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Determinants of Efficiency of Commercial Banks in Ethiopia

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ABSTRACT

Ethiopian bank sector reform measures were implemented to generate a more competitive and efficient banking sector. However, total capital and interest income may suggest greater inefficiencies in the banking industry. This paper analyses the developments and main determinants of bank efficiency in the Ethiopian banking industry during 2005-2015. The Data Envelopment Analysis (DEA) methodology is applied to obtain efficiency estimates and then a Tobit model is run to find its main determinants. The first result indicates that the Ethiopian banking sector experienced average inefficiencies for the period of study of 1%, 2% and 1% for Technical Efficiency (TE). In particular, an increase in bank efficiency is observed from 2005 to 2007, however, a decline in the efficiency levels is found from 2008 to 2011, although a recovery in efficiency is observed from 2012 onwards. Furthermore, the main determinants of increased bank efficiency are loan intensity, net interest income, non-interest income, size and degree of capitalization; on the other hand, non-interest expenses reduce bank efficiency.

CHAPTER I: INTRODUCTION

This chapter begins by presenting brief background of the study which is followed by the statement of the problem. Under the statement of the problem, the study states the reasons to carry out this study. Following the statement of the problem, the general and specific objectives of the study are presented. After that, the next section presents the research hypothesis. Finally, significance of the study, scope and limitation of the study including organization of the paper are presented.

BACKGROUND OF THE STUDY

The financial sector has an important role to play in the economic development process. Financial institutions are the main intermediation channels between saving and investment in a country. The best financial systems limit, quantify, gather and negotiate all operation risks, and incite the savers to invest, by offering them a proportional payment to the scale of the incurred risks. Financial intermediaries when they are efficient allow mobilizing saving from diverse sources and allocate it to more productive activities, what benefits not only investors and beneficiaries of the investments but also the whole economy (Gulde, Patillo and Christensen, 2006). Indeed, a banking system which efficiently channels financial resources to productive use is a powerful mechanism for economic growth (Levine 1997).

In Sub Saharan Africa, banks are the main financial intermediaries. Therefore, restructuring policies have been led in order to improve their efficiency (Sandrine 2007). In Ethiopia Banking industry has experienced dramatic changes over the last decade or so. Deregulation, financial innovation and automation have been major forces impacting on the performance of the banking sector. In such a context, banks have become increasingly concerned about controlling and analysing their costs and revenues, as well as measuring the risks taken to produce acceptable returns.

The efficiency of banks has been widely and extensively studied in the last few decades. For banks, efficiency implies improved profitability, greater amount of funds channelled in, better prices and services quality for consumers and greater safety in terms of improved capital buffer in absorbing risk (Berger et al. 1993). The information obtained on the evaluation of the bank's performance may be used to improve its overall efficiency of operations and in turn, may contribute towards achieving its competitive edge. The banking systems in the developing countries like Ethiopia suffered ample mutations with the purpose of creating some efficient banking institutions and with a high degree of soundness capable of facilitating economic growth. The efficiency of the banking system is a theme of interest both for the academic world, as well as for the decision factors around the world. During last three decades a large number of papers has been published in which the efficiency of banking industry both in the developed and developing countries has been investigated. Generally, in papers concerning developed the attention has been focused on analysing the market structure, the degree of concentration, and deregulation and their impacts on efficiency. On other hand, in case of developing countries the concentration has generally been on investigation of the impact of the bank reforms, of the privatizations of the state banks, of entering foreign banks and their effects on the efficiency (Asaftei and Kumbhakar, 2008; Bauer et al., 1998; Bauer, Berger and Humphrey, 1993; Beccalli, Casu and Girardone, 2006; Berger and Humphrey, 1997, Berger and Mester, 1997; Berger and Mester, 2003; Bonin, Hassan and Wachtel, 2005; Casu and Girardone, 2002; Casu, Girardone and Molyneux, 2004; Guzmán and Reverte, 2008; Koutsomanoli-Filippaki et al., 2009; Yildirim and Philippatos, 2007). The increasing number of studies pertaining to the analysis of performance and efficiency of banks is a result of the transformations in the financial services sector and unprecedented advancement in financial and non-financial technologies (Berger and Mester, 2003). The valuation of the productivity of the banking system presents a major interest for the public authorities because an increase of the productivity of banks can lead to better banking performances, the decrease of costs and improvement of the quality of services, as well as to an improvement of the allocation of resources and increase of productivity on the level of the entire economy. The increase of productivity contributes, also, to the increase of the soundness and stability of the banking system provided that the achieved profits are channelled towards the increase of equity and of provisions that allow for a better absorption of risks (Casu et al., 2004).

Thus, this study analyses the efficiency of Ethiopian commercial banks and explores the key factors that affect the efficiency of the banks over the period 2005 to 2015.

STATEMENT OF PROBLEM

In Ethiopia the financial sector remains closed and is much less developed compared with sub-Saharan countries (Habtamu 2013). In order to accelerate the economic growth process, the current government of Ethiopia has embarked on a number of reforms to improve the efficiency and competitiveness of the banking sector. For instance, in 1994, the government legalized domestic private investment in the banking industry. In addition, it restructured the two development banks as commercial banks, and introduced a new Banking and Monetary Proclamation that gave more autonomy and further clarified the National Bank of Ethiopia's activities as the regulator and supervisor of the banking sector. The key provisions of these reforms in the Ethiopian banking services were mainly tailored to expanding customer access, improving efficiency and encouraging competition. Although the banking sector has grown somewhat since 1994 when the above stated reform measures were implemented, thus far the banking sector still remains monopolistic, inefficient and is incapable of improving the intermediation of private sector savings. As a consequence, the contribution of the banking system to facilitating the economic growth of Ethiopia is marginal (Admassu & Asayehgn 2014).

