Decomposition of the Technical Efficiency: Pure Technical and Scale Efficiency of the Financial System

Sanderson Abel and Alex Bara

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Abstract

The study investigated the technical efficiency of the commercial banks in Zimbabwe during the period 2009-2015. The study entailed the decomposition of the technical efficiency into pure technical and scale efficiency to understand the sources of the technical inefficiency of the commercial banks in Zimbabwe. To accomplish the task the study sampled eleven commercial banks of which six are domestic and the other five foreign banks. The study used the data envelopment analysis method. The results of the study revealed that commercial banks in Zimbabwe are technically inefficient with an efficient score of 82.9 percent. The average pure technical and scale efficiency scores were 96.6 percent and 85.6 percent respectively. The results imply that technical inefficiency of the Zimbabwean commercial banks is mainly a result of scale inefficiency emanating from decreasing returns to scale. The deduction is that commercial banks in Zimbabwe are operating at below their optimum capacity hence have scope to increase their operations in order to improve on technical efficiency.

Key words: Technical efficiency, Scale efficiency, Pure technical efficiency, Data envelopment analysis

JEL Classification: C61; G21

1 Introduction

Banks are vital institutions in any society as they significantly contribute to the development of an economy through facilitation of business. Banks facilitate the development of saving plans and are instruments of the government’s monetary strategy. The global financial crisis in 2008/2009 impacted the banking system leading to declining banking sector profitability, levels of credit growth

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and quality of assets (Ganiâ 2012). This then forced Governments to intervene through a raft of policy measures to restore financial sector stability. The measures included central bank liquidity support; state guarantees to financial institutions; targeted facilities and increased capital requirements (Eden 2009).

The experience of the crisis called for a closer analysis of the performance of the banking sector.

Analysing bank performance is necessary to distinguish efficiency in resource utilisation among banks (Berger & Humphrey 1997). Analytical information is supposed to guide regulators in designing proactive processes for ensuring the stability of the system. The analysis of the banking sector performance also assists in assessing the effect of government policies such as deregulations, mergers and interest rate restrictions among others, and how they affect the economy while also helping banks to reduce wastage in resources, enhance competition and reduce market prices of financial products (Berger & Humphrey 1997). In competitive environments, performance measures are used to compare the performance of peers and evaluate the trend over time (Berger & Humphrey 1997).

One of the important performance measures is the efficiency with which resources are deployed by the banks. An analysis of the bank efficiency is used to evaluate the sources of banking profitability. An efficient bank is supposed to generate its profits through effective utilisation of resources rather than through exploitation of market power (Berger 1995). Banks that are efficient reduces wastage of resources and enhance competition (Berger & Humphrey 1997). A strong legal framework should be able to ensure managers are efficient in resource allocation as it encourages competition. Bank managers can improve cost efficiency by adopting better technologies; alternatively, enhance capital through improving profit efficiency by adopting new marketing and pricing methods (Buchs & Mathisen 2005).

The current study seeks to measure the technical efficiency of the commercial banks in Zimbabwe during the period 2009-2015 using the non-parametric approach of data envelopment analysis. The study decomposes the technical efficiency of commercial banks into pure technical efficiency and scale efficiency so as identify the sources of inefficiency in the banking system with emphasis on whether this is a result of managerial underperformance or the wrong choice of scale.

A number of studies on bank efficiency have produced divergent results (Roy 2014; Li 2014; Kumar & Singh 2015; Marwa & Aziakpono 2015; Singh & Fida 2015; Hacini & Dahou 2016), but studies in the Zimbabwean context remains limited. This motivated the current study to contribute to the literature drawing lessons from Zimbabwe banking sector.

A notable study on the banking sector efficiency in Zimbabwe, Abel & Le Roux (2016), established that banks were both revenue and cost inefficient but it did not discuss the issues of managerial and scale efficiency in the sector. It is important to further decompose the inefficiency into component factors technical or scale because inefficiency in the financial scale has been identified as one of the major determining factors of financial crisis in emerging markets. Disaggregating technical efficiency helps in understanding how banks are earning
their profits, which consequently has an implication on financial sector stability.

The Zimbabwean financial sector has experienced a number of changes, beginning 2009, which had a bearing on its performance. The net interest rate margin, which approximates banking sector efficiency, has been increasing over time. Resultantly, players in the banking sector became more reliant on interest income as their source of revenue. This prompted intervention by the monetary authorities to control the lending rates in the banking sector. On the other hand, there have been nine bank failures since 2009, signifying an element of inefficiency in the system. The banking system has been characterised by deteriorating asset quality during the period 2009 to 2016, which could signal managerial inefficiency in the process of asset creation. Further inefficiency was brought about as banks tried to recover the bad loans as they incur higher cost in trying to recover from the menacing non-performing loans.

The rest of the study is organised as follows; section 2 discusses the background of the study followed by a review of theoretical and empirical literature in section 3. The study methodology is discussed in section 4 while section 5 presents the study results and their discussion. Section 6 concludes the study and proffers some recommendations.

2 Background to the study

After experiencing serious economic crisis during the period 2000-2008, which resulted in the domestic currency losing value, Zimbabwe officially abandoned its currency in favour of foreign currencies in February 2009 (GoZ 2009). The country adopted a basket of currencies that managed to arrest the hyperinflation and sustained economic activity in the economy. Following the adoption of the multicurrency system, the banking system encountered a number of positive developments, including increase in deposits, loans, assets, profitability and capitalization. Prior to the introduction of multicurrency system the banking sector experienced flight-to-quality situations where the banking public shifted their deposits to established international banks. The flight-to-quality experiences is reflected by the high market shares of the top four banks which reached 97 per cent at the height of the hyperinflation in 2008. With the introduction of the multicurrency system, the market share of the top four banks significantly declined during the period 2009 to 2012. Due to competition under a dollarised environment, in the first 2 years of dollarization, banks embarked on aggressive lending in order to increase their market share. Banks started issuing medium to long term loans financed by short term deposits and lines of credit, as an incentive to attract business. With these incentives, banks were able to attract increased numbers of clients which led to a decline in the market share of the top four banks.

On the downside, the excessive lending by banks created non-performing loans, one of the biggest challenges faced in the banking sector, in the dollarized environment. The Non-performing loans (NPLs) increased from 1.8 per cent
in Feb 2009 to 20.1 per cent in September 2014 as shown in Figure 1. The non-performing loans were attributed to the high cost of borrowing, weak credit risk management, absence of robust credit reference systems, insider loans, over indebtedness and inappropriate loan structuring (RBZ 2013). The weak credit risk management was attributed to the tough operating environment in the country and the absence of a credit referencing system.

The growth in NPLs limited the capacity of banks to expand financial intermediation. High and rising levels of NPLs in Zimbabwe exerted strong pressure on bank balance sheets, with adverse effect on banks’ lending operations hence limiting the capacity of banks to expand financial intermediation. The increasing amount of the NPLs led to the problem of disintermediation where the banks had to cut down on their lending and requested borrowers to pledge collateral even for small loans. Non-performing loans affected bank performance, reducing the profitability of the sector through increased provisioning.

Overall, the growth in the amount of non-performing loans had an impact on the performance of the banking sector including its competitiveness. The non-performing loans also resulted in the collapse of some of the banking institutions as it led to insolvency and liquidity challenges.

The banking sector was also faced with a number of other challenges, among them liquidity challenges, insolvency and bank failures. These challenges led to the collapse of some banking institutions as well as the consolidations and mergers in the sector that took place in an effort to meet the stringent regulatory capital requirements, during the period 2009-2016. Consequently, the number of operating banking institutions declined from 28 in December 2008 to below 20 by mid-2014. The country’s central bank, however argues that, failure of the banks was mostly due to poor corporate governance, insolvency and imprudent lending activities (RBZ 2014).

