosse model. Also, a study by Tregenna (2009), which uses a linear regression panel model to examine US commercial banks in the period 1995-2005 points that, bank concentration increases profitability in the country. The study concludes that high profitability of commercial banks in the US prior to the financial crisis in 2008 was not a result of efficiency in the market, but rather was through market power. Furthermore, the profits obtained were not reinvested to strengthen the capital base of the commercial banks in USA. A study by Giustiniani and Ross (2008) assesses bank competition and efficiency in Macedonia and finds that competition in the banking market remains weak and to date the improvements in the bank efficiency are limited. The study also suggests the existence of a small number of "pocket banks", which might pursue different objectives than those of normal commercial banks hence affecting the conclusions of the study. Ab-Rahim et al (2011) investigates concentration, competition and efficiency in Malaysian commercial banks. The study establishes a link between bank competition and efficiency using the Granger causality tests. The results from this test show a positive impact of competition on technical efficiency, pure technical efficiency and scale efficiency. The results also reveal a negative causality from technical efficiency to competition.

Dermirguc-kunt & Levine (2000) and Cetroli (2004) point that the increase in competition increases efficiency of banks, which is supported by the studies, Claessen & Leaven (2004) and Goddard et al. (2001) which point that the increase in competition do increase the efficiency of the banks and hence the profitability level. Casu and Girardone (2004) finds no evidence between the relationship between the competition and efficiency. The study suggests that there is no straight forward relationship as the increase in competition can lead to efficiency in banks but the increase in efficiency cannot lead to the competitive behavior of the banks. Further study Weill (2004) studies the x –efficient and competition among the European banks and the results reveal a negative relationship between the efficiency and competition.

3. Methodology of the Study

We used panel secondary data from the related banks which are published for public consumption. Section 47 of the banking and financial institutions Act of 1995 requires all banks and financial institutions to publish their audited balance sheets and income statements. The Panzar-Rosse model is used to estimate the value of H-statistics, as the determination of competition level require the estimation of H-index which is defined as the sum of the elasticities of the total revenue to the unit factor prices. This method is widely accepted and arguably one of the most popular and appropriate, see: Claesvens & Leaven (2004); Shaffer (2004); Bikker & Haaf (2002); and, Molyneux and Thornton (1996).

The results of H-statistics are assessed in both interest revenues and total revenues of the banks. This implies that, currently the size of non-interest revenue in Tanzania has increased significantly in Tanzania.

3.1 Analysis of the adopted empirical model

The assumptions of the Panzer-Rosse model is as follows:

Let,

$$T = (T^1, T^2, \ldots, T^n) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

Where; T is the vector of n input prices;

Also, $R = R(T, X)$;

Where; R=Revenue

X=Exogenous variable

$$H = \sum_{n=1}^{n} \frac{dR}{dT} \cdot \frac{T^n}{R} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \ldots\ldots \text{(ii)}$$

This study adopts both scaled and unscaled revenue equations.

$$R = \alpha_0 + \sum_{i=1}^{n} \alpha_n \cdot T_{it}^{n} + X_{it}\beta + \varepsilon_{it} \quad \text{.....} \quad \text{(iii)}$$

$$\ln(R/T_A) = \alpha_0 + \sum_{n=1}^{n} \alpha_n \cdot \ln T_{it}^{n} + X_{it}\beta + \varepsilon_{it} \quad \text{.....} \quad \text{(iv)}$$

Where

R is Revenue, T_A is Total Asset, T^n is the unit price of factors, X is the vector of exogenous variables, e is the error few, α_0 is constant.

$$\ln(TR/TA) = \alpha_0 + \sum_{n=1}^{n} \alpha_n \cdot \ln T_{it}^{n} + InX_{it}\beta + \varepsilon_{it} \text{.....} \quad \text{...} \quad \text{(v)}$$

Where: TR is the total of interest

$$\ln(TR/TA) = \alpha_0 + \sum_{n=1}^{n} \alpha_n \cdot \ln T_{it}^{n} + \ln(TA) + \ln(TA/TE) + InX_{it}\beta + \varepsilon_{it} \text{....} \quad \text{(V)}$$

Therefore, the value of H-statistic is estimated as follows:

$$H = \sum_{n=1}^{n} \frac{dR}{dT} \cdot \frac{T^n}{R}$$

The economic meaning is: if the input price is increased, the marginal cost also increases, and the equilibrium output and total revenue must decrease or remain unchanged. Also, H-statistic will be equal to or smaller than zero which indicates monopoly. If the change in price is greater than the change in revenue, this implies monopolistic competition and it should be greater than 0 but less than one. Finally when H-statistic is equal to one, then it implies perfect competition.

3.2 The specification of the variables

The dependent variable of the model is total revenue/total asset (price)

The independent variables includes the following

- The unit price of labour, calculated by total employee expenses divided by total assets,
- The unit price of finance (finance costs), total interest expenses divided by total asset
- The unit price of fixed capital, total fixed depreciation expenses divided by total asset
- Exogenous variable, this take into account into risks, efficiency and un expected losses of the banks
- The values of control are :Total asset, total asset to total equity

To determine the relationship between the competitions we adopted the generalized regression where the coefficients computed by the DEA are added as the bank specific characteristics in the equation of the reduced form of revenue equation.

3.3 The efficiency score established by the DEA is as follows

We Assumed a single decision-making unit j (j=1, n) has m different input variables and s different output variables, then its input vector is $X_j = (x_{1j}, ..., x_{ij}, ..., x_{mj})' > 0$ and its output vector is $Y_j = (y_{1j}, ..., y_{rj}, ..., y_{sj})' > 0$. Then from the input perspective, the DEA Model (also called CCR model) for evaluating the technical efficiency of decision making unit (X_0, Y_0) is:

Min { θ }

s.t. $\sum_{j=1}^{n} \lambda_j X_j \le \theta X_0, \sum_{j=1}^{n} \lambda_j Y_j \ge Y_0$ ..... (vi)

$$\sum_{j=1}^{n}\lambda_j = 1,\ \forall\lambda_j \geq 0$$

When the optimum value of equation (VI) is $\theta_0(\theta_0 \leq 1)$, the technical efficiency of decision making unit (X_0, Y_0) is θ_0. We need to note that θ_0 is only based on the technical efficiency of all the inputs .The output technical efficiency is decided by the following model:

Max { α }

$$\text{s.t.} \sum_{j=1}^{n}\lambda_j X_j \leq X_0, \sum_{j=1}^{n}\lambda_j Y_j \geq \alpha Y_0 \quad \text{..... (vii)}$$

$$\sum_{j=1}^{n}\lambda_j = 1,\quad \forall\lambda_j \geq 0$$

When the optimum value of equation (VI) is $\alpha_0(\alpha_0 \geq 1)$, the technical efficiency of decision making unit (X_0, Y_0) is $1/\alpha_0$ to apply the above model in practical issues, we first give the definition of DEA efficiency of CCR model (VI)

Definition 1 If the optimal solution of model (1) $\lambda^{\square}, S^{\square-}, S^{\square+}, \theta^{\square}$ meet the condition that $\theta^{\square} = 1$, then the decision making unit (X_0, Y_0) is called Weak-form DEA efficient (CCR)

Definition 2 If the optimal solution of model (VI) $\lambda^{\square}, S^{\square-}, S^{\square+}, \theta^{\square}$ meet the condition that $\theta^{\square} = 1$, and $S^{\square-} = 0, S^{\square+} = 0$, then the decision making unit (X_0, Y_0) is called DEA efficient (CCR)

According to the above definition, to analyze whether a decision making unit is DEA efficient, we need to find out if every $S^{\square-}, S^{\square+}$ in the model equals to zero. This is obviously not an easy task. Thus, in practice, the common practice is to use the CCR model with non-Archimedean infinitesimal ε . The non-Archimedean infinitesimal ε is a positive number that greater than zero but smaller than any other positive number (in practice, we usually use a number that is small enough, such as 10^{-6}.The model used total loans and total investments as the output while the input used was the total deposits, total costs and depreciation expenses.

The model under this condition is:

$$\text{Min}\left\{\theta - \varepsilon(e'S^{-} + e'S^{+})\right\}$$

$$\text{s.t}\sum_{j=1}^{n}\lambda_j X_j + S^{-} = \theta X_0.,$$

$$\sum_{j=1}^{n}\lambda_j Y_j - S^{+} = Y_0 \quad \text{..... (viii)}$$

$$\sum_{j=1}^{n}\lambda_j = 1, \forall\lambda_j \geq 0\ \ S^{+} \geq 0,\ \ S^{-} \geq 0$$

Then the above efficiency scores are added in the reduced revenue equation form

$$\ln(R/T_A) = \alpha_0 + \sum_{n=1}^{n}\alpha_n \cdot \ln T_{it}^{n} + X_{it}\beta + \gamma DEA_{score} + \mu \text{.....} ix$$

4.0 Empirical results:

4.1 Descriptive statistics

This entails the variable used in measuring competition and efficiency. The variables used are total revenue (tr), total asset (ta), price of labour (pl), price of capital (pk), price of funds (pdk), return on asset (roa), and efficiency.

Table 1: Descriptive statistics


```
. summarize tr ta te tate pl pk pdl roa efficiency
```

Variable	Obs	Mean	Std. Dev.	Min	Max
tr	385	23.07813	1.920569	15.26096	27.04376
ta	385	25.7015	1.904653	20.43673	29.79297
te	385	23.7595	1.691716	19.08033	27.55809
tate	385	1.936859	.6363779	-.3928638	4.277589
pl	385	-4.958212	1.031045	-10.91446	-2.557399
pk	385	-5.955671	.8208304	-10.16973	-3.593914
pdl	385	-4.366336	.9364672	-10.75735	-1.829307
roa	385	-3.033392	.704947	-8.952259	-.1246342
efficiency	385	.8268971	.135145	.039337	.9999

4.2 Overall Competition Pattern of the Whole Banking Industry

Here, all banks are pooled together to observe the intensity of competition in the banking industry as a whole. Random effects model is chosen due to its robustness as the total residual is partitioned into two groups within and between groups, and for its ability to accommodate different characteristics as compared to the fixed effect model. In this context the sum of H-statistics indicates the value of 0.8, which shows the industry as a whole to be contestable, and it can also be further proved that the reforms in the banking process have significantly improved the industry. The price of labour has a negative coefficient meaning that an extra increase in labour tends to reduce revenues. This somehow makes sense as less developed countries have less developed technical know-how, and a large part of the banking activities are manually done, which increases overhead cost. Thus, the over-clouding of labour in the banking system tends to lower revenues, while other coefficients such as price of funds and price of capital are positively related.

Table 2: Overall competition

```
. xtreg y1 control1 control2 conrtol3 x1 x2 x3,re
note: control1 dropped because of collinearity

Random-effects GLS regression                   Number of obs      =       380
Group variable: bank                            Number of groups   =        41

R-sq:  within  = 0.8023                         Obs per group: min =         1
       between = 0.9384                                        avg =       9.3
       overall = 0.8684                                        max =        13

Random effects u_i ~ Gaussian                   Wald chi2(5)       =   1713.69
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000
```

y1	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
control2	.8306386	.0286805	28.96	0.000	.7744259	.8868513
conrtol3	-.0000349	.0002907	-0.12	0.905	-.0006045	.0005348
x1	-.2332728	.0399652	-5.84	0.000	-.3116031	-.1549425
x2	.1663034	.0548215	3.03	0.002	.0588552	.2737516
x3	.9307247	.070516	13.20	0.000	.7925158	1.068934
_cons	2.161589	.2955201	7.31	0.000	1.58238	2.740798
sigma_u	.18567954					
sigma_e	.22621726					
rho	.40252693	(fraction of variance due to u_i)				

Note: X1, X2, and X3 are the price of inputs (labour, capita and funds, respectively)

4.2.1 Robustness test (confirmation of the results)

To verify the above results, we use EVIEWS to see if the results are on a par with those obtained with STATA. However, the overall results are not significantly different between Stata and Eviews, that is, all the instrumental variables tested on Eviews are valid and consistent with the results obtained on Stata.

Table 3: Summary of the regression results (1998-2011)

Dependent Variable: log (TR)
Method: Least Squares
Date: 11/24/13 Time: 02:19
Sample: 1 385
Included observations: 385

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	29.39661	8.899417	3.303206	0.0010
Log (TA)	2.170000	0.348099	6.233851	0.0000
Log (TE)	1.280521	0.376864	3.397834	0.0008
Log (PK)	0.055156	0.018109	3.045708	0.0000
Log (PL)	-0.059236	0.013875	-4.269235	0.0000
Log (PDL)	0.781488	0.019791	34.434238	0.0000
Log (TA/TE)	-26.50411	8.223062	-3.223143	0.0014

R-squared	0.981077	Mean dependent var	23.07813
Adjusted R-squared	0.980777	S.D. dependent var	1.920569
S.E. of regression	0.266282	Akaike info criterion	0.209492
Sum squared resid	26.80249	Schwarz criterion	0.281369
Log likelihood	-33.32722	F-statistic	3266.329
Durbin-Watson stat	2.081590	Prob (F-statistic)	0.000000

Table 4 Summary results competition and efficiency

Dependent Variable: TR

Method: Least Squares

Date: 11/24/13 Time: 03:53

Sample: 1 385

Included observations: 385

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	29.39661	8.899417	3.303206	0.0010
Log (PL)	0.059236	0.013875	4.269235	0.0000
Log (PK)	0.055156	0.018109	3.045708	0.0025
Log (PDL)	0.781488	0.019791	39.48792	0.0000
Log (TA)	2.170000	0.348099	6.233851	0.0000
Log (EFFE)	-1.280521	0.376864	-3.397834	0.0008
Log (TA/TE)	-26.50411	8.223062	-3.223143	0.0014

R-squared	0.981077	Mean dependent var	23.07813
Adjusted R-squared	0.980777	S.D. dependent var	1.920569
S.E. of regression	0.266282	Akaike info criterion	0.209492
Sum squared resid	26.80249	Schwarz criterion	0.281369
Log likelihood	-33.32722	F-statistic	3266.329
Durbin-Watson stat	2.081590	Prob(F-statistic)	0.000000

4.3 Granger Causality test of the competition , efficiency and Profitability

The hypotheses results have shown that competition does cause efficiency since the altenate hypothesis was accepted in favour of null hypothesis as the P value is less than 5%. On the other hand based on the reported table efficiency was not granger competition cannot be rejected as the P-value was higher than 5%. ROA which is a measure of profitability does not granger competition which is measured by H statistics was rejected in favor of altenate hypothesis, hence ROA does granger Competition as the P value was less than 5% but on other hand H statistic does not granger ROA cant be rejected as the reported P value was higher than 5%. Efficiency does not Granger Cause ROA was rejected in favor of alternate hypothesis where ROA does not granger efficiency can't be rejected as the P value was greater than 5%. Therefore it can be seen that in all cases there is only one way direction causality: in the first instance, it is competition which influences efficiency; second, profitability influences competition; and third, efficiency does influence profitability.

Table 5: Pairwise Granger Causality Tests

Pairwise Granger Causality Tests

Date: 11/24/13 Time: 04:09

Sample: 1 385

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
H-statistics does not Granger Cause efficiency	385	10.1669	5.0E-05
Efficiency does not Granger Cause H-statistics		5.14599	0.00624
ROA does not Granger Cause H statistics	385	11.79551	0.00278
H statistics does not Granger Cause ROA		0.01452	0.98558
Efficiency does not Granger Cause ROA	385	5.82998	0.00321
ROA does not Granger Cause efficiency		1.67958	0.18784

4.4 Discussion of measurement of Bank Competition and Efficiency in Tanzania

In general, the study has shown that the Bank competition depicts monopolistic competition, which is in tandem with Simpansa (2011). The chance of competition for the industry at large can be further improved. Also, Sanya and Gaertner (2012) and Fosu (2013) find low level of competition which is characterized by lower levels of intermediation and saving level in East African community including Tanzania. The study also confirms that more than 75% of banking assets have been dominated by the four largest banks in the country, namely; FBME, CRDB, NBC and NMB, which reflects monopolistic market. The price of labor is negative which indicates that there is overstocking of labor in many banking systems due to poor technology, hence outweighing the revenue level. Price of funds is positively related to revenue as the interest expenses is the source of banking revenue. In this context, when there is an increase in interest, price of funds tends to increase the revenue level. Also, the price of fixed capital is positively related to revenue due to the fact that nowadays there is a sudden increase in fee-based income, thus increase in capital expenses tends to increase capital generating revenues, such as ATM.

Competition in general has not improved efficiency level as it depicts a negative relationship. The increase in competition tends to reduce efficiency level. The result is consistent with the studies; De Nicolo (2005), Diamond (2005), Hauner and Peiris (2005), as well as, Podpiera et al (2007), which show competition to reduce efficiency by encouraging immoral behaviors and charging higher interest rates, information asymmetry between banks and borrowers, which force banks to adopt certain mechanisms which increase monitoring and screening costs, reduce customer relationship, which in turn increase operation cost. However, this study contradicts Claessens and leaven (2004), Tregenna (2009), Giustinniami and Ross (2004), Ab-Rahim et al. (2011), and Goddard et al. (2001), who argue competition to be a positive force for increasing efficiency due to lower product costs, higher innovation level, and increase in financial products and services. However, Cassu and Girradone (2004) find no evidence on the relationship between bank efficiency and competition as there is no straight forward relationship.

4.5 Testing the Shot-run and Long-run relationship between Competition and Efficiency

For the variables to have a crucial significance there need to be a long run relationship (stability), therefore we use unit root test and augmented dickey fuller to test for short run and long run relationship, respectively. The unit root test has shown the existence of shot run stability to all levels, hence it necessitates performing co-integrations which is the test for long relationship. Therefore, at 1%, 5% and 10%, the value of residual have both long run and short run relationships as the critical values at all levels are higher than the augmented dickey

fuller test statistic. And, the values are significant at all levels as the P values are less than 0.1, and this confirms the model to be stationary at all levels.

Table 6: Null Hypothesis: D(RESID02) has a unit root

Exogenous: Constant

Lag Length: 3 (Automatic based on SIC, MAXLAG=16)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-17.92980	0.0000
Test critical values:	1% level	-3.447350	
	5% level	-2.868928	
	10% level	-2.570772	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(RESID02,2)

Method: Least Squares

Date: 11/24/13 Time: 02:21

Sample (adjusted): 6 385

Included observations: 380 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RESID02(-1))	-3.243290	0.180888	-17.92980	0.0000
D(RESID02(-1),2)	1.368505	0.149646	9.144970	0.0000
D(RESID02(-2),2)	0.724216	0.102277	7.080929	0.0000
D(RESID02(-3),2)	0.259189	0.049875	5.196791	0.0000
C	-0.001126	0.014592	-0.077163	0.9385

R-squared	0.823371	Mean dependent var	0.000281
Adjusted R-squared	0.821487	S.D. dependent var	0.673237
S.E. of regression	0.284448	Akaike info criterion	0.336538
Sum squared resid	30.34149	Schwarz criterion	0.388382
Log likelihood	-58.94219	F-statistic	437.0230
Durbin-Watson stat	2.048368	Prob(F-statistic)	0.000000

5. Conclusion

Although the degree of competition cannot be easily detected in banking systems, this study concludes that commercial banks in Tanzania are operating at monopolistic competition market structure. The findings are in

tandem with those of Simpasa (2011) who points that commercial banks in the country operate at the monopolistic level. The H-statistics has indicated stiff competition among the commercial banks. Therefore, the positive initiative taken by the bank regulators has increased the competition level although not to a large extent as large population is still unbanked. Competition mainly exists in urban areas where the level of commercial banks intermediation is large. Competition in general has not improved the efficiency level as many banks still operate at higher levels of bank inefficiency and it has showed the negative relationship.

Despite the convincing trends and efforts towards awakening competition, major efforts still need to be taken to foster further improvements: policies should be directed to initiate foreign banks to increase their channels in retail banking since their current operations are largely concentrated on corporate customers, institutional investors, pension funds and provident funds. Foreign banks should channel their funds to rural and urban areas to enhance intermediation process and hence boost the level of competition. Also, commercial banks should reduce interest gap to attract potential customers from rural areas so as to increase demand for financial services. And, finally, it is worth noting that the increase in integration between the regional and small banks can increase the level of competition, for instance, sharing ATM services, which can attract more customers as well as boosting the level of competition with large banks.

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Appendix

year	Efficiency	year	Efficiency scores
2000	0.25507778	2006	0.82479022
2001	0.35697508	2007	0.81300878
2002	0.46831019	2008	0.88879968
2003	0.5392378	2009	0.91323246
2004	0.67829692	2010	0.89828282
2005	0.69941715	2011	0.92452789

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