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# An Evaluation of the Cost and Revenue Efficiency of the Banking Sector in Zimbabwe

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## Abstract

The study was meant to evaluate the cost and revenue efficiency of the Zimbabwean banking sector during the period 2009-2014. The study employed the Data Envelopment Analysis and the Tobit Regression methods. The estimation of cost and revenue efficiency shows that revenue and cost efficiency increased during the period 2009-2012. This coincided with high positive growth rates and economic stability. Efficiency declined in 2013-14 as a result of government controls on banking sector pricing and general decline in economic activity. The study found that private banks were more revenue and cost efficient compared to public banks. Domestic banks were relatively cost and revenue efficient compared to foreign banks supporting the home field advantage hypothesis. The study further found that commercial banks were cost and revenue efficient than building societies. Cost and revenue efficiency is determined by cost income ratio, capital adequacy, macroeconomic growth, and inflation. The results shows that credit risk is significant in explaining cost efficiency. The study recommends that the Zimbabwean government should improve the macroeconomic operating environment and desist from tampering with the smooth flow of market forces. The government should refrain from imposing anticompetitive measures as they negatively affect banking sector efficiency. Financial sector reforms which improve competition should be adopted to enhance efficiency.

## 1 Introduction

Banking sector efficiency measures how close a decision making unit gets to its production possibility frontier, composed of sets of points that optimally combine inputs in order to produce one unit of output (Kablan 2010). Efficiency can be distinguished between allocative and technical efficiency (Hassan and Sanchez 2007). Allocative efficiency is the extent to which resources are being

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allocated to the use with the highest expected value. A firm is technically efficient if it produces a given set of outputs using the smallest possible amount of inputs (Falkena et al, 2004). A combination of the technical efficiency and allocative efficiency provides a measure of economic efficiency. Economic efficiency can be distinguished into cost efficiency, revenue efficiency and profit efficiency. Cost efficiency measures how far a bank's cost is apart from the best practice bank's cost that produces the same output level and under the same environmental conditions (Lovell 1993). Revenue efficiency measures the ratio between current revenues to optimal revenues given prices and output. Profit efficiency measures the ratio of current profits to optimal profits, given inputs, output and their respective prices (Hassan and Sanchez 2007).

Banking sector efficiency is important for the design of monetary policy in an economy. Understanding the monetary policy primary transmission channel allows policymakers to obtain feedback on how changes in the regulatory environment affect bank efficiency and how efficiency translates into profitability of banks (Kablan 2010). Banking sector efficiency assists in benchmarking an individual bank against best practice (Das *et al.* 2009). It further assists in assessing the effect of various policy measures on performance of these institutions. The ability of banks to fulfil these tasks depends on their ability to efficiently utilize resources.

The study of banking sector efficiency is important given the important role played by banks in financial intermediation. Banks are responsible for disseminating information to both investors and borrowers. Banks monitor and ensure that borrowers make proper use of depositors' funds. They smooth out unexpected consumption shocks through insurance to depositors. Banks also contribute to the growth of the economy by funding various economic activities and ensuring good corporate governance (Allen & Carletti 2008). The ability of banks to fulfil these mandates is dependent on an enabling environment for efficient financial intermediation.

Interest in banking sector efficiency among policymakers and scholars emanates from the role played by banks in ensuring an unimpeded flow in financial and real resources to where they can earn higher returns (Karimazadeh 2002). Efficiency of the banking system has an impact on the reduction in spreads between lending and deposit rates which stimulate greater demand for loans and the mobilisation of savings. The monetary system of a country has an effect on the drivers of efficiency in the banking sector. Efficiency of banking sectors in countries under own currency, regional currency or dollarization have different variables that drive their cost and revenue efficiencies. This study focuses on a dollarized monetary system.

There are a number of studies on the performance of the banking sector in dollarized economies (Quispe-Agnoli & Myriam. 2001; Baliño, Tomas, Bennett & Borensztein 1999; Berg & Borensztein 2000; Bogetic 2000). Dollarization is a process where a country adopts the currency of another country as legal tender. Dollarization can be unofficial when the citizens of a country carry a fraction of their financial wealth in foreign currency but not used as legal tender. This happens when the citizens of the country adopt foreign currencies to hedge against

inflation but not as part of government policy (Balín̄o *et al.* 1999), whereas with official dollarization the government replaces the domestic currency with the currencies of other countries. Official dollarization can take more than one form and these vary in respect of the number of foreign currencies allowed to circulate as full legal tender (Bogetic 2000). Dollarized economies may allow one currency full legal tender status and in other countries two or more currencies can serve as full legal tender. Andorra adopted two currencies, the French franc and the Spanish peseta, as legal tender (Bogetic 2000). Zimbabwe adopted more than two currencies as legal tender hence the term multicurrency system.

One of the major characteristic of dollarized economies is the lack of lender of last resort, which alters the way banking institutions manage financial, liquidity and solvency risks; hence efficiency. In such instances, authorities demand higher reserve requirements, higher liquidity requirements, and deposit insurance as a risk management mechanism (Gulde *et al.* 2004). Such policy interventions ultimately affect the efficient financial intermediation process.

The study evaluates the revenue and cost efficiency of the Zimbabwean banking sector for the period 2009-2014. The study employs the data envelopment analysis and Tobit regression methodology to estimate revenue and cost efficiencies of the banks. Estimating the cost and revenue efficiency of various categories of Zimbabwean banks serves to resolve a number of important questions: (i) how did the bank efficiency evolve in a dollarized economy? (ii) Which categories of banks were more efficient? (iii) Which factors drove the efficiency of the banking sector during the period from 2009 to 2014?

The study is organised as follows: Section two reviews the background of the Zimbabwean banking sector; Section three reviews literature on banking sector efficiency. Section four outlines the methodology used for the study; Section five presents an analysis of the results; and sections six discusses policy recommendations.

## **2 Background of the Zimbabwean banking sector**

The evolution of the banking sector in Zimbabwe can be categorised into four distinct phases: post-independence (1980-1990), the reform period (1991-1999), the crisis period (2000-2008) and the multicurrency period (2009-2014). The policy thrust of each phase was quite distinct and shaped the performance of the banking sector. Policy decisions made during the different phases were based on the broad macroeconomic direction that the government took.

During the post-independence period (1980-1990) the banking sector was heavily regulated and followed a segmented market approach. The sector was oligopolistic in nature and was dominated by a few foreign banks with limited competition (Chipika & Malaba 2011). This allowed the banks to form cartels to fix interest rates. The entry and exit into the sector was prescribed by various regulatory barriers. There were a few notable foreign banks, namely

Barclays, Standard Bank and First Merchant Bank among others (Kanyenze *et al.* 2011). Pricing of banking products was determined by the banks and government determined the minimum lending rates; typical of repressive financial regulatory regimes (Mabika 2001). The banking sector was pro-urban, which deprived rural dwellers of the financial services (Moyo 1999).

The government liberalised the financial system in 1991. Financial liberalisation was meant to establish financial efficiency, competition and profitability in the financial sector. Regulatory barriers were lifted and new entrants were allowed into the banking sector with the first Zimbabwean indigenous bank, the United Merchant Bank, being licenced in 1997 (Mumvuma *et al.* 2003). Subsequently the number of banks in the country increased from ten in the post-independence period to thirty in 1999 (Mumvuma *et al.* 2003). Despite the liberalisation of interest rates and entry of new players, not much change was experienced in terms of competition. Product offering on the market did not change as all banks competed in the generic products such as deposit mobilisation and lending to established corporates (Kanyenze *et al.* 2011).

The country experienced an economic crisis during the period (2000-2008), during which time the reform agenda continued to characterise the policy environment. The number of banking institutions that had increased to forty-three in 2003 (Kanyenze *et al.* 2011), decline as the economic crisis persisted. Thirteen financial institutions closed down as a result of liquidity problems, corporate governance challenges and inadequate risk management. There was also rampant insider dealing and abuse of central bank liquidity advances window. In response to these complications, the central bank stopped the lender of last resort function and instituted a raft of measures to control the problem (Makoni 2010). The confidence of Zimbabweans in the banking sector declined as a result of the closure of banks, cash shortages at banks and their depleted savings as a result of hyperinflation. Consequently people resorted to keeping their money outside the banking sector (Kanyenze *et al.* 2011).

In order to abate the persistent economic crisis and restore macroeconomic stability, the government dollarized in 2009 and the Zimbabwean dollar was abandoned in favour of a basket of currencies (multi-currency system). The foreign currencies adopted, became the legal tender functioning as the store of value, unit of account and medium of exchange. The government failed to immediately demonetise the Zimbabwe dollar cash and bank balances until 2015. Resultantly, Zimbabwean dollar depositors lost all their savings, which led to lose of confidence in the banking institutions by the banking public. The banks were also affected as they lost out on all their liquid assets, which were denominated in Zimbabwean dollars. The multicurrency system created a number of challenges for the banking sector including insolvency, liquidity challenges, and undercapitalisation (RBZ 2013). The banking sector experienced an increase in non-performing loans, absence of a credit reference bureau, human resource flight, liquidity challenges, lack of lender of last resort, and reduced activity on the interbank market, among other challenges (RBZ 2013). As a result of these challenges eight banks closed down between 2009 and 2015. With these challenges in the banking system combining with macro-economic challenges the

country was experiencing, performance of the banking sector became a function of a number of factors worth investigating

The study evaluates the cost and revenue efficiency of the Zimbabwean banking sector under a multicurrency system. Secondly, the study ascertains the evolution of efficiency under the same system. The study further determines the drivers of cost and revenue efficiency contributing to the literature on determinants of banking sector efficiency in a dollarized environment.

### 3 Literature review

Banking sector efficiency can be measured by two main methods; the parametric (econometric) and non-parametric (mathematical programming) methods (Stavarek & Øepkova 2012). The parametric and non-parametric approaches differ in their underlying assumptions of the random noise and the structure of production technology. The approaches are different in their assumptions of how they envelopment a data set. There is no consensus on the superiority of one method over the other (Berger & Humphrey 1997).

The Stochastic Frontier Approach (SFA), Distribution Free Approach (DFA) and Thick Frontier Approach (TFA) fall under the parametric approach methods. The parametric methods assume a particular functional form for the cost function or production technology and allow for an error term composed of a symmetrically distributed random error term and truncated inefficiency term. The main drawback here is the imposition of functional form on the behaviour of economic variables (Poghosyan & Borovička, 2007).

The two main nonparametric methods are the Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH). The non-parametric methods use linear programming tools. The efficiency frontier in non-parametric estimations is formed as a piecewise linear combination of best-practice observations. DEA is a deterministic method for examining relative efficiency, based on the data of selected inputs and outputs of a number of entities called decision making units (DMUs). The relative efficient DMUs are then identified from the available data. They then become the reference points which describe the efficiency frontier. Reference points help to determine the inefficiency of other DMUs below that frontier (Casu & Molyneux 2000; Noulas 2001; Barr *et al.* 2002; Jemric 2002; Loukoianova 2008).

The DEA methodology is based on the information on inputs and outputs of individual entities to construct an efficiency frontier enveloping the data. The model chooses a benchmark entity, which lies on this frontier, and measures the efficiency of other individual entities relative to the benchmark entity (Casu & Molyneux 2000 and Noulas 2001). Two alternative approaches are available in Data Envelopment Analyses to estimate the efficiency frontier. One is input-oriented, and the other is output-oriented. In the input-oriented model, the inputs are minimised and the outputs are kept at their current levels (Charnes, Cooper & Rhodes 1978). In the output-oriented model (Banker, Charnes & Cooper 1984) the outputs are maximised and the inputs are kept at their current

level.

Cook *et al.* (2000) studied the efficiency of the Tunisian banking sector using the DEA method. The study found that efficiency in the Tunisian banking sector was negatively related to the size of the bank and the credit issues. A positive and statistically significant relationship was found in ownership structure and bank efficiency. Private Banks were found to be more efficient compared to public banks. Grigorian and Manole (2002) estimated the efficiency scores in transition countries using the Data Envelopment Analysis (DEA) approach. In the second stage, the study ascertained the factors affecting efficiency using the Tobit censored regression. The results showed that foreign ownership and consolidation improved commercial bank efficiency. The level of capitalisation, market share and GDP per capita significantly influenced efficiency. Bank efficiency was found to be negatively affected by the securities market and non-bank financial institutions.

Sathye (2003) studied the productive efficiency of the Indian banking sector using the DEA approach. The study measured the efficiency of the different categories of banks: public banks, private and foreign capital. The results revealed that the efficiency of commercial banks in the private sector was lower than in the public sector and foreign banks in India. Hussein (2003) analysed the characteristics of cost efficiency of Islamic banks in Sudan between 1990 and 2000. The study revealed that there were marked differences in the efficiency of Sudanese Islamic banks. The findings showed that efficiency in the Sudanese banking sector was determined by the size of the bank, with smaller banks being more efficient than the larger banks. The ratio of capital adequacy and cost efficiency was found to be positive. The study recommended that Sudanese banks should implement programs for the development of human capital in order to reduce cost inefficiencies.

Using the DEA method, Casu and Molyneux (2003) examined productive efficiency of the European banking system for the period 1993-1997. Their study used a Tobit regression model to ascertain the factors determining the efficiency of European banks. The results indicated that efficiency and profitability ratios were positively related. Girardone *et al.* (2004) evaluated the efficiency of Italian banks for the period 1993 to 1996. The results showed that efficiency negatively correlated with capital and positively related to the level of non-performing loans. The study concluded that efficient banks pay more attention to the activities of credit monitoring. The results did not find any relationship between the size of asset holdings and efficiency.

Fries and Taci (2005) studied the cost efficiency of banks in East European countries. The results showed that large asset ownership by foreign banks is associated with lower costs. The study further found that there is a nonlinear relationship between cost efficiency and banking sector development. Pasiouras *et al.* (2007) examined Greek banks' efficiency and its determinants using the DEA approach. The study estimated the technical, allocative and cost efficiency of the Greek banks and employed the Tobit regression technique to ascertain the internal and external determinants of bank efficiencies. The study found that the size of the bank is positively associated with greater bank efficiency. The

results revealed that GDP per capita and unemployment were negatively related to bank efficiency. The degree of capitalisation, the number of branches and quantity of ATMs were found to influence bank efficiency differently depending on the measure of efficiency used.

Hassan and Sanchez (2007) examined the determinants of efficiency in Latin American banking industry. The study established that the degree of capitalisation, profitability ratios, the interest rate spread and GDP growth were positively related to greater bank efficiency. Loan loss reserves, the value of stock traded, and the inflation rate were negatively related to bank efficiency. Khediri *et al.* (2009) analysed the factors affecting efficiency of Islamic banks. The study revealed that operating costs and efficiency were negatively correlated while efficiency was positively correlated with economic growth. Delis and Papanikolaou (2009) examined the effects of bank-specific, industry specific and macroeconomic variables on bank efficiency. The results revealed that foreign ownership, market interest rates and GDP growth were positively related to bank efficiency. Credit risk and the concentration of the industry were negatively related to bank efficiency.

Using DEA approach, Daley and Mathews (2009) studied the technical efficiency of Jamaican Banks during the period 1998-2007. Cost over income ratio and the size of the bank were negatively related to bank efficiency, whereas GDP growth was positively related to bank efficiency. Tecles and Tabak (2010) evaluated the determinants of bank efficiency in Brazil for the period 2000-2007 and found that large banks were the most cost and profit efficient alongside foreign owned banks. The results showed that the degree of capitalisation and bank efficiency was positively related.

Nitoi (2009) analysed the efficiency and productivity of the Romanian banks from 2006 to 2008, using the DEA approach. Based on a sample of 15 commercial banks, the study found that although the efficiency of the Romanian commercial banks improved since 2006; the cost efficiency scores were relatively low. Jemric (2002) investigated the efficiency of banks in Croatia. The main results showed that foreign banks were, on average, the most efficient and that banks that recently entered the market are more efficient than those that had been operating for a long time. Small banks were found to be more efficient than large ones.

Poshakwale and Qian (2009) examined the competitiveness and efficiency of Egypt's banking sector following a series of key reforms over the period 1992 to 2007. The findings of the study suggested that the banking sector in Egypt had become more competitive and efficient over time which was consistent with the conventional view that efficiency improvement enhances industry competition. The results further revealed that competition and productive efficiency significantly influence economic growth in the short run but not in the long run. Hauner and Peiris (2005) researched the efficiency of Ugandan banks. The results confirmed that efficiency levels are higher after privatisation and consolidation in the banking sector and, on average, larger banks and foreign-owned banks have become more efficient. Di Patti and Hardy (2005) assessed the efficiency of the Pakistan banking sector. The results revealed that there was



efficiency improvement in terms of both revenue and costs after the financial sector reforms; thus the benefits of reform were passed on to consumers.

Mertens and Urga (2001) assessed the efficiency of the Ukraine banking sector. The results revealed that small banks were more efficient in terms of cost, but less efficient in terms of profit. Large banks in Ukraine were found to exhibit significant scale diseconomies. Jemric (2002) examined the Croatian banking system and found that small banks were more efficient than the larger ones.

Bonin *et al.* (2005), found that state-owned banks were not less efficient compared to non-domestic private banks. The results showed that privatisation by itself was not sufficient to increase bank efficiency as government owned banks are no less efficient than domestic private banks. Kraft, Hofler and Payne (2006) examined the Croatian banking sector. The study found that new private and privatised banks were not more efficient than public banks. The results showed that privatisation did not immediately improve efficiency, while foreign banks were significantly more efficient than all domestic banks. Boubakri *et al.* (2005), in a study of developing countries found that the banks that were held under government control were more efficient than the private banks.

Berger *et al.* (2000) distinguished between the home field advantage hypothesis and the global advantage hypothesis. The home field advantage postulates that domestic institutions are generally more efficient than institutions from foreign nations due to organisational diseconomies in operating or monitoring an institution from a distance; diseconomies also exist due to differences in regulatory and supervisory environments. However, the global advantage hypothesis suggests that foreign institutions are able to overcome these disadvantages and operate more efficiently. They spread their superior managerial skills or best-practice policies and are able to lower their costs. Levine (1996) established that there were a number of advantages associated with the entry of foreign banks into the domestic banking sector. The first advantage was that foreign bank entry enhanced local banking efficiency by improving the financial setup and financial policy. Secondly, it facilitated the host country to access international capital markets. Thirdly, it stimulated competition which enhanced the financial services quality through bank competition, thus encouraging the domestic banks to put in place sophisticated banking skills and technology.

Claessens *et al.* (2004) found that foreign banks' presence in a country was characterised by lower average margins. The entry of foreign banks also led to competitive pressure in the banking sector which resulted in efficiency gains. Kirkpatrick, Murinde and Tefula (2008) realized that there was an inverse relationship between foreign bank penetration and X-inefficiency. The study concluded that entry of foreign banks into Africa improved management and performance of commercial banks and also brought expertise which enhanced the banking system's efficiency. Berger *et al.* (2004) found that foreign banks were more profit efficient, followed by private domestic banks, and lastly the state-owned banks. Buchs and Mathiesen (2005) also found that foreign banks were more efficient in generating revenue (interest, commissions, and fees) compared to domestic banks. Bonin, Hasan and Wachtel (2005) also found that foreign-

owned banks were efficient in mobilising deposits and advancing more loans than domestic private banks. The study further found that the foreign banks were more efficient in the distribution of financial services.

## 4 Methodology

This study employs a two-step approach to evaluate the determinants of banking sector efficiency under the multicurrency system (2009-2014). Firstly using the data envelopment analysis approach, the study estimates the efficiency scores for the banking sector. The DEA scores are used as the dependent variable in ascertaining the determinants of efficiency in the banking sector using the Tobit regression model in the second stage

Data envelopment analysis uses linear programming techniques to calculate the relative efficiency of DMUs. DEA determines the efficient frontier of a set of DMUs based on the input and output variables without knowing *a priori* the relationship among the variables. Farrell (1957) proposed the use of relative efficiency which involves multiple inputs and outputs though not necessarily in equal proportion.

Assume there are  $n$  DMUs and the  $j^{th}$  DMU,  $DMU_j$ , produces  $s$  outputs  $(y_{1j}, \dots, y_{sj})$  by using  $m$  inputs  $(x_{1j}, \dots, x_{mj})$ . Morita and Avkiran (2008) posited that the efficiency score observed  $DMU_0$  is given as the optimal value to the following linear programming model

$$\begin{aligned} \theta_o^* &= \min \theta \\ & \text{s.t} \\ & \sum_j \lambda_j x_{ij} \leq \theta x_{io}, i=1, \dots, m \\ & \sum_j \lambda_j y_{rj} \geq y_{ro}, r = 1, \dots, s \\ & \lambda_j \geq 0, j = 1, \dots, m \end{aligned} \tag{1}$$

This is an input oriented constant return to scale (CRS) model. The efficiency of  $DMU_0$  is determined from efficiency score  $\theta_o^*$  and its slack values. If  $\theta_o^* = 1$  and there is no slack,  $DMU_0$  is said to be efficient.  $\theta_o^* = 1$  and there are non-zero slacks,  $DMU_0$  is inefficient and is regarded as weakly efficient. The weakly-efficient DMUs and efficient DMUs constitute the efficient frontier. This study seeks to ascertain the cost and revenue efficiencies of the Zimbabwean banking sector.