The dollarized monetary system also created distortions in the interest rates in the banking sector. There was the marked disparity between lending and deposit rates that has deterred both borrowers and savers. Lending rates that were being offered by the banks were very high, ranging between 6% and 25% with most banks quoting average lending rates of around 20%. The high lending rates have been a result of high premiums sustained by persistent liquidity shortages that characterized the multicurrency regime. During the same time the deposit rates quoted by most banks for demand deposits ranged from 0.5% to 5% whilst savings deposits ranged from 0.3% to 17% as at 31 December 2015. Given the centrality of the interest rate in margin the economy, this was assumed to be punitive to the productive sectors. The margin shows that the additional costs related to banks intermediary role of linking borrowers with the ultimate lenders. The high interest rate margins that prevailed under the multicurrency system were counter-productive as they acted a disincentive to both savers and borrowers, culminating in financial disintermediation. This has undesirable repercussions on efforts geared at fostering savings culture as low returns deter depositors (Reserve Bank of Zimbabwe, 2015). From an economic perspective, huge interest rate margins signify inefficiency in the banking system.

Given the continuous changes being experienced in the banking sector in
Zimbabwe, there is need to understand how these changes impacted on the efficiency of the sector. This is more so given the regulatory interventions that have seen the central bank dictating pricing in the sector, a development that affects efficiency of individual banks. As such it becomes apparent to try and decompose technical efficiency into pure technical efficiency and scale efficiency to ascertain sources of inefficiencies in the Zimbabwean banking sector.

3 Literature Review

This section discusses both the theoretical and empirical literature on banking sector efficiency. The theoretical literature dwells on the discussion on efficiency and how it impacts the banking system. The empirical literature discusses a number of studies that have looked at the technical, pure technical and scale efficiency in the banking sector and the methodologies used. The section concludes by summarizing what has been the main findings and lessons from these studies.

3.1 Theoretical Literature

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). Alternatively, efficiency is defined as the ability of a firm to derive maximum output given a set of input levels under certain conditions (Coelli 2000). An efficient banking sector reflects a sound intermediation process and makes monetary policies effective. Understanding the 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). The interest among policy makers and scholars in banking sector efficiency emanates from the role played by banks in ensuring unhindered flows in financial and real resources to where they can earn higher returns (Karimazadeh 2002). Efficiency of the banking system results in the reduction of spreads between lending and deposit rates which stimulate greater demand for loans and the mobilization of savings.

The concept of efficiency in banking is multifaceted and has been studied in different dimensions. Allocative efficiency is the extent to which resources are being 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. Alternatively, technical efficiency is the ability of the firm to maximise outputs from a given set of inputs and is associated with managerial decisions (Lovell 1993). The technical efficiency scores can be decomposed into pure technical and scale efficiency to determine the main source of the technical efficiency. Scale efficiency refers to the relationship between the level of output and the average cost hence it relates to the size of operation in the organisation.

Organisations can operate under three possibilities; constant returns to scale,
increasing returns to scale and decreasing returns to scale. Constant returns to scale attains when the relationship between input and output is constant. In this case output changes proportionately with an increase or decrease in inputs hence the organisation is scale efficient. An organisation is said to be experiencing increasing returns to scale if the output increases more than the increase in the inputs. This means that the organisation is suffering the problem of undersize hence has scope to increase its size. Decreasing returns to scale attains when the increase in output is far less than the increase in the inputs. This means that the organisation is overly large above the optimal size. Both the phenomena of increasing returns to scale and decreasing returns to scale shows that the organisation is operating outside the optimal scale hence exhibit scale inefficiency. The various forms in which efficiency has been studied shows that the concept of efficiency is a multi-faceted concept with several meanings depending from which perspective it is regarded (Leibenstein 1966).

3.2 Empirical Literature

There are a number of studies that have been undertaken to estimate the technical efficiency of the banking sector. The majority of these studies have been undertaken using the stochastic frontier approach of the data envelopment analysis. The data envelopment analysis has been used to decompose the technical efficiency into pure technical efficiency and scale efficiency. The studies have shown that the main source of technical inefficient could be scale inefficiency or pure technical inefficiency. There is no uniformity among the studies.

Kumar & Gulati (2008) evaluated the technical, pure technical, and scale efficiencies of Indian public sector banks. The study established that the overall technical efficiency of the public sector banks was 88.5 percent and there were only seven technically efficient banks in the sample. The study also found that public sector banks were more pure technically inefficient as compared to scale inefficiency hence it implies that the public sector banks suffered more from managerial inefficiency as compared to the scale efficiency. The predominant form of scale inefficiency identified in the study is the decreasing returns to scale. The results from the regression show that the banks' exposure to off balance sheet activities had a positive effect on technical efficiency.

Al-Muharrami (2008) investigated the technical, pure technical, and scale efficiency, for Gulf Cooperation Council (GCC) banks for the period 1993 - 2002. Smaller banks were found to be overall technical efficiency than bigger banks. Big banks were more successful in adopting best technology while medium sized banks had successes in adopting optimal levels of output while Islamic banks were successful in both technology adoption and choosing optimal levels.

Tahir, Bakar & Sudin Haron (2009) evaluated the technical and scale efficiency of commercial banks in Malaysia during the period 2000-2006 using the data envelopment analysis. The study identified that the degree of scale efficiency was lower than the technical efficiency. The result implies that the greater part of the technical inefficiency was attributed to producing below the production frontier. Foreign banks were found to be less efficient as compared
to foreign banks. Foreign banks inefficiency was attributed to scale inefficiency while domestic banks inefficiency is a result of pure technical inefficient a result of producing below the production frontier.

Mongid & Tahir (2010) studied the rural Indonesian banking system with a view to estimating the technical and scale efficiency using the data envelopment analysis for the period 2006 and 2007. The study established that the degree of scale efficiency was higher than the technical efficiency. The result meant that the greater proportion of inefficiency was mostly a result of producing below the efficient frontier instead of producing at an inefficient scale. The majority of the banks were found to be operating at suboptimal scale calling for expansion to reach the optimal scale.

Sok-Gee (2011) estimated the technical, pure technical, and scale efficiency of commercial banks in China for the period 2001-2007 using the data envelopment analysis. The commercial banks in China were found to be on average technically inefficient. The technical inefficiency of the commercial bank was driven mostly by pure technical inefficiency implying that banks were facing the challenge of resource allocation to strike a balance between input and output mix. Foreign banks exhibited a significant decline in technical efficiency between 2003 and 2006, which was attributed to increased cost of production during their expansion process with the country’s entrance into WTO and the gradual liberalisation of the banking system.

Gulati (2011) using the data envelopment analysis estimated the extent of technical, pure technical and scale efficiencies of Indian domestic banking during the period 2006/7. The study found that there were 9 banks in the sample of 51 banks who were operating on the efficiency frontier. Inefficiency in the Indian banking sector was mostly a result of managerial inefficiency rather than scale inefficiency. Most of the efficient banks were the new private sector banks. A significant scale efficiency difference was ascertained between large and medium sized banks. The study also found that profitability and exposure to off balance sheet activities were the main determinants of technical efficiency.

Tandon, Tandon, & Malhotra (2014) also investigated the technical, pure technical and scale efficiencies of the Indian banks with different ownership structure for the period 2009-2012. The study established that of the 44 banks in the sample only 7 lie of the efficiency frontier. There was no significant difference which was observed among public, private and foreign banks. The technical efficiency of the private and public banks was almost similar. There was scope for increasing the scale efficiency of the foreign banks. The main determinants of efficiency were found to be non-interest income.

Roy (2014) analysed the efficiency of the Indian banking system during the Basel changes using the data envelopment analysis. The study identified that inefficiency in the banking system was caused mostly by improper size allocation.

Li (2014) studied the technical and scale efficiencies of Thai commercial banks using the data envelopment analysis during the post financial crisis period from year 1997 to 2006. The average technical efficiency was estimated at 90.73 percent. The average pure technical efficiency was estimated to be higher than the average scale efficiency. The result implies that the technical inefficiency
was mostly a result of scale inefficiency instead of pure technical efficiency. The major source of scale inefficiency was found to be decreasing returns to scale. The study also established that banks which were majority owned by foreigners had lower technical, pure technical and scale efficiencies. Smaller banks were found to have higher technical and scale efficiencies. Similar technical, pure technical and scale efficiencies were identified between private- and government-owned banks.

Kumar & Singh (2015) evaluated the technical and scale efficiency of commercial banks in India for the period 2006-2010. The study employed the CRR and BCC models. The study established that there was an increase in efficiency as a result of deregulation of the banking sector. The increase in efficiency was a result of an increase in both pure technical efficiency and scale efficiency. The study established that there was a great disparity in the technical efficiency between the banks during the study period. Private sector banks fared better than public sector bank with scale inefficiency being predominant over pure technical efficiency.

Marwa & Aziakpono (2015) evaluated the technical and scale efficiency of the Tanzanian saving and Credit Cooperatives. The study sample was composed of 103 saving and Credit Cooperatives for the year 2011. The technical, pure technical and scale efficiencies scores were found to be 42 percent, 52 percent and 76 percent respectively. The sources of inefficiencies were both technical and scale hence the study recommended that the smaller firms should increase their scale of operations while those firms operating beyond the optimal scale may need to downsize. There was need for a reduction in the wastage in the utilisation of resources by the banks.

Singh & Fida (2015) using the data envelopment analysis evaluated the degree of technical, pure technical, and scale efficiencies in commercial banks of Oman. The study identified that the scale inefficiency was higher than the pure technical inefficiency in the total technical efficiency of the Oman banking sector. The scale inefficiency was mostly attributed to decreasing return to scale. The profitability of the banking system and liquidity were found to be the main drivers of efficiency.

Hacini & Dahou (2016) studied the technical, pure technical, and scale efficiency of the Algerian banks for the period 2000-2012. The study found that the technical efficiency of the banks improved during the study period. The average technical efficiency over the period was estimated at 95 percent. It was established that the main source of technical inefficiency was the scale inefficiency. Most of the banks were operating either under constant returns to scale or decreasing returning.

A review of the literature has shown that banking systems are susceptible to inefficiencies as a result of either operating at the wrong scale or because of managerial inefficiencies. Depending on the peculiar situation in the country of study, there have been some differences in the efficiency of the banking system. Neither scale inefficiency nor pure technical inefficiency is predominant in these studies.
4 Methodology

The Data envelopment analysis is one of the prominent methods used to measure the efficiency of the commercial banks. The method is derived from the concept of Pareto efficiency and was initially introduced by Charnes, Cooper and Rhodes (1978) in order to measure relative efficiency. The method estimates efficiency using data on inputs and outputs of some decision-making units (DMUs). The method 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 (Casu & Molyneux 2000; Noulas 2001). The efficient DMUs are only efficient in relation to others in the sample. The model is based on linear programming techniques which allow calculating the relative efficiency of DMU (Hassan & Sanchez 2007). Farrell (1957) proposed the use of relative efficiency which involves multiple inputs and outputs though not necessarily in equal proportion. The major goal of the relative efficiency technique is to develop a frontier of the most efficient decision units (DMUs) and then ascertain the distance of the less efficient units from the frontier (Bader 2008). The current study seeks to decompose the technical efficiency (T) into pure technical efficiency (PT) and scale efficiency (S). Following Chan (2011), the model for measuring the technical efficiency is shown in equation 1.

\[ \theta^* = \min \theta \]

Subject to

\[ \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta x_{io} \quad i = 1, 2, \ldots, m \]
\[ \sum_{j=1}^{n} \lambda_j y_{rj} \leq y_{ro} \quad i = 1, 2, \ldots, m \]
\[ \sum_{j=1}^{n} \lambda_j = 1 \]
\[ \lambda_j \geq 0 \]

The model has \( n \) DMUs being investigated. \( x \) and \( y \) represents the \( i^{th} \) input and the \( r^{th} \) output for the DMUo, respectively. \( \lambda \) are unknown weights and \( j = 1, 2, \ldots, m \) represents the number of DMUs. The optimal value of \( \theta^* \) shows the distance of the banks from the efficient frontiers. This means that the most technically efficient banks have \( \theta^* = 1 \) and the inefficient banks will have \( \theta^* < 1 \).

Efficiency can be estimated under the assumption of variable returns to scale (VRS) or constant returns to scale (CRS). The choice between CRS and VRS affects the shape of the envelopment surface and resultanty on the number of efficient DMUs. CRS attains proportional increase if all inputs lead to a proportional increase in output. Models that apply the CRS are called CCR (Charnes, Cooper and Rhodes) models. The CCR Model develops the Farrells’
efficiency measurement concept from several inputs and one output to several inputs and several outputs. In this model (Charnes et al. 1978) using a linear combination, different inputs and outputs are changed into one virtual input and output. The ratio of these virtual combinations of outputs to inputs will be the estimations of efficiency boundary for the measurement of relative efficiency given that the yield is constant (Karimzadeh 2012).

The CRS model is more restrictive and yields fewer numbers of efficient units and lower efficient scores compared to the alternative VRS (Karimzadeh 2012). VRS can be decreasing or increasing. Increasing returns to scale entail a proportional increase in all factor inputs of production leads to a more proportional increase in output while the converse is true for decreasing returns to scale where a proportional decrease in factor inputs leads to a less than proportional decrease in output (Titko 2014). Models applying the VRS are called the BCC’s (Banker, Charnes and Coopers 1984) model. In contrast to constant yield in the CRR model, the BCCs model assumes a variable output in respect of the scale. Tahir, Bakar and Haron (2009) argue that a firm which is efficient under VRS is considered technologically efficient; the VRS score represents pure technical efficient (PT), whereas a firm which is efficient under CRS is technologically efficient and also uses the most efficient scale of operation. Scale efficiency \( S \) is derived from the measures of technical efficient \( T \) and pure technical efficient \( PT \)

\[
S = \frac{PT}{T} \quad (2)
\]

Or

\[
S = \frac{CRS}{VRS} \quad (3)
\]

Where \( 0 \leq s \leq 1 \) since \( CR \leq VR \). If the value of \( S \) equals 1, the firm is scale efficient and all values less than 1 reflect scale inefficiency.

The definition of the inputs and outputs adopted by the study follows the intermediation approach which views banks as intermediaries that facilitate the transfer of funds from surplus agents to deficit agents rather than producers of loans and deposit account services. Three inputs capital \( (K) \), interest expense \( (IE) \) and non-interest expenses \( (NIE) \) are considered for the evaluation of the bank’s performance. Two outputs considered for the study: total loans \( (TL) \) and non-interest income \( (NNI) \). These outputs represent bank revenue and the major income generating business activities (Liu et al. 2010). The empirical model for this study becomes \( \theta^* = \theta \)

Subject to
\[
\begin{align*}
\lambda_j K_j + \lambda_j IE_j + \lambda_j NIE_j & \leq \theta x_{i0} \quad i = 1, 2, \ldots, 3 \\
TL_j + \lambda_j NII_j & \leq y_{roi} = 1, 2, \ldots, m \\
\sum_{j=1}^{n} \lambda_j & = 1 \\
\lambda_j & \geq 0
\end{align*}
\]

Where K is capital, IE interest expense and NIE non-interest expenses, TL is total loans and NNI is non-interest income.

The study sample involved 11 commercial banks in the Zimbabwean banking system. Of the chosen banks are five foreign banks and six domestic banks. The study relied on published annual financial statements composed of balance sheet and income statements for the period 2009 to 2015 for the bank specific data. The data is therefore balanced annual panel data sets.

5 Presentation of Results and Analysis

The technical efficiency of the Zimbabwean commercial banks was estimated using the data envelopment analysis and was decomposed into pure technical and scale efficiency. The summary statistics of the data envelopment analysis is presented in table 1.

The results in table 1 show that commercial banks in Zimbabwe were technically inefficient with the average efficient score of 82.9 percent during the period 2009-2015. This result implies that the average commercial bank suffered a 17.1 percent level of technical inefficiency. In other words there was increased scope for the commercial banks to increase their output if they had operated at the same efficient level as the most efficient bank in the sample. The standard deviation, of 0.2025, shows that there was greater dispersion in terms of technical efficiency among the commercial banks during the study period.

The results also indicate that in Zimbabwe, on average, banks are relatively better off in pure technical efficiency (at 96.59%) compared to scale efficiency (at 85.64%). Table 2 shows the decomposition of the average annual technical efficiency scores into pure technical and scale efficiency scores for the period 2009-2015.

Table 2 shows that the average pure technical efficiency score was 96.6 percent for the period 2009-2015. The pure technical efficiency score was increasing over the period 2009-2015 implying that the managerial efficiency of the banks was improving during that period. The average pure technical efficiency was one in 2014, meaning that all the commercial banks attained pure efficiency of one during that year. All banks in the sample were experiencing managerial efficiency in 2014. A decline in the pure technical efficiency was experienced in 2015. Borrowing from table 1 reveals that there was little dispersion in the pure technical efficiency score with standard deviation of 0.07 during the whole
study period. As shown in table 1, the average pure technical efficiency varied between 0.67 and 1 during the whole study period.

The results in table 2 show that the average scale efficiency of the commercial banks in Zimbabwe for the period 2009-2015 was 0.8564. The scale efficiency scores were not stable reflected by the declines experienced between 2009 and 2011 then followed by an increase up to 2014 before further declining in 2015. Based on the descriptive statistics in table 1, the dispersion of the scale efficiency was relatively higher compared to the dispersion in pure technical efficiency. The minimum technical efficiency score was 0.2560 while the maximum was 1. The standard deviation, a measure of dispersion for the scale efficiency was 0.189.

This does not compare favorably while that of pure technical efficiency which was 0.07 during the period 2009-2015.

Based on the results in table 1 and table 2, the source of the technical inefficiency of the Zimbabwean commercial banks is the scale inefficiency instead of pure technical efficiency. The results are in conformity with studies by Li (2014) for Thai banking sector and Fida (2015) for Oman. The results mean that the banks are mostly suffering from the problem of operating at the wrong scale of operations. The study result could be explained by the developments in the banking sector, where in most banks were highly constrained by limited capital and liquidity constraints for them to operate and optimal level of scale efficiency. Furthermore, given the banking sector challenges, mostly cash and subsequent growth on demand for electronic banking services in 2014 to 2015, most banks were failing to meet demand for banking services and this pushed their returns, making most of the m to be operating at below scale efficiency levels. The cautious trading and aggressive collection of bad loans implemented by most banks in response to growth in NPLs, as well as interventions by the Central Bank to manage the NPLs also contributed to the slowdown in scale efficiency by most banks, particularly from 2014-2015.

Figure 2 shows the trend in the technical, pure technical and scale efficiency for the period 2009-2015. The figure reveals that the pure technical efficiency was higher than the scale efficiency giving credence to the fact that the main source of the technical inefficiency during the whole period was scale inefficiency rather than pure technical inefficiency. Since scale efficiency refers to the relationship between the level of output and the average cost hence it means banks are facing the challenge of determining the optimal size of operation.

Table 3 shows the sources of the scale inefficiency identified above.

Table 3 shows that the majority of the banks were operating under increasing returns to scale. The result shows that 8 banks were operating under increasing returns during the period 2009-2011 and the highest operating under the same were registered in 2013 with nine banks. During the whole study period there was no bank which operated under decreasing returns to scale. This means that the majority of banks were operating below their optimum capacity implying that there had scope to increase their operations. Under increasing returns to scale output increases more than the increase in the inputs.
6 Conclusions

The study evaluated the technical efficiency of the commercial banks in Zimbabwe using the method of Data Envelopment Analysis. The study further decomposed the technical efficiency into pure technical and scale efficiency in order to determine whether the inefficiencies among commercial banks was a result of managerial inefficiencies or due to wrong choice of scale of operation. The study has shown that managerial efficiency scores were higher than technical efficiency scores, implying that commercial banks in Zimbabwe are technically inefficient. The technical inefficiency is a result of scale inefficiency, i.e., the majority of banks were operating at the wrong scale of operations. Specifically the banks were operating under decreasing returns to scale, where there is still opportunity to increase operations to obtain optimum scale. The study therefore recommends that banks should review and rescale their scope of operations so that they optimize the scale of operations to levels that guarantees both pure technical and scale efficiency.

References


### Table 1: Descriptive Statistics of Data Envelopment Analysis Measures

<table>
<thead>
<tr>
<th></th>
<th>Technical Efficiency</th>
<th>Pure Technical Efficiency</th>
<th>Scale Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.8296</td>
<td>0.9659</td>
<td>0.8564</td>
</tr>
<tr>
<td>Median</td>
<td>0.8939</td>
<td>1.0000</td>
<td>0.9283</td>
</tr>
<tr>
<td>Maximum</td>
<td>1.0000</td>
<td>1.0000</td>
<td>1.0000</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.2325</td>
<td>0.6731</td>
<td>0.2560</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.2025</td>
<td>0.0737</td>
<td>0.1889</td>
</tr>
<tr>
<td>Observations</td>
<td>77</td>
<td>77</td>
<td>77</td>
</tr>
</tbody>
</table>

*Source: Own Computation*

### Table 2: Average Technical, Pure technical and Scale Efficiency

<table>
<thead>
<tr>
<th>Year</th>
<th>Technical Efficiency</th>
<th>Pure Technical Efficiency</th>
<th>Scale Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>0.7646</td>
<td>0.9090</td>
<td>0.8394</td>
</tr>
<tr>
<td>2010</td>
<td>0.7420</td>
<td>0.9394</td>
<td>0.7858</td>
</tr>
<tr>
<td>2011</td>
<td>0.7682</td>
<td>0.9800</td>
<td>0.7844</td>
</tr>
<tr>
<td>2012</td>
<td>0.8668</td>
<td>0.9779</td>
<td>0.8841</td>
</tr>
<tr>
<td>2013</td>
<td>0.8661</td>
<td>0.9735</td>
<td>0.8853</td>
</tr>
<tr>
<td>2014</td>
<td>0.9218</td>
<td>1.0000</td>
<td>0.9218</td>
</tr>
<tr>
<td>2015</td>
<td>0.8659</td>
<td>0.9830</td>
<td>0.8804</td>
</tr>
</tbody>
</table>

**Average for the period**

<table>
<thead>
<tr>
<th></th>
<th>Technical Efficiency</th>
<th>Pure Technical Efficiency</th>
<th>Scale Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.8296</td>
<td>0.9659</td>
<td>0.8564</td>
</tr>
</tbody>
</table>

*Source: Own Computation*

### Table 3: Sources of scale inefficiency

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of banks with increasing returns to scale</th>
<th>Number of banks with decreasing returns to scale</th>
<th>Number of banks with constant returns to scale</th>
<th>Total number of banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>2010</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>2011</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>2012</td>
<td>7</td>
<td>0</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>2013</td>
<td>9</td>
<td>0</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>2014</td>
<td>5</td>
<td>0</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>2015</td>
<td>6</td>
<td>0</td>
<td>5</td>
<td>11</td>
</tr>
</tbody>
</table>

*Source: Own Computation*
Figure 1: Non-performing loans

Source: Reserve Bank of Zimbabwe (2015)

Figure 2: Trend of the Average technical, pure technical and Scale efficiency

Source: Own Computation