 However, despite the reforms introduced in the sector, the financial sector still remains to be undiversified in types of ownership, market share and financial instruments. With regard to market share, the Commercial Bank of Ethiopia (CBE) has been the dominant bank in both deposit and loan market taking more than half of the industry share (National Bank of Ethiopia & Ecobank Research 2013); The government-owned Commercial Bank of Ethiopia (CBE) is the dominant commercial bank and accounts for 70% of total assets of banks and 30%, is accounted by the other 15 banks (IMF 2013:20). Unlike many government-owned commercial banks, CBE is relatively well run and profitable. Hence, such the state-owned Commercial Bank of Ethiopia, which accounts for two-thirds of system-wide assets, can play a critical role in making more credit available to the private sector (IMF 2015); In other countries, including

Ethiopia and Ghana, reforms were gradual. The process took the form of restructuring of public sector banks to make them more financially viable before privatization. However, Worku (2011) has questioned the timing and sequencing of the reforms in Ethiopia and argues that the benefits of financial liberalization have been limited. The regulatory restriction of foreign bank entry has particularly been detrimental to the Ethiopian banking system, from the perspective of competitive conduct, and the policy should therefore be reconsidered. Financial distress in the banking sector was itself a precursor to the reforms in Cameroon, Senegal and Uganda and the reforms included improvements in operating procedures and strengthening of regulatory and supervisory framework (Fowowe, 2013). This is mainly for the reason that such type of structure hampers the performance of the industry and enables inefficiency to reign in the sector among others. The current government continuing different reform measures undertaken for instance, merging Construction & Business Bank of Ethiopia with Ethiopia commercial Bank and give permission E-Banking services.

So far, various studies have been done in Ethiopia concerning related to bank sectors (Emishaw 2016; focused on only determinants of efficiency, Tesfaye 2014; Kokobe &Birhanu 2015) focused on only determinants financial performance. However, most of them focused on only determinants of financial performance or bank efficiency using non-parametric models. As to the knowledge of the researcher, there is no such a prior research conducted in the specified topic in the case of the determinants of efficiency banking sector using the parametric and non-parametric model. The DEA Method is a deterministic method based on linear programming which does not take into account the random errors and thus requires no predefinition of the distribution of the error term. While the SFA Method is a stochastic method, which integrates the random errors but also requires the predefinition of the functional form. In the case of the SFA method the output of a firm is a function of inputs, inefficiency and random error and requires the predefinition of the distribution of the error term. The DEA method does not take into account the "statistical noise", and such the estimates regarding efficiency can be biased if the production process of the firm is characterized by stochastic elements.

Thus, this study attempts two stage analysis to investigates the evolution of efficiency by estimating efficiency estimators using DEA Model (Non- Parametric approach) and then attempts to find out the determinants of commercial banking efficiency using SFA Model and fill the gap in the existing literature by including new variables operationalize in Ethiopia and by covering a longer time period.

OBJECTIVE OF THE STUDY

The main objective of the paper is to identify the determinants of commercial banks efficiency.

The specific objectives are:

- ➢ To measure the efficiency commercial banks of Ethiopia by applying the non-parametric Data Envelopment Analysis (DEA) methodology.
- ➢ To examine the impact of internal (bank Specific) factors on commercial banks efficiency in Ethiopia.
- ➢ To examine the impact of industrial factors on commercial banks efficiency in Ethiopia.
- ➢ To examine the impact of macroeconomic factors on commercial banks efficiency in Ethiopia

RESEARCH HYPOTHESIS

H1: Degree of capitalization is positively significant relationship related to commercial banks efficiency;

H2: Net interest rate margin is positively significant relationship related to commercial banks efficiency;

H3: Non-interest expenses is negatively significant relationship related to commercial banks efficiency;

H4: Non-interest income is positively significant relationship related to commercial banks efficiency;

H5: Bank size is positively significant relationship related to commercial banks efficiency;

H6: Loan intensity is positively significant relationship related to commercial banks efficiency;

H7: Market concentration is positively significant relationship related to commercial banks efficiency;

SIGNIFICANCE OF THE STUDY

 Understanding how the commercial banks in Ethiopia are efficiently operating and identifying the key factors that sway the banks' efficiency is valuable to the various claimants of the banking industry. Indeed, banks are supposed to balance and congregate the interests and aspirations of the various individuals, organizations and the public at large. Policy makers call for banks to efficiently operate and ensure appropriate allocation of resources by channelling resources from those that have surplus capital to those who are in need of the capital. By doing so, banks could support investment, trade and commerce to grow vigorously.

The study enables the supervisory body (National Bank of Ethiopia) to device a policy which fixes inefficiency in the banking sector. Moreover, each commercial bank can take advantage of the study as it detects efficiency level of each sector based on the selected parameters. Meaning by taking the results of each indicator, a commercial bank will be in a better position to correct area of its in efficiency. Finally, the study could serve as a springboard for other studies in the area. Further, it will serve as a bench mark and reference material for those who want to conduct further research in the same area. Moreover, the findings of the study would contribute to the body of knowledge in a way that it adds value to the theory of financial distress theory. This is because some of its findings are in line with the existing theory and in some it directs areas for the future research.

RESEARCH DESIGN AND METHODOLOGY

This section discusses the research methodology applied for the study. The methodology of this research is constructed based on the objectives of the study. The section is organized under sub sections which are namely: Sampling technique and Population, Types and method of data collection and Data analysis method.

RESEARCH DESIGN

To achieve the objective of this study, explanatory research design will be adopted. Besides, this study used quantitative research approach to address stated objective. Because quantitative research is the systematic empirical investigation of observable phenomena via statistical, mathematical or computational techniques (Creswell 2009). The objective of quantitative research is to develop and employ mathematical models, theories and/or hypotheses pertaining to phenomena. The process of measurement is central to quantitative research because it provides the fundamental connection between empirical observation and mathematical expression of quantitative relationships.

SAMPLING TECHNIQUE AND POPULATION

This study the target population used all the Commercial banks registered by NBE. when population elements are selected for inclusion in the sample based on the ease of access, but to select items for the sample, concerning the choice of items as supreme based on the selection criteria set by the researcher. Thus the researcher set a criterion of exclusive based on the commercial banks under operation in the country at least for the last 11 years. Hence, based on the availability of data for the time period of 11 years (2005-2015) and the sample of 8 commercial banks which fulfilled the researcher's exclusive criterion.

DATA Type and SOURCES

As the study is intended to determine the efficiency of commercial banks, it is reasonably sufficient to make use of secondary data since they adequately capture past financial performance of the commercial banks under consideration. Based on the nature of the study, the secondary data sources will be collected and analysed.

METHOD OF DATA COLLECTION

In order to conduct this study and achieve its stated objectives all relevant and necessary secondary data will be use in the research. In order to analyze the performance of the commercial banks in Ethiopia the study will be collect secondary sources of data include the records of National Bank of Ethiopia audited reports of individual banks under consideration for the period under study. The study carried out over the period of 2005 to 2015, covering 11 years in total. These commercial banks would be selected based on the fact that they are the top senior commercial banks, by age of establishment.

DATA ANALYSIS METHOD

The analysis of the efficiency of banks can be performed with the help of the parametrical methods and that of non-parametrical methods (Berger and Humphrey (1997), Berger and Mester (2003) and Casu et al. (2004)).