The Data envelopment analysis model is used because it accommodates both multiple inputs and multiple outputs. The model is also convenient in that it does not require prior aggregation of the outputs or a specific functional form of the production function as in the SPF approach (Lovell & Schmidt 1988)

The definition of the inputs and outputs for the study follows the intermediation approach of Sealey and Lindley (1977). The intermediation approach views the bank as an intermediary that facilitates the transfer of funds from

surplus agents to deficit agents rather than producers of loans and deposit account services. Three inputs were considered for the evaluation of the banks performance; deposits, labour and capital. The outputs which were included were: total loans (short-term, medium and long-term loans), and total income (sum of interest income and non-interest income). These outputs represent bank revenue and the major profit making business activities (Liu 2010). Whether products (inputs and outputs) should be measured in terms of the number of accounts or dollar values presented a further complication. Kolari and Zardkoohi (1987) inspired this study. They argue in favour of using dollar values because banks compete to increase the market share for dollar amounts rather than the number of accounts. Secondly, the various accounts offered by banks have different costs; for example, time deposit accounts differ from savings accounts. Thirdly, banks offer a number of services, in which case the dollar amount is the only common denominator; for example, custodial services cannot be measured in terms of the number of accounts.

The estimation of cost efficiency requires the specification of the prices of inputs. The price of a deposit is calculated as an interest expense over total deposits; price of labour is labour costs over total number of employees and price of capital is calculated as total expenses less labour expenses over total assets. The calculation of revenue efficiency requires the specification of the prices of the output. Price of total revenue is defined as total revenue divided by fixed assets, while price of loans is defined as interest income divided by total loans.

After estimating the cost and revenue DEA efficiency scores the study employed a Tobit econometric regression model based on the efficiency scores as the dependent variables. The Tobit regression model is useful when the dependent variables are limited by a specific threshold. The Tobit model was first suggested in econometrics literature by Tobin in 1958, and can be regarded as truncated or censored regression models where expected errors are not equal to zero. DEA scores fall between the interval 0 and 1 making the dependent variable a limited-dependent variable. Under such circumstances, estimating the regression using the ordinary least square leads to biased parameter estimates, since OLS assumes a normal and homoscedastic distribution of the disturbance and the dependent variable (Maddala 1983).

Jackson and Fethi (2000) argued that estimation with OLS would lead to biased results for the efficiency parameter since it assumes normality and a homoscedastic distribution of the variance of the error term. Studies that have employed this method included those of Coelli *et al.* (1998) and Casu and Molyneux (2003), to arrive to the estimate scores.

Sanchez *et al.* (2013) posited that the efficiency of a banking system depends on bank-level performance, the level of development in the financial system, and the macroeconomic health of the country. This current study considered the following independent variables; return on assets, capital adequacy, bank size, non-performing ratio, cost income ratio, market share, inflation and economic growth.

The study estimates the following empirical model:

$$EF_{it} = \alpha_i + \beta_1 ROA_{it} + \beta_2 LNSIZE_{it} + \beta_3 LI_{it} + \beta_4 CAD_{it} + \beta_5 NPL_{it} + \beta_6 CIR_{it} + \beta_7 VMI_{it} + \beta_8 INF_{it} + \beta_9 MKT_{it} + \varepsilon_{it} \quad (2)$$

The variables in equation (2) are explained below:

Credit risk (NPL) measures the ratio of non-performing loans to the total loan portfolio. An increase in the ratio implies that the quality of the loan portfolio is deteriorating hence the lower expected efficiency. The *a priori* expectation is that  $\beta_5$  is negative.

Capital adequacy (CAD) measured by the ratio of equity capital to total assets reflects the bank's management efficiency and risk preference (Kamaruddin 2007). First, a highly efficient bank is able to increase capitalisation if it is efficient through retaining more earnings as capital (Carvalho & Kasman 2005); consequently, a positive relationship between efficiency and capital.

Competition (LI) as substituted by the Lerner index is expected to have a positive effect on efficiency. The greater the competition in the banking sector, the more it is expected that the banks will be efficient.

The Cost-to-income (CIR) ratio is a measure of efficiency in profitability; the higher this ratio, the lower is the efficiency expected.

Return on assets (ROA) measures the profitability of the banking institutions. It is related to the optimal use of resources. The expectation is a positive relationship between the profitability and efficiency measures (Sufian 2009).

The proxy for the Size of the bank (SIZE) is the amount of its assets. It is used to measure the possible cost advantages associated with size (Sufian 2009).

Market share (MKT) is expected to have a negative relationship to bank efficiency. Increasing market share for a single banking institution reduces the amount of competition in the banking sector. The smaller the market share for individual banks the higher the competition in the market (Sufian, 2009).

The effect of economic growth (VMI) on efficiency is ambiguous. This is because growth in GDP has an effect on both demand and supply for loans (Carvalho & Kasman 2005).

Inflation (INF) as a measure of economic instability has a negative effect on the banking sector efficiency (Boyd *et al.* 2001; Khan, Senhadji & Smith (2001).

This empirical research employed quarterly data over the multicurrency period 2009 to 2014. A total of 18 financial institutions constituted the sample with an equal number of observations across the banks, reflecting a balanced panel. The study relied on published financial statements (balance sheets and income statements) as the main sources of bank specific variables. The data on macroeconomic variables were sourced from Government Budget Statements and Zimbabwe Statistic Agents (ZimStats) publications.

## 5 Results Presentation and Analysis

This section presents the results of measuring the revenue and cost efficiency. The measurement of the cost and revenue efficiency is undertaken using a DEA

method. The DEA model identifies relative efficient DMUs which are used as reference points. The relative efficient points are then used to define the efficiency frontier and evaluate the inefficiency of other DMUs which lie below that frontier. Efficiency scores are used to benchmark banks against the optimal producing banks operating under the same environment

The average cost efficiency of the banking sector for the period 2009-2014 was 64.7 percent. This result means that an average bank operated at an efficient level of 64.7 percent of the best performing bank in the sample. This means the best performing bank used less resources in producing the same amount of output as compared to the average bank in the sample. It implies that the average bank could have used 35.3 percent less resources if it had used the method adopted by the best practice bank. In other words had the average bank operated at the same efficient level as the most efficient bank in the sample it could have saved 35.3 percent of the resources in producing the same amount of output.

The average revenue efficiency score for the banking sector was 66.4 percent. This suggests that the average bank could have generated the same amount of revenue using 33.6 percent less resources if they had produced following the most efficient bank in the sample. The results imply that using the same amount of resources, the average bank could have generated a relatively high volume of revenue if it had adopted the standard of the best practice performance bank in the sample.

The results show that banks were on average marginally revenue efficient than cost efficiency. The difference in the revenue and cost efficiency was 1.8 percent. Given that both cost and revenue inefficiency are high suggest that banks experienced high levels of wastage in the intermediation process. The banks had substantial room for significant cost savings if they had operated at the level of best practice performance bank in the sample.

Fig 1 depicts the trend in revenue efficiency (RE) and cost efficiency (CE) during the period 2009-2014. Revenue and cost efficiency increased during the period 2009-2012. The increase is attributed to significant growth in bank balance sheets; assets, capital levels, deposits and loans. The growth in bank balance sheets during 2009-2014 took place after the decimation of the balance sheets during hyperinflation and when the country abandoned its local currency. There was also increased competition among the banks as they sought to attract new clients who had abandoned banking during the hyperinflation period (2000-2008). The economy also stabilised and registering positive growth for the first time in a decade in 2009 and subsequent years which led to increased demand for banking products.

Cost and revenue efficiency declined in 2013 and 2014. The decline in efficiency was a result of a number of factors. In 2013 the government introduced a memorandum of understanding between banks and the central bank to guide the pricing of the banking products. This defacto instituted price controls in the banking sector. Banks became constrained in their revenue generation. During the period the growth of the economy decelerated which increased defaults by those who had borrowed from the banks leading to an increase in the non-

performing loans. The economy started to experience declining capacity utilisation and the shedding of labour which led banks to slow down on their asset creation. Banks became more involved in recovery of bad loans which increased their costs as well as reducing their incomes through increased provisioning.

Table 1 shows the average revenue and cost efficiency scores for public and private banks. The table indicates that the average revenue and cost efficiency scores for both private banks and public banks were increasing and reached their maximum scores in 2012 before declining again. The only exception was the revenue efficiency of public banks which reached a maximum in 2011 and declined during the period 2012-2014.

Table 1 depicts that throughout the period 2009-2014 private banks had a higher revenue efficiency score compared to public banks. Indicatively, private banks were in a better position in respect of generating revenues. On the other hand private banks were more cost efficient between 2009 and 2010 while public banks became cost efficient during the period 2011-2014.

The average revenue efficiency score for private and public banks were 68.5 per cent and 59.1 per cent respectively. The results mean that private banks were operating at a lower level of efficiency as compared to the best performing efficient bank in the sample. The result implies using the same amount of resources, private banks generated less revenue compared to the best performing bank by 31.5 percent. In the same way public banks generated 40 percent less revenue compared to the best performing bank using the same amount of inputs compared to the best performing bank. The results suggest that private banks are more revenue efficient as compared to public banks. The results are supported by previous studies (Fries & Taci 2005 and Kraft, Hofler & Payne 2006).

The average cost efficiency scores for private and public banks were 65.4 per cent and 64.5 per cent respectively. The results mean that both private and public banks were using more resources in generating a single unit of output compared to the best performing banks. The best performing bank was using 65.4 percent and 64.5 percent of the resources used by the average private and public banks respectively to produce the same amount of output produced by the two. The result implies that if the private and public banks had employed resources efficiently as the best practice bank, they could have produced more output than they were actually producing. The cost efficiency scores for the private and public banks do not show much difference hence the two are equally inefficient.

Table 2 shows the average revenue and cost efficiency scores for domestic and foreign banks. The results confirm that domestic banks were more cost and revenue efficient than foreign banks. The results reveal that domestic banks were more efficient compared to foreign banks. The results are supported by prior studies (Green, Murinde and Nikolov 2004). The low efficiency score for foreign banks in Zimbabwe can be explained by the cautious approach these banks adopted during the period of the study. Foreign banks have not been aggressive on the market as compared to domestic banks. The government policy on indigenisation and empowerment which took centre stage during the

study period forced foreign banks to be cautious as there was discord on how the policy was going to be implemented. The central bank was adamant that the banking sector was not going to be indigenised while the Ministry responsible for indigenisation was insisting on indigenising the sector. The indigenisation policy required that for all corporates, 51 percent of shareholding was supposed to be held by indigenous/ local shareholders and 49 percent by foreign shareholding. This reduced the commitment of the foreign banks as it brought uncertainty on the security of their investment. Secondly, the MoU that was put in place by the government in 2013 sent the signal that the government was bent on controlling the sector which has an impact of the performance of banks. The policy had the effect of forcing the foreign banks to become cautious given most of foreign banks are used to operating in liberalised environments with little interference by the government.

Table 3 displays the trend in the average efficiency scores of building societies and commercial banks. The results show that commercial banks were both cost and revenue efficient as compared with building societies. The average efficient scores for commercial banks and building societies were 68.5 per cent and 51.33 per cent respectively. This implies that the best performing bank in the sample was using the 68.5 per cent and 51.33 per cent of resources used by the commercial banks and building societies respectively to produce a unit of output. In other words best performing bank in the same could produce more output had it used the same amount of resources used by the commercial banks and building societies implying that the two were producing inefficiently. Despite their inefficiency commercial banks were operating at lower inefficiency level as compared to building societies.

The results of this study indicate that there was a decline in the average efficiency scores across all banks and categories in 2013. The upward trend in efficiency across the two categories was reversed in 2013, leading to a significant decline during the period 2013-2014. The impact of the MoU between government and banks affected the efficient operations of the banks.

The results reveal building societies are more efficient in revenue generation compared to cost containment. The results show that commercial banks are more revenue efficient compared to cost efficiency. Banks in Zimbabwe operate under a universal banking license that allow them to also venture into various banking activities including leasing, hire purchase and mortgage financing among others.

## **5.1 Determinants of Cost and Revenue Efficiency**

This section presents the results of the determinants of cost and revenue efficiency in the banking sector. The determinants of efficiency are important for the development of banking sector policies as well as strategies for enhancing bank efficiency by bank managers. The Tobit (censored) regressions with boundaries of 0 at the left and 1 at the right was applied and the results are shown in Table 4 below.

Table 4 shows that there is a positive relationship between competition and

efficiency. This implies that an increase in competition leads to an increase in cost and revenue efficiency. These results confirm the "quiet life" hypothesis for the Zimbabwean banking sector which assumed that competition should positively influence efficiency. The results are supported by Schaek & Èihák (2008) who investigated the relationship between efficiency and competition. They found that increased competition increased bank soundness through the efficiency channel.

Capital adequacy has a negative and statistically significant relationship with cost efficiency while it has a negative and insignificant relationship with revenue efficiency. The findings appear to suggest that the more efficient banks use less capital and that the less efficient banks hold more capital in the process. The lack of a relationship between revenue efficiency and capital adequacy is supported by Pasiouras *et al.* (2007) who did not find any significant relationship between the level of capitalisation and measures of efficiency. Berger & Mester (1997) argued that a banking institution which increases its capital through issuance of additional shares rather than using deposits yields an inverse relationship between efficiency and capitalisation levels.

Non-performing loans are also not significant in explaining revenue efficiency of the banks. This is supported by Altunbas *et al.* (2000) who argued that efficiency is not very sensitive to credit risk. There is a positive and significant (10 per cent) relationship between cost efficiency and non-performing loans. This result implies that an increase in the amount of NPLs increases the level of cost efficiency.

There is a negative relationship between return on assets and both cost and revenue efficiency, implying that profitability has a detrimental effect in the determination of cost and revenue efficiency. This could explain the increase in the NPLs where the profitable banks have the higher levels of NPLs. This means that banks build their assets and liabilities without due diligence, allowing some of the assets to deteriorate, affecting both the cost and revenue.

Cost income ratio is an indicator for measuring banks' management quality. It reveals a positive and statistically significant relationship with both revenue and cost efficiency estimates in all types of banks. On the other hand, a lower CIR ratio may impact performance positively because the use of new electronic technology, for instance ATMs and other automated means of delivering services reduced other types of expenditure.

Market share has a positive and significant relationship at a 10 per cent level. The result supports the Efficient-Structure paradigm, which suggests that relatively efficient banks compete more aggressively for greater market share which leads to a more concentrated market (Demsetz 1973). The result also supports the finding by Grigorian and Manole (2002) who found a positive relationship between efficiency and market share and that banks with greater market share are more efficient due to the benefits of economies of scale.

The level of macroeconomic activity has a positive effect on both cost and revenue efficiency. This result is supported by Daley and Mathews (2009) and Delis and Papanikolaou (2009). Their studies found that there was a positive and significant relationship between the measure of economic activity and effi-



ciency. The results imply that an increase in the economic activity increases the demand for financial services; thus improving bank efficiency (Daley & Mathews 2009) and Delis and Papanikolaou 2009).

Inflation has a positive and significant relationship with both cost and revenue efficiency; this implies that an increase in inflation increases the efficiency of the banks. The result could be explained by the low levels of inflation which in some circumstances were negative. Khan *et al.* (2001) found that low inflation is harmful to the banking sector. The very low rates of inflation make planning difficult, worse still in the case of sustained negative inflation rates.

The results show that the bank size has no influence on either bank revenue or cost efficiency. The interesting aspect of the result is that the size of the bank has a negative relationship to revenue efficiency while positively related to cost efficiency though not significant.

## 6 Conclusion & Recommendations

The study sought to evaluate the cost and revenue efficiency of the Zimbabwean Banking sector using the data envelopment analysis and Tobit regression method. The results shows that banks were operating with cost and revenue inefficiency levels of above thirty percent. This implies that banking institutions encountered resource wastages in their production of banking services and generation of revenue. The study has shown that banks could produce more banking products using the same level of inputs if they reduce their inefficiency. Alternatively banking institutions could produce more revenue than currently produced without increasing the amount of inputs.

The study illustrates that cost and revenue efficiency increased during the period 2009-2012. The increase in efficiency was a result of increased economic activity which led to an increase in demand for the various banking products. The period was also characterised by intense competition as banks sought to regain market shares which were lost during the period 2000-2008. Cost and revenue efficiency declined in 2013 and 2014. The decline in efficiency is attributed to the memorandum of understanding which was put in place between the central bank and banking institutions. The memorandum of understanding outlined the pricing structure of the banking products. As a result of the MoU the profits of the banking sector declined in 2013. The price controls had a negative impact on cost and revenue efficiency reflected on the decline in the efficiency.

The study revealed that private banks are more revenue-efficient compared to public banks, and public and private banks are equally cost-inefficient. The results revealed that domestic banks were relatively efficient compared to foreign banks supporting the home field advantage hypothesis. Commercial banks were superior in relative efficiency (both cost and revenue) compared to building societies. The results are of significance because of the universal banking licence which allows banking institutions to venture into any banking business irrespective of whether there are commercial banks, savings bank or building

societies. There are also important given there is freedom of entry and exit in the banking sector. Foreign banks do not face any restriction to enter the banking sector.

An evaluation of the determinants of the banking sector efficiency suggest that both bank specific factors and macroeconomic factors determines cost and revenue efficiency. The study established that cost and revenue efficiency are determined by banking competition, bank size, credit risk, bank capitalisation, economic growth and inflation. The result implies that efficiency in the banking sector is dependent on the strategies that bank management adopt and also the policy measures put in place to enhance the macroeconomic environment. Policy makers should ensure that they put in place procompetitive policies in order to improve the efficiency of the banking sector. This then calls for the implementation of financial sector reforms in order to remove all bottlenecks that hinders competition. The study revealed that tampering with market forces is detrimental to the efficiency. The imposition of the memorandum of understanding in 2013 was accompanied by the decline in both revenue and cost efficiency supporting the need for upholding the operations of free market forces. The macroeconomic environment has a bearing on the efficiency of the banking sector in Zimbabwe. This means an increase in economic activities increases the demand for financial services which increases efficiency. This result calls for banking policy makers to put in place user friendly policies that enhances economic activity

## References

- [1] Allen, F. & Carletti, E. (2008). Mark-to-market accounting and liquidity pricing, *Journal of Accounting and Economics*, 45(2-3): 358-378.
- [2] Altunbas, Y., Evans, L. & Molyneux, P. (2001). Ownership and efficiency in banking. *Journal of Money, Credit and Banking*, 33(4): 926-54.
- [3] Amel, D., Barnes, C., Panetta, F. & Salleo, C. (2004). Consolidation and efficiency in the financial sector: A review of the international evidence. *Journal of Banking Finance*, 28(10): 2493-2519.
- [4] Bader, M.K.I. (2008). Cost, revenue, and profit efficiency of Islamic versus conventional banks: International evidence using data envelopment analysis. *Islamic Economic Studies*, 15(2): 23-76.
- [5] Barr, R.S. *et al.* (2002). Evaluating the productive efficiency and performance of U.S. commercial banks. *Engineering Management*, 28(8): 19.
- [6] Ben Khedhiri, K. & Ben-Khedhiri, H. (2009). Determinants of Islamic bank profitability in the MENA region. *International Journal of Monetary Economics and Finance*, 2(3/4): 409-426.

- [7] Berger, A.N. & Humphrey, D.B. (1997). Efficiency of financial institutions: International survey and directions for further research. *European Journal of Operational Research*, 98: 175-212.
- [8] Berger, A.N. & Mester, L.J. (2003). Explaining the dramatic change in performance of US banks: Technological change, deregulation, and dynamic changes in competition. *Journal of Financial Intermediation*, 12: 57-95.
- [9] Berger, A.N. 2004. *Potential competitive effects of Basel II on banks in SME credit markets in the United States*. Finance and Economics Discussion Series.
- [10] Berger, A.N., DeYoung, R., Genay, H. & Udell, G. (2000). Globalisation of financial institutions: Evidence from cross-border banking performance. *Brookings-Wharton Papers on Financial Service*, 3: 23-120.
- [11] Berger, A.N., Hasan, I. & Klapper, L. 2004. Further Evidence on the Link between Finance and Growth: An International Analysis of Community Banking and Economic Performance. *Journal of Financial Services Research*, 25(2):169-202.
- [12] Bikker, J. & Gorter, J. (2008). Performance of the Dutch non-life insurance industry: Competition, efficiency and focus. *DNB Working Papers*, No. 164.
- [13] Bonaccorsi di Patti, E. & Hardy, D. (2005). Bank reform and bank efficiency in Pakistan. *Journal of Banking and Finance*, 29: 2381-2406.
- [14] Bonin, J.P., Hasan, I. & Wachtel, P. (2005). Bank performance, efficiency and ownership in transition countries. *Journal of Banking and Finance*, 29: 31-53.
- [15] Bos, J.W.B. & Schmiedel, H. (2007). Is there a single frontier in a single European banking market? *Journal of Banking and Finance*, 31(7): 2081-2102.
- [16] Boubakri, N., Cosset, J.C. & Guedhami, O. (2005). Post-privatization corporate governance: The role of ownership structure and investor protection. *Journal of Financial Economics*, 76:369-399.
- [17] Boyd, J.H., De Nicolo, G. & Jalal, A.M. (2006). Bank risk-taking and competition revisited: New theory and new evidence, *IMF Working Papers*, No. WP/06/297.
- [18] Buchs, T. & Mathisen, J. (2005). Competition and efficiency in banking: Behavioral Evidence from Ghana. *IMF Working Papers*, No. WP/05/17.
- [19] Carvalho, O. & Kasman, A. (2005). 'Cost efficiency in the Latin American and Caribbean banking systems. *Journal of International Financial Markets, Institutions and Money* 15(1): 55-72.

- [20] Casu, B. & Molyneux, P. (2003). A comparative study of efficiency in European banking. *Applied Economics*, 35(17): 1865-1876.
- [21] Casu, B. & Molyneux, P. (2003). A comparative study of efficiency in European banking. *Applied Economics* 35(17): 1865-1876.
- [22] Chen, Z. (2009). Systemic risk and bank business models. *DNB Working Papers*, No. 442.
- [23] Claessens, S. & Laeven, L. (2004). What drives bank competition? Some international evidence? *Journal of Money, Credit and Banking*, 36: 562-583.
- [24] Coelli. T., Prassada Rao, D. & Battese, G. (1998). *An Introduction to efficiency and productivity analysis*. Kluwer Academic Publishers.
- [25] Cook, W.D., Hababou, M. & Tuenter, H.J.H. (2000). Multi-component efficiency measurement and shared inputs in data envelopment analysis: An application to sales and service performance in bank branches. *Journal of Productivity Analysis*, 14: 209-224.
- [26] Cook, W.D., Hababou, M. & Tuenter, H.J.H. (2000). Multi-component efficiency measurement and shared inputs in data envelopment analysis: An application to sales and service performance in bank branches. *Journal of Productivity Analysis*, 14: 209-224.
- [27] Daley, J. & Matthews, K. (2009). *Measuring bank efficiency: Tradition or sophistication? – A note*. Cardiff: Cardiff Business School, Cardiff University.
- [28] Das, A. & Ghosh, S. (2009). Financial deregulation and profit efficiency: A non-parametric analysis of Indian banks. *Journal of Economics and Business*, 61(6): 509-528.
- [29] Delis, M.D. & Tsionas, E.G. (2009). The joint estimation of bank-level market power and efficiency. *Journal of Banking and Finance*, 33(10): 1842-1850.
- [30] Fries, S. & Taci, A. (2005). Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries. *Journal of Banking and Finance*, 29(1):
- [31] Girardone, C., Molyneux, P., Gardener, E.P. (2004). Analysing the determinants of bank efficiency: The Case of Italian Banks. *Applied Economics*, 36: 215-227.
- [32] Hassan, K. & Sanchez, B. (2007). Efficiency determinants and dynamic efficiency changes in Latin American banking industries. *Networks Financial Institute, Working Papers*, No. 32. Indiana University.

- [33] Hauner, D. & Peiris, S.J. (2005). Bank efficiency and competition in low income countries: The case of Uganda. *IMF Working Papers*, No. WP/05/240.
- [34] Hefferman, S. (2005). *Modern Banking*. Chichester: John Wiley & Sons Ltd.
- [35] Isik, I. & Hassan, M.K (2002). Cost and profit efficiency of the Turkish banking industry: An empirical investigation, *The Financial Review*, 37: 257-280.
- [36] Isik, I. (2008). Productivity, technology and efficiency of De Novo banks: A counter evidence from Turkey. *Journal of Multinational Financial management*, 18(5): 427-442.
- [37] Jackson, P. & Fethi, M. (2000). *Evaluating the efficiency of Turkish commercial banks: An Application of DEA and Tobit Analysis*. International DEA Symposium. Brisbane, Australia: University of Queensland, 2-4 July 2000.
- [38] Jemric, I. & Vujcic, B. (2002). Efficiency of banks in Croatia, A DEA approach. *Comparative Economic Studies*, 44: 169-193.
- [39] Kablan, S. (2010). Banking efficiency and financial development in Sub-Saharan Africa. *IMF working papers*, No. WP/10/136.
- [40] Kamaruddin, B.B. (2007). Efficiency evaluation of Islamic banking in the dual banking system: An analysis of commercial banks in Malaysia. Unpublished Thesis, Unversiti Utara Malaysia.
- [41] Karimazadeh, M. (2002). Efficiency Analysis by using Data Envelopment Analysis Model: Evidence from Indian Banks. *International Journal, Latest Trends. Financial and Economic Science*, 2(3): 228-237.
- [42] Khan, M., Senhadji, S. & Smith, B.D. (2001). Inflation and financial depth. *IMF Working Papers*, No. WP/01/44).
- [43] Kirkpatrick, C., Murinde, V. & Tefula, M. (2008). The measurement and determinants of X-efficiency in commercial banks in Sub-Saharan Africa. *The European Journal of Finance*, 14(7): 625-39.
- [44] Koetter, M., Bos, J.W.B., Heid, F., Kolari, J.W., Kool, C.J.M. & Porath, D. (2007). Accounting for distress in bank mergers. *Journal of Banking and Finance*, 31: 3200–3217.
- [45] Kolari, J. & Zardkoohi, A. (1987). *Bank Costs, structure, and performance*. Massachusetts/Toronto.
- [46] Kraft, E., Hoffer, R. & Payne, J. (2006). Privatization, foreign bank entry and bank efficiency in Croatia: A Fourier flexible function stochastic frontier analysis. *Applied Economics*, 38(17): 2075-2088.

- [47] Levine, R. (1996). Foreign banks, financial development and economic growth. In: Barfield, C.E. (Ed.). *International Financial Markets: Harmonization versus Competition*. Washington DC: AEI Press.
- [48] Liu, J.S. *et al.* (2010). *Data envelopment analysis 1978–2010: A citation-based literature survey*. *Omega* (2012), doi:10.1016/j.omega.2010.12.006.
- [49] Loukoianova, E. (2008). Analysis of the efficiency and profitability of the Japanese banking system. *IMF Working Papers*, No. 08/63.
- [50] Maddala, G.S. (1983). *Limited-dependent and qualitative variables in econometrics*. Cambridge: Cambridge University Press.
- [51] Mercan, M., Reisman, A., Yulalan, R. & Emel, B.A. (2003). The effect of scale and mode of ownership on the financial performance of the Turkish banking sector results of a DEA-based analysis. *Socio Economic Planning Sciences*, 37(2003): 185-202.
- [52] Mertens, A. & Urga, G. (2001). Efficiency, scale and scope economies in the Ukrainian banking sector in 1998. *Emerging Markets Review*, 2(3): 292-308.
- [53] Nitoi, M. (2009). Efficiency in the Roman banking system: An application of Data Envelope Analysis. *Romanian Journal of Economics*, 29(38): 162-176.
- [54] Noulas, A.G. (2001). Deregulation and operating efficiency: The case of the Greek Banks. *Managerial Finance*, 27(8):35-47.
- [55] Papanikolaou, N., Delis, M. & Brissimis, S. (2008). Exploring the nexus between banking sector reform and performance: Evidence from newly acceded EU countries. *DEOS Working Papers*, No. 0917. Athens: Athens University of Economics and Business.
- [56] Pasiouras, F. (2007). International evidence on the impact of regulations and supervision on banks' technical efficiency: An application of two-stage data envelopment analysis. *Working Paper Series*, No. 2007.01. UK: School of Management, University of Bath.
- [57] Pasiouras, F., Tanna, S. & Zopounidis, C. (2007b). The identification of acquisition targets in the EU banking industry: An application of multi-criteria approaches. *International Review of Financial Analysis*, (in press).
- [58] Poghosyan, T. & Borovicka, J. (2007). Banking efficiency in emerging economies: The impact of ownership endogeneity and EU accession. *CERGE-EI Discussion Paper*, No. 189.
- [59] Poshakwale, S. & Qian, B. (2009). Banking sector and economic growth in Egypt. *African Development Review*, 21(3): 435-453.
- [60] Reztis, A. (2006). Productivity growth in the Greek banking industry: A nonparametric approach. *Journal of Applied Economics*, 9(1): 119-138.

- [61] Sánchez, F.I., Abellán, J.M., & Oliva, J. (2013). Gestión pública y gestión privada de servicios sanitarios públicos: más allá del ruido y la furia, una comparación internacional. *Real Instituto Elcano Working Paper*, No. 4/2013.
- [62] Sathye, M. (2003). Efficiency of banks in a developing economy: The Case of India. *European Journal of Operational Research*, 148(3): 662-671.
- [63] Schaeck, K. & Èihák, M. (2008). How does competition affect efficiency and soundness in banking? New empirical evidence. *ECB Working Paper Series*, No. 932. European Central Bank.
- [64] Schmidt, P. & Lovell, C. A. K. (1988). A Comparison of Alternative Approaches to the Measurement of Productive Efficiency. In Dogramaci A and F Rolf (eds.) *Applications of Modern Production Theory: Efficiency and Productivity*, Kluwer: 3-32
- [65] Sealey, C.W. Jr. & Lindley, J.T. (1977). Inputs, outputs, and a theory of production and cost at depository financial institutions. *The Journal of Finance*, (32)4: 1251-1266.
- [66] Stavarek, D. & Repkova, I. (2012). Efficiency in the Czech banking industry: A non-parametric approach. *Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis*, 60(2): 357-366.
- [67] Sufian, F. (2009). Factors influencing bank profitability in developing economy: Empirical evidence from Malaysia. *Global Business Review*, 10(2): 225-241.
- [68] Sufian, F. (2009a). 'The determinants of Islamic banks' efficiency changes: Empirical evidence from the MENA and Asian banking sectors.' *International Journal of Islamic and Middle Eastern Finance and Management* 2(2): 120-138.
- [69] Tecles, P. & Tabak, B.M. (2010). Determinants of bank efficiency: The case of Brazil. *Central Bank of Brazil, Working Papers*, No. 210:1-53.
- [70] Tobin, J. (1958). Estimation of relationship for limited dependent variables. *Econo-metrica*, 26: 24-36.
- [71] Weill, L. (2003). Banking efficiency in transition economies: The role of foreign ownership. *Economics of Transition*, 11: 569-592.

**Table 1: Average efficiency score between public and private banks**

	Revenue Efficiency		Cost Efficiency	
Year	Public revenue efficiency	Private revenue efficiency	Public cost efficiency	Private cost efficiency
2009	0.4573	0.5739	0.4736	0.5398
2010	0.6884	0.7821	0.6773	0.7185
2011	0.7017	0.7268	0.7707	0.6125
2012	0.6988	0.8074	0.8142	0.7804
2013	0.6394	0.7250	0.8138	0.6993
2014	0.6268	0.6926	0.6922	0.5408
Average	0.591	0.685	0.654	0.645

Source: Researches own computations

**Table 2: Average efficiency scores between domestic and foreign banks**

	Revenue Efficiency		Cost Efficiency	
Year	Foreign Revenue Efficiency	Domestic Revenue Efficiency	Foreign Cost Efficiency	Domestic Cost Efficiency
2009	0.4801	0.5741	0.6415	0.4803
2010	0.6071	0.8206	0.7215	0.7046
2011	0.4829	0.8129	0.5624	0.7343
2012	0.5877	0.8197	0.6446	0.8430
2013	0.5563	0.7636	0.5506	0.7917
2014	0.5452	0.7291	0.3482	0.6615
Average	0.544	0.710	0.561	0.680

Source: Researches own computations



**Table 3: Average efficiency scores between building societies and commercial banks**

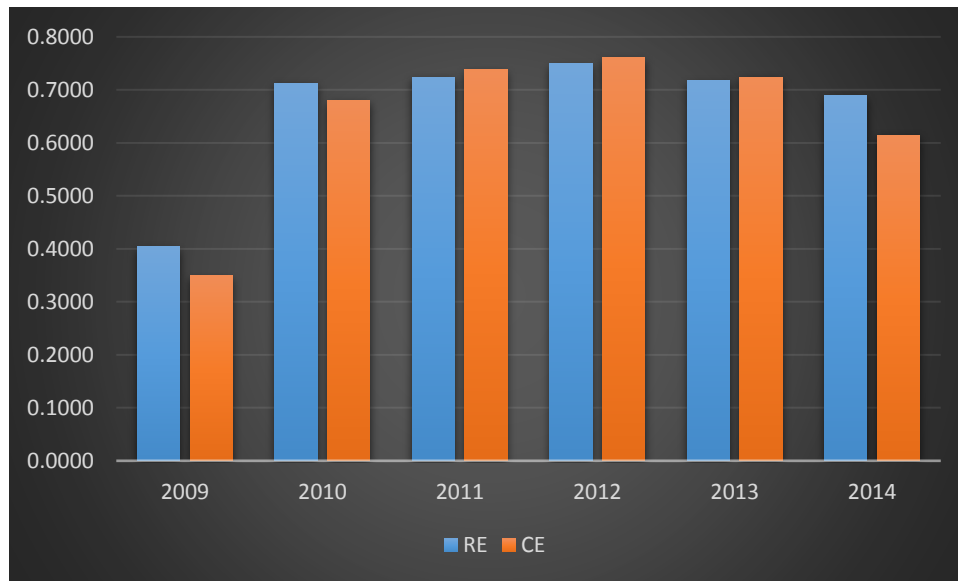
Year	Revenue Efficiency		Cost Efficiency	
	Commercial	Building	Commercial	Building
2009	0.5309	0.4272	0.5961	0.2765
2010	0.7444	0.8205	0.7925	0.4181
2011	0.7096	0.7617	0.7264	0.5471
2012	0.7997	0.7257	0.8184	0.6811
2013	0.7120	0.6851	0.7367	0.6829
2014	0.6864	0.6486	0.5874	0.5924
Average	0.6757	0.6232	0.6854	0.5133

Source: Researcher's own computations

**Table 4: Tobit regression results**

Variable	Revenue Efficiency			Cost Efficiency		
	Coefficient	Standard error	Probability	Coefficient	Standard error	Probability
C	-0.247393	0.489934	0.6136	0.924073	0.421100	0.0282
LI	0.219547***	0.050067	0.0000	0.277844***	0.040773	0.0000
SIZE	0.051212	0.065531	0.4345	-0.073686	0.056215	0.1899
CAD	-0.171127	0.127642	0.1800	-0.752883***	0.110051	0.0000
NPL	0.128458	0.167755	0.4438	0.263679	0.143799	0.0667
CIR	0.559718**	0.256297	0.0290	1.205304***	0.224931	0.0000
VMI	0.009898***	0.003155	0.0017	0.007130***	0.002692	0.0081
INF	2.362214***	0.731044	0.0012	2.895082***	0.627788	0.0000
ROA	-0.125357**	0.053916	0.0201	-0.045273	0.033047	0.1707
MKT	0.745742*	0.429605	0.0826	0.602191*	0.357214	0.0918

**Fig 1: DEA annual cost and revenue mean scores**



Source: Researcher's own computations