The methodology in this paper follows a two-stage analysis following previous studies (Casu and Molyneux, 2003; Delis and Papanikolaou, 2009). The first stage includes the estimation of measures of efficiency by applying the non-parametric Data Envelopment Analysis (DEA) methodology. Consequently, a Stochastic Frontier Approach (SFA) in run using the efficiency estimates obtained as the dependent variables and including other control variables as explanatory variables of bank efficiency.

SCOPE OF THE STUDY

Efficiency is one of the important dimensions of bank performances. There are different types of efficiency measures that can be used to examine efficiency of commercial banks including cost efficiency, revenue efficiency, scale efficiency, profit efficiency, technical efficiency, and allocative efficiency. However, this study will be focus only to know the key determinants of efficiency of commercial banks related with technical efficiency by analysing the financial statements start from 2005 to 2015 fiscal year.

ORGANIZATION OF THE PAPER

This study consists of five chapters. Chapter one presents introduction, statement of the problem, objective of the study, hypotheses, scope and limitations and significance of the study. Chapter Two reviews the most significant theoretical and empirical studies. Chapter three presents methodology of the study. Then chapter four provides the interpretation and analysis of DEA &SFA model outcomes and finally, chapter five gives conclusions and recommendations with policy implication and further research direction.

CHAPTER II: REVIEW OF RELATED LITERATURE

There are several studies which have analysed efficiency in banking, particularly using parametric or non-parametric methods to do so. However, only a few studies have analysed the determinants of bank efficiency. Many studies have been conducted to examine the efficiency of banks in the industrialized and emerging economies though there is lack of literature in African and the developing world in general. Particularly, studies related to the efficiency and its determinants of commercial banks in Ethiopia are very limited. This chapter presents the reviews in two sections as theoretical and empirical section carried on efficiency and determinants of commercial banks

Theoretical Literature

CONCEPT OF EFFICIENCY

Efficiency is a relative term which shows the ratio of achieved results to the means used. It is the ability of individuals or organizations effort to produce the desired result with minimum use of efforts and expenses. Therefore, in most of the situations, efficiency is a relative concept and must involve comparisons. It is the way of producing maximum value of output with a given value of inputs; or equivalently, by using minimum value of inputs to produce a given value of output (Bhat, 2001). According to Cooper (2004) a firm is said to be efficient on the basis of available evidence if and only if the performance of other firms do not show improvement in inputs or outputs without worsening some of its other inputs or outputs.

The measurement of relative efficiency where there are multiple possibly incommensurate inputs and outputs was addressed by (Farrell, 1957). He laid the foundation to measure efficiency and productivity studies at the micro level. Farrell, proposed efficiency consists of two components: technical efficiency and allocative efficiency. The former reflects the ability of a Decision Making Unit (DMU) to minimize input use as to produce a given amount of output. The latter reflects the ability of a DMU to use inputs in optimal proportions, given their respective prices and the production technology Together, these two measures represent a total efficiency measure (Coelli et al., 1997).

The other efficiency type having similar context with the concept of Farrell is X-efficiency. It is an intra-firm inefficiency or the deviation from the production efficient frontier, which depicts the maximum attainable output for a given level of input. This inefficiency can arise from the differences in managerial ability to control cost and/or maximize profits (Leibenstein & Harvey, 1966). Berger (1993) describe X-inefficiency, as a variance from the efficient frontiers set by the best practice or benchmark firm. It incorporates two components, those technical and allocative inefficiencies. According to Farrell (1957) technical inefficiency occurs due to sub optimal usage of input leading to waste, while allocative inefficiencies arise from inappropriate mix or composition of inputs using inefficient business process. Both inefficiencies are attributed to employee, management or environment factors. Scale Efficiency often arises from the ability of large firms to allocate fixed costs such as advertising expenses or cost of technology across a greater volume of output. It also shows whether the decision-making units (e.g. banks) operate at the minimum of their long run average cost curve. It focuses on technical efficiency, which is the ability of a bank to produce maximal output from a given set of inputs over a certain time period (Adongo et al., 2005).

According to Chen (2001) efficiency can be classified as scale efficiency, scope efficiency, technical efficiency, and allocative efficiency. A bank has the scale efficiency when it operates in the range of constant returns to scale. Scope efficiency occurs when a bank operates in different diversified locations. When a bank maximizes output from the given level of inputs technical efficiency occurs and when a bank chooses maximizing revenue, allocative efficiency occurs. Erkoc (2013) define efficiency as the ability of firms to produce output using a given level of inputs with minimum cost. This definition indicates that banks should allocate inputs and outputs properly with the aim of obtaining maximum result with minimum cost.

Efficiency represents the degree of success in which producers achieve in allocating the available inputs and outputs they produce in order to achieve their goals (Kumbhakar & Lovell, 2000). Hoyo et al. (2004) define efficiency as the relationship between what an organization produces and what it could be feasibly produced under the assumption of full utilization of the available resources. Hughes & Mester (2008) define efficiency as the microeconomic concept which indicates the minimum inputs required to produce any given

level of output. It is the measure of the difference between the desired performance and actual performance of firms. Generally, the above definitions relate the concept of efficiency as the relationship between inputs and outputs.

A number of researchers and scholars have used different methods to measure the efficiency of commercial banks. The various studies carried out to measure the efficiency of commercial banks could be grouped into three major categories: (1) those that used financial ratios, such as Unal et al. (2007), (2) those that used the stochastic frontier approach, such as Isik & Hassan (2002), Maudos et al. (2002), Fuentes & Vergara, (2003), Fries & Taci (2005), and Cadet (2008), and (3) those that used the data envelopment analysis, which is a non-stochastic approach, such as Miller & Noulas (1996), Maudos & Pastor (2003), Al-Delaimi & Al-Ani (2006), Pasiouras (2008) and Assaf et al. (2011). There are also certain researchers, such as Fiorentino et al. (2006), Wozniewska (2008), and Tahir et al. (2010), and Yeh (1996) who make use of a combination of two or three of these methods in measuring the efficiency of commercial banks. Nevertheless, there is no concurrence as to which method is better than the other in the literature of bank efficiency (Yildirim and Philippatos, 2002).

A common and widely used method of measuring bank efficiency is the use of financial ratios, such as liquidity, profitability, risk and asset quality ratios. Traditionally, analysts have analysed the efficiency of organizations by focusing on certain simple ratios such as labour productivity (output per unit of labour employed) or capital intensification. In the first quarter of the 20th century, the DuPont firm introduced the return on investment (ROI) measure and the pyramid of financial ratios. Other models and methods have developed ever since, such as discounted cash flow (DCF), residual income (RI), Economic value added (EVA) and cash flow return on investment (CFROI). Much of the work in the for-profit sector is concerned with financial measures of performance such as profitability, earnings per share and market share. Yeh (1996) argues that the major demerit of ratio analysis is that its reliance on arbitrary and misleading benchmark ratios. Further, Sherman and Gold (1985) note that financial ratios do not capture the long-term performance and aggregate many aspects of performance such as operations, marketing and financing. Though financial ratios are useful tools of analyzing the financial condition of a firm and are good indicators of a firm's economic attributes, competitive strategies, operating, financing and investment decisions, Sherman and Gold (1985) note that financial ratios do not capture the long-term performance and aggregate many

aspects of performance such as operations, marketing and financing. Yet, financial ratios are often used in determining how well a firm is financially operating over time (interfirm analysis) or compared to other similar firms or the industry to which the firm belongs (intra-firm comparative analysis over a selected period (Reddy, 2010).

Though accounting ratios are easy to compute, they are duly criticized and considered by many as disingenuous gauges of efficiency for they fail to control for product mix or input prices of banks (Berger[21] et.al., 1993). Yeh (1996) suggests that, though financial ratios are the most commonly used measures of bank performance, there is no definite underlying principle which would allow one to acquire a composite score on the overall financial soundness of a bank. That is, since financial ratios take in one variable compared to another, financial ratios do not yield sufficient information concerning the various dimensions of banks. Moreover, Berger et.al (1993) argued that accounting ratios are not good measures of bank efficiency because they fail to differentiate between X-efficiency gains and scope and scale efficiency gains. As Kohers et al. (2000) note, accounting data, from which financial ratios are computed, fail to take into account the current market value of a firm and do not in any parameter represent economic value-maximizing behavior. In general, financial ratios fail to take into account multiple inputs that banks make use of to yield multiple outputs.

The shortcoming of financial ratios to take into account multi-input and multioutput variables in measuring bank efficiency is overcome by the frontier methods of measuring efficiency. Berger and Humphrey (1997) state that frontier approaches are more likely to be superior compared to the traditional financial ratios in measuring bank efficiency. They assert that compared to the traditional financial ratios the frontier approaches provide an overall objective numerical score and ranking, and an efficiency proxy along with the economic optimization mechanism. In effect, in recent years, a trend has been observed towards measuring bank performance using one of the frontier analysis methods. However, both financial ratios and frontier approaches suffer from the same shortcoming for they both make use of accounting data and not market value. Yet the literature on bank efficiency witnesses that the efficiency proxies determined using the frontier approaches are better measures of bank performance than those determined using the traditional financial ratios.

The original sources of the frontier methods can be traced to the early works of Farrell (1957). Farrell proposes that the efficiency frontier could be estimated using the sample data employing either a non-parametric or a parametric approach. One of the most known non-parametric approaches to measuring efficiency that is developed by Charnes et al. (1978) is the Data Envelopment Analysis, which is a linear programming model. Several new methods under the umbrella of non-parametric approach have since been developed and are widely applied since the late 1970s in measuring bank performance. Another frontier approach to measuring bank efficiency is the parametric or stochastic approach. As cited by Bhattacharyya et al. (1997), the parametric or deterministic approach to measuring efficiency is developed by Aigner et al. (1977) and meeusen and Van Den Broeck (1977).

In line with these developments, an extensive literature has evolved examining financial firm efficiency issues (Berger and Humphrey, 1997), and different methodological approaches have been employed to investigate financial firm efficiency (i.e. parametric and non-parametric techniques). However, only a handful of studies have so far investigated how risk and output quality factors influence bank efficiency levels (Mester, 1996; Berger and Mester, 1997; Altunbas, Liu, Molyneux and Seth, 1999).

A firm's productivity is the ratio of outputs to inputs, which depends upon production process technology and differences in the environments in which production occurs, among others variables. The firm's efficiency is a comparison between observed and optimal values of outputs and inputs. The set of the optimal outputs, given the inputs (or the optimal inputs, given the outputs) is the efficient frontier. Farrell (1957) defined a simple measure of firm efficiency that could account for multiple inputs. He proposed that efficiency of any firm consists of two components: (a) technical efficiency, the ability of the firm to maximize outputs from the given set of inputs; and (b) allocative efficiency, the ability of the firm to use these inputs in optimal proportion given their respective prices. Combining these two components provides a measure of economic efficiency, which is also known as productive or overall efficiency.

An alternative measure of economic efficiency is cost efficiency, which measures how far a bank's costs deviate from the best practice bank's costs, producing at the same level of output and under the same environmental conditions. Cost efficiency can be decomposed into

technical efficiency and allocative efficiency. The level of technical efficiency is usually related to managerial decision making, while allocative efficiency is usually related to regulatory environment or macroeconomic conditions (Lovell, 1993).

Technical efficiency can be further decomposed into two parts: scale efficiency and pure technical efficiency. Pure technical efficiency refers to the firm's ability to avoid waste by producing as much output as input usage allows or by using as little input as output production allows. Scale efficiency refers to the firm's ability to work at its optimal scale.

Other measures of economic efficiency are revenue efficiency and profit efficiency. Revenue efficiency measures the ratio between current revenues and optimal revenues, given prices and outputs, while profit efficiency measures the ratio of current profits to optimal profits, given inputs, outputs, and their respective prices.

Empirical Reviews

Over the past several years, a considerable research effort has been made to measure the efficiency of financial institutions, particularly commercial banks. The research has been focused on estimating an efficient frontier and measuring the average differences between observed banks and banks on the frontier. Many studies found a significant difference in cost inefficiencies. However, there is no consensus on the sources of the differences in measured efficiency (Berger & Mester, 2008).

Berger and Mester (2008) find out the sources of efficiencies comes from the following three sources:(1) differences in the concept of efficiency used; (2) differences in measurement methods used to estimate efficiency within the context of these concepts; and (3) correlates of efficiency such as bank specific, macroeconomic, and regulatory characteristics which may explain some of the efficiency differences after controlling for efficiency concept and measurement method.

This section reviews the empirical literature on banking efficiency studies. Over the past several years, considerable research efforts have gone into measuring the efficiency of commercial banks by using both parametric and non-parametric frontier efficiency

measurement techniques such as stochastic frontier analysis (SFA), data envelopment analysis (DEA), thick frontier analysis (TFA), etc.

Ajlouni et al. (2011) examines the determinants and efficiency of banks in Jordan using the two-stage approach during the period 2005-2008. In the first stage they use the DEA methodology to estimate the relative efficiency of the banks. In the second stage, they apply the Tobit regression model to examine the factors that influence the efficiency of the banks in Jordan wherein the efficiency score obtained in the first stage is used as a dependent variable. In defining the inputs (labor, physical capital and deposits) and outputs (total loans and net investments) for the DEA model they use the intermediation approach. The result of the study indicates that average efficiency of the Jordanian banks is high and stable over the study period. The study also indicates that larger banks are more efficient than smaller and medium sized banks but banks with higher capital adequacy ratio are found to be less efficient.

Tochkov and Nenousky (2009) examined the determinants of bank efficiency in Blugaria using non-parametric methodology. The study considered bank-specific (factors related to profitability, credit risk, liquidity and capitalization), institutional and EU-related factors and found that foreign banks are more efficient than domestic private banks, and state owned banks inefficient on average. They also found capitalization, liquidity, enterprise restructuring, the treaty of accession, and EU membership as factors that enhance bank efficiency while bank reforms had an undesirable effect on the efficiency of the banks.

Grigorian and Manole (2002) study the determinants of bank performance in transition economies. They estimate the efficiency scores by applying the Data Envelopment Analysis (DEA) methodology and then run a Tobit censored regression in order to obtain the determinants of bank efficiency. Their main results suggest that foreign ownership and consolidation enhance commercial bank efficiency. They also find that well capitalized banks, greater market share, and GDP per capita are positive determinants of bank efficiency. Finally, they find evidence suggesting that the securities market and nonbank financial institutions hinder bank efficiency.

Casu and Molyneux (2003) apply the DEA approach in order to investigate whether the productive efficiency of European banking systems has improved and converged to a common

frontier for the period 1993-1997. They also employ a Tobit regression to indentify the main determinants of European bank efficiency. Their main results indicate that profitability ratios are positively related to bank efficiency as well as public listed banks; at the same time they do not find any relationship between the degree of capitalization and bank efficiency.

Pasiouras *et al*. (2007) analyzed the cost efficiency of Greek cooperative banks and its determinants. They apply a DEA approach to estimate technical, allocative and cost efficiency. Moreover, they use a Tobit regression to find the internal and external factors influencing the level of bank efficiency. The main results indicate that Greek banks operate at an average efficiency of 82%. Furthermore, they find that the size of the bank is positively associated with greater bank efficiency; however, they find that GDP per capita and unemployment influences bank efficiency negatively. Finally, they argue that the degree of capitalization, the number of branches and quantity of ATMs influence bank efficiency differently depending on the measure of efficiency used.

Nigmonov (2010) analysed the efficiency levels of banks in Uzbekistan using the two models of DEA over the period 2004 to 2006. The study indicated that the ownership type did have significance influence on efficiency levels, and that medium sized banks were more efficient compared to the small ones. Moreover, the study revealed that the overall average efficiency levels of the banks decreased over the study period. Naceur *et al*. (2009) evaluate the level of bank efficiency in MENA countries using a Meta frontier calculated by DEA. Afterwards, they apply a Tobit regression to investigate the impact of institutional, financial and bank-specific determinants of bank efficiency. They find that on average, MENA countries show an efficiency score of 67%. On the other hand they find that highly capitalized banks, greater liquidity, and stock market developments increase bank efficiency; whilst greater credit to the private sector and higher market concentration lowers bank efficiency.

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Tecles and Tabak (2010) undertook a study to examine factors that affect the cost as well as the profit efficiencies of Brazilian Banks using the data of 156 banks over the period 2000 to 2007. They used the stochastic frontier approach to measure the efficiency of the banks. Labor, physical capital and purchased funds were considered as inputs and investment, total deposits and total loans as outputs in the efficiency scores of the banks. They also considered market share of loans, nonperforming loans, equity to assets ratio and ownership as determinants of bank efficiency. The study finds average cost efficiency of 66 percent for Brazilian Banks while the average profit efficiency is 75 percent, indicating that higher levels of inefficiencies are found on the cost side in Brazilian banks. As far as the mean cost efficiency for public, private and foreign banks is concerned, the study finds 0.73 for public, 0.71 for private, and 0.53 for foreign banks. Thus, in terms of cost efficiency, foreign banks show much lower results than domestic banks, while public banks have the lowest efficiency on the profit side. Regarding profit efficiency, foreign banks have shown with the best profit strategies on average with a mean efficiency of 0.79 in which private and public banks follow with 0.73 and 0.70 mean efficiencies, respectively. Their result indicated that large banks were the most cost and profit efficient banks. Moreover, their result showed that public banks were relatively profit inefficient though they had certain improvements in their cost efficiency indicating that cost efficiency and profit efficiency are necessarily not correlated.

Daley and Mathews (2009) use the DEA methodology to estimate technical efficiency scores among a group of Jamaican banks for the period 1998-2007. They estimate conditional convergence using panel data estimation techniques and find that cost over income and the size of the bank are inversely related to bank efficiency; whereas GDP growth is positive with regards to bank efficiency.

Kalluru and Bhat (2009) examine the determinants of cost efficiency of commercial banks in India for the period 1992- 2006. In order to calculate the efficiency scores, they apply the

parametric Stochastic Frontier Approach (SFA) and then obtain the determinants of the efficiency scores by applying a Tobit regression. The first set of results indicates that cost efficiency in commercial banks in India has decreased for the period of study. They also find that the earning capacity of banks is the main positive determinant of bank efficiency followed by diversification and other non-interest activities.

Sufian and Noor (2009) analyse bank efficiency using unbalanced data set of 37 Islamic banks operating in MENA and Asian countries over the period 2001 to 2006. The study uses the two-stage approach wherein in the first stage DEA is used to estimate the efficiency of the banks and in the second stage the Tobit regression model is used to identify the factors that affect the efficiency of the banks. In defining the inputs (Deposits and physical capital) and outputs (loans, income and investment) for efficiency analysis the study uses the intermediation approach. The result of the study indicates that MENA Islamic banks are more technically efficient than the Asian banks over the study period. Over the entire period under study the study finds higher levels of pure technical inefficiency than scale inefficiency for both the MENA and Asian countries banking sector. The study also finds a positive association between bank efficiency and loan intensity, size, capitalization (equity to asset ratio), expense preference behavior (Non interest expense to total assets), and profitability. The study finds a negative association between efficiency and market share, loan loss reserve to total loans Moreover, the study indicates that banks that achieve higher levels of technical efficiency have smaller market share and low non-performing loans ratio.

Bhattacharyya et al. (1997) use stochastic frontier analysis to examine the efficiency patterns across ownership groups and through time for Turkish commercial banks. The findings of the study showed that foreign owned banks improved their efficiency over time whereas the opposite happens for the public sector banks. According to this study, the efficiency declines for foreign owned banks at the beginning of the period as a result of the adverse effect of capital adequacy requirement. However, the efficiency increases at the end due to the increase in the number of branches and significant temporal effects. Jemric and Vujcic (2002) used DEA model and adopted the intermediation approach to measure bank efficiency in Croatia for the period 1995-2000. They use fixed assets, technology, number of employees (labor) and total deposits collected as inputs, and total loans extended and short term

securities issued by official sectors were used as outputs. They found evidence that the relationship between bank size and efficiency is U-shaped.

Girardone et al. (2004) used SFA to estimate the efficiency scores and their determinants for Italian banks over the period 1993-1996.The result found that there is a positive relationship between efficiency and capital and a negative relationship of efficiency with non-performing loans. In addition, the study showed that there is no significant relationship between the size of banks and efficiency. Pasiouras (2008) used a DEA method to estimate efficiency scores of Greek commercial banks during the period 2000-2004. The result indicates that the inclusion of provisions on loans as input increases the efficiency score. In addition, banks which extended their activities abroad seem to be more technically efficient than those which are doing their business only at a national level.

Havrylchyk (2006) studied the cost efficiency of the polish domestic and foreign banking industry during the period 1997-2001 using DEA and an intermediation approach. The author includes labor, capital, and deposits as inputs while the outputs include loans and government bonds. In order to identify the determinants of efficiency the author used the second stage of Tobit approach. The result shows that neither size nor capitalization is related to the efficiency but the ratio of total loans to total assets shows a significant negative sign suggesting that banks that took more risks were less efficient. Pancurova and Lyocsa (2013) estimate the cost efficiency and their determinants for a sample of 11 central and Eastern European countries over the 2005-2008 periods by using data envelopment analysis. They found evidence that the size and financial capitalization of banks are positively associated with cost efficiency but the loans to asset ratio was negatively associated with cost efficiency.

Rouissi (2011) examine the cost and profit efficiency level of French commercial banks by classifying them as domestic and foreign by use of SFA over the period 2000 to 2007. The result indicates that foreign banks exhibit higher cost and profit efficiency than domestic banks. Garcia (2010) apply data envelopment analysis methodology to obtain efficiency estimates and a Tobit regression model to determine the major factors that affect efficiency of Mexican banks over the period 2001 to 2009. He found the result that the Mexican banking sector experienced an average efficiency score of 85% and the major determinants of

efficiency are loan intensity, GDP growth, and foreign ownership. On the other hand non-interest expenses, non-performing loans and inflation rate reduce banking efficiency.

Tahir et al., (2010) uses SFA to examine the cost efficiency levels of domestic and foreign commercial banks in Malaysia for the year 2000 to 2006. The result indicates that domestic banks are found to be more cost efficient than foreign banks. On the other hand, Shen (2008) used stochastic frontier analysis to study the cost efficiency and their determinants for a sample of ten Asian countries during the period 2000 to 2006. The result shows that banking concentration may have a positive or negative impact on efficiency. Net interest margin and average capital ratio have a positive effect on efficiency.

The study of Rozzani & Rahman, (2013) explores the area of bank efficiency and its determinants for conventional and Islamic banks in Malaysia with the usage of Stochastic Frontier Analysis. The study covers the period 2008-2011 for a sample of 19 conventional banks and 16 Islamic banks that operate in Malaysia. The result indicates that the levels of efficiency for both conventional and Islamic banks in Malaysia were highly similar. Further, it could be observed that efficiency would be better for conventional banks with the increment of bank size and also the decrement of both operational cost and credit risk, while the efficiency for Islamic banks would be better with only the decrement of operational cost.

Shin et al., 2008) investigate the productivity of Japanese and South Korean banks using SFA. They also use the intermediation and value added approach in order to identify inputs and outputs. In both approaches the study found that Japanese banks are efficient and productive than South Korean banks. Altunbas et al. (2000) estimate the technical efficiency of Japanese commercial banks over the period 1993-1996. They specified total loans, and total securities as outputs and three inputs (price of labor, price of total deposits, and price of physical capital).The study extended the existing literature to evaluates the impact of risk and asset quality on cost efficiency and shows that scale economies will tend to be overstated if these factors are not taken into account.

Sufian (2009) used DEA method to estimate the efficiency of the Malaysian banking sector during the Asian banking crisis in 1997 and found a significant and negative relationship between bank deposits and levels of efficiency which implies that banks which have large amount of deposits tends to be less efficient. In addition banks which have higher ratios of

loan to assets have higher efficiency scores. This positive relationship can be explained by the efficient market hypothesis that the most efficient banks can achieve lower production costs enabling them to offer reasonable credit and gain market share from large inefficient banks.

Regarding African studies, Kablan (2010) uses SFA to assess the determinants of banking system efficiency and financial development in Sub Saharan Africa over the period 2007 to 2009. Sub Saharan African banks found to be generally cost efficient, however non-performing loans undermine efficiency. The result shows that in order to improve efficiency there should be an improvement in the regulatory and credit environment. In addition the political and economic environments have a negative impact on the financial development in SSA. Raphael (2013) employs DEA to estimate the relative efficiency of 58 selected commercial banks operating in the East African community from 2008 to 2011. The result shows that most commercial banks in East Africa are operating under decreasing returns to scale. Therefore, inefficient utilization of input resources could be one of the reasons for the inefficiency of commercial banks in East Africa.

Ncube (2009) employs SFA to determine the cost and profit efficiency of South African banks during the period 2000 to 2005. The result of the study shows that South African banks have significantly improved their cost efficiency over the period of the study.
Abaoub and Nouali (2015) studied the cost efficiency of Tunisian banking system using SFA during the period 1997 to 2012. The result shows that banks which have a high population density, high ratio of intermediation, high return on assets and equities ratio found to be more efficient. However, cost efficiency of Tunisian banks negatively affected by a high capital assets ratio, a greater concentration, and a wide density of deposits request as well as per capita income.

Kiyota (2009) provides a comparative analysis of cost and profit efficiency of commercial banks operating in 29 Sub Saharan African countries during the period 2000 to 2007. The study uses SFA in the first step and tobit model for the second step analysis and provides cross country evidence on the impact of environmental factors on efficiency. The result shows that medium and larger banks are the most cost efficient than others. Hussein (2003) provides analysis of the characteristics of cost efficiency of Islamic banks in Sudan between 1990 and 2000. Using the stochastic approach, the author estimates the cost frontier for a sample of 17 commercial banks. The results show large variations in the efficiency of Sudanese Islamic

banks. In addition, the analysis extended in order to examine the determinants of bank efficiency and found that smaller banks are more efficient than their larger counterparts. He found a positive relationship between the ratio of capital adequacy and cost efficiency. Therefore Sudanese banks should implement serious policy instruments for the development of human capital in order to reduce cost inefficiency.

In Ethiopia, Muluneh (2006) employed the SFA to examine the determinants of cost efficiency for six private banks by using quarterly data over the period 1994-2001. The result shows that size of banks is negatively related with efficiency while capital is found to be positively affecting efficiency of banks. The study does not include public banks and restricted the study only to private banks. Eskindir (2013) uses the stochastic frontier analysis to investigate the cost efficiency of commercial banks based on their ownership during the period 2007-2012. The result shows private commercial banks are more cost efficient than state owned bank. Emishaw (2016) employed the SFA to examine the determinants of cost efficiency for twelve Commercial banks by using unbalanced panel data over the period 2000-2013. The results show that Ethiopian banks are on average inefficient in the order of 7.5 %, indicating that mismanagement of resources remains a problem to better cost performance. However, over the years, there has been some improvement in the relative cost efficiency of banks, with new small banks displaying spectacular growth in performance. This could be caused by the aspiration of large banks to provide services with better quality for their customers, leading these banks to incur higher costs. Hence, the plan of bank expansion through the setting of new branches should be reconsidered as the cost of setting up new branches would lead to an over utilization of capital.

Knowledge Gaps

The present study differs from the earlier studies in many ways and enriches the existing literature in the following ways: Firstly, it has included variables other than the variables included by other scholars in Ethiopia context for measuring bank efficiency. Secondly, the study presents the performance of banks from 2005 to 2015. Thirdly, the study tries to highlight the changing situation of banks towards their efficiency in developing country like Ethiopia. Fourthly, the study presents the experiences of reforms on Ethiopian economy. It is a fusion of parametric and non-parametric techniques however; earlier studies were based on either parametric or non-parametric techniques.

CHAPTER *III*: METHODOLOGY OF THE STUDY

This chapter discusses the major issues in the banking efficiency measurement analysis. The first issue is the selection and specification of inputs, inputs prices, and outputs variables. The second issue is on the choice of appropriate measurement techniques for cost efficiency analysis. Concerning the first issue, there are different approaches which are used by different researchers. However, the intermediation and production approaches are the most widely used in the literature to model the efficiency of banking firms. On the second issue, efficiency results can differ due to measurement techniques, and there is no general agreement on the preferred estimation methodology of banking efficiency analysis.

RESEARCH DESIGN

To achieve the objective of this study, explanatory research design is adopted. Besides, this study used quantitative research approach to address stated objective. Because quantitative research is the systematic empirical investigation of observable phenomena via statistical, mathematical or computational techniques (Creswell 2009). The objective of quantitative research is to develop and employ mathematical models, theories and/or hypotheses pertaining to phenomena. The process of measurement is central to quantitative research because it provides the fundamental connection between empirical observation and mathematical expression of quantitative relationships.

Quantitative data is any data that is in numerical form. The researcher analyses the data with the help of statistics. The researcher is hoping the numbers will yield an unbiased result that can be generalized to some larger population. Quantitative research is generally made using scientific methods, which can include: The generation of models, theories and hypotheses, the development of instruments and methods for measurement, Experimental control and manipulation of variables, Collection of empirical data and Modelling and analysis of data. Under this study, panel data from the year 2005- 2015 is used. This is because panel data has the advantage of giving more informative data as it consists of both the cross sectional information, which captures individual variability, and the time series information, that captures dynamic adjustment.

SAMPLING TECHNIQUE AND POPULATION

This study the target population used all the Commercial banks registered by NBE. when population elements are selected for inclusion in the sample based on the ease of access, but to select items for the sample, concerning the choice of items as supreme based on the selection criteria set by the researcher. Thus the researcher set a criterion of exclusive based on the commercial banks under operation in the country at least for the last 11 years. Hence, based on the availability of data for the time period of 11 years (2005-2015) and the sample of 8 commercial banks which fulfilled the researcher's exclusive criterion.

Table: 1 *Ethiopian commercial banks, their establishment period and observations*

S/N	Bank	Year of establishment	Data period	Observations
1	CBE	1963	2005-2015	11
2	CBB	1975		
3	AIB	1994	2005-2015	11
4	DB	1995	2005-2015	11
5	WIB	1997	2005-2015	11
6	BoA	1996	2005-2015	11
7	UB	1998	2005-2015	11
8	NIB	1999	2005-2015	11
9	CBO	2004	2005-2015	11
10	LIB	2006		
11	OIB	2008		
12	ZB	2008		
13	BuIB	2009		
14	BIB	2009		
15	AB	2010		
16	AAIB	2011		
	Total observations		2005-2015	88

Source: NBE

DATA Type and SOURCES

As the study is intended to determine the efficiency of commercial banks, it is reasonably sufficient to make use of secondary data since they adequately capture past financial performance of the commercial banks under consideration. Based on the nature of the study, the secondary data sources will be collected and analysed.

METHOD OF DATA COLLECTION

In order to conduct this study and achieve its stated objectives all relevant and necessary secondary data will be use in the research. In order to analyse the performance of the commercial banks in Ethiopia the study will be collect secondary sources of data include the records of National Bank of Ethiopia audited reports of individual banks under consideration for the period under study. The study carried out over the period of 2005 to 2015, covering 11 years in total. These commercial banks would be selected based on the fact that they are the top senior commercial banks, by age of establishment.

DATA ANALYSIS

The analysis of the efficiency of banks can be performed with the help of the parametrical methods and that of non-parametrical methods (Berger and Humphrey (1997), Berger and Mester (2003) and Casu et al. (2004)).

The methodology in this paper follows a two-stage analysis following previous studies (Casu and Molyneux, 2003; Delis and Papanikolaou, 2009). The first stage includes the estimation of measures of efficiency by applying the non-parametric Data Envelopment Analysis (DEA) methodology. Consequently, a Stochastic Frontier Approach (SFA) in run using the efficiency estimates obtained as the dependent variables and including other control variables as explanatory variables of bank efficiency.

In literatures of financial institutions there are two computing approaches commonly used to measure efficiency of institutions namely parametric which include among others, Stochastic

Frontier Approach (SFA) and non- parametric mainly the Data Envelopment Analysis(DEA). DEA and stochastic frontiers are two alternative methods for estimating frontier functions and thereby measuring efficiency of production. DEA involves the use of linear programming whereas stochastic frontiers involve the use econometric methods (Coelli, et al., 1998). In contrast to SFA which attempts to determine the absolute economic efficiency of institution DEA tries to evaluate the efficiency of an institution relative to other institutions in the same industry. Studies acknowledged that both approaches have advantages and limitations as well (see for example, Berger and Humphrey, 1997; Coelli, et al., 1998).The superiority of one approach over the other has been a subject of discussion and is still remaining debatable in literature. Apparently, however, others suggest that, for instance, (Resti 1997; Bauer et al., 1998; Ondrich and Ruggiero, 2000; Leon 2001) both produce similar rankings, and conclude that both approaches are complimentary to measure efficiency, but using two approaches have importance to come up accurate finding and conclusions.

Specification of the Data Envelopment Model

The choice of the approach adopted is a matter of convenience and is largely influenced by the data used in the analysis and ease of application. Consequently, this study chooses to use the Data Envelopment approach on the First stage.

The DEA model of measuring efficiency: is a mathematical programming approach used to develop efficient frontiers, which are then used to generate relative efficiency measurements. In other words, DEA generates a specific efficiency score for a Decision Making Unit (DMU) relative to other DMUs and not as an absolute standard. Non-parametric approaches have the characteristic that they do not require a model specification in order to compute the best-practice frontier. The DEA methodology in this study follows an input oriented (intermediation) approach since commercial banks are considered as acting as financial intermediaries following previous studies (e.g. Hasan and Morton, 2003; Ray, 2007; Berger et al., 2009), and the inefficiency levels are identified as a as a proportional reduction of inputs (Casu and Molyneux, 2003).

The DEA input oriented model was first proposed by Charnes et al. (1978) and assumed that the model followed constant returns to scale (CRS). However, CRS is appropriate only when all DMUs are operating at an optimal scale, and factors. The statistical software R was used to estimate the DEA efficiency scores. The Tobit regression was run using STATA. such as imperfect competition and constraints on finance may impede a DMU from operating at an optimum level (Casu and Molyneux, 2003). Banker et al.(1984) suggested the alternative variable returns to scale (VRS) model, which absorbs other factors explained above. The VRS linear program can be defined as:

$$
\begin{aligned}
&\min_{\theta,\lambda} \theta, \\
&st - y_i + Y\lambda \geq 0 \\
&\theta x_i - X\lambda \geq 0 \\
&N1' = 1 \\
&\lambda \geq 0
\end{aligned}
$$

Where θ is a scalar which represents the efficiency score for the ith bank and will range from 0 to 1, λ is a vector of N ×1 constants, y is the output vector for the ith DMU, Y is the matrix of outputs of the other DMUs and the number of DMUs ranges from i=1…n ; x is a vector of input of the i-th DMU and X is the matrix of input of the other DMUs. When the convexity constraint λ =1 is omitted from (1) we obtain the CRS based efficiency scores. A firm which is efficient under CRS is considered to be Pure Technically Efficient (PTE), whereas a firm which is efficient under VRS is Technically Efficient (TE). On the other hand, a firm is Scale Efficient (SE) under SE = CRS / VRS, and when SE = 1 then the bank is efficient under both CRS and VRS, when SE < 1 the bank is not scale efficient. This paper computes the efficiency scores considering VRS, CRS and SE. The selection of inputs and outputs was considered by analysing previous studies (Sealey and Lindley, 1977; Beccalli et al., 2006; Chortareas et al., 2011). The study considers two inputs: the total costs (the sum of personnel expenses, administrative expenses and interest rate expenses) and total deposits, and two outputs: total loans and other earning assets.

The study is used various measures of efficiency such as technical, pure technical, scale, allocative, and cost efficiencies of Ethiopian commercial banks. The most important issue in measuring bank efficiency is the technique one has to employ to measure the efficiency of the commercial banks. The study employed the Data Envelopment Analysis model (DEA), a non-parametric technique, to estimate the various measures of efficiency of the banks because of the following reasons:

1. DEA is less data demanding and requires small sample size compared to the parametric measures of efficiency.
2. Compared to the parametric techniques, DEA requires no specification of the functional form of the production function, handles multiple inputs and outputs, needs no assumption as to the relative importance of the inputs and outputs, and provides targets for enhancement for the inefficient units, and
3. Since commercial banks in Ethiopia provide various financial services, it complicates the use of parametric approach to measure technical efficiency, and thus the DEA model is chosen. Though DEA can be estimated either as input-oriented or output-oriented index, the study preferred the input-oriented DEA model in measuring the efficiency of the commercial banks since the managers of the commercial banks have more discretion on controlling the inputs than the outputs. Thus, efficiency of the banks is measured by holding output fixed and determining the maximum possible reduction in inputs.

Specification of Inputs and Outputs

It is generally recognized that the selection of variables in efficiency studies significantly affects the results. Two approaches dominate the banking theory literature: the production and intermediation approaches (Sealey and Lindley, 1977).

The production approach views banks as primarily services producing for customers. The banks generate transactions and process documents for customers as an output, such as loans applications, credit reports, checks, or other payment instruments, while the input includes only the physical variables, such as the number of employees and the physical capital. The intermediation approach treats the work of banks as primarily intermediating funds between savers and investors (depositors and borrowers). The banks use operating and interest expenses to produce major assets. For instance, they use labour and capital as inputs to

produce loans, investments, and other means of financing as outputs. Under the intermediation approach, a deposit is treated as an input.

To calculate the technical efficiency, we are able to collect data on two outputs and three inputs namely: loan income (y1) (Drake, Hall, and Simper, 2009), profit after tax (y2) (Mostafa, 2007), No. of employees (x1) (Wu, Yang, Liang, 2006), total fixed assets (x2) (EL Moussawi and Obeid, 2011), and deposits (x3) (Sufian, 2007; Sufian, 2009; and Sufian, 2011). Variables y1, y2, x2, and x3 measured in millions of Libyan Dinar. And we are using DEAP software to analyse the data that are obtained of inputs and outputs.

Related to Input and Output Variables to each other

	Input Variable	Output Variable
1.	Deposit	loan
2.	Fixed Asset	Capital
3.	Interest Expense	Interest Income
4.	Non- Interest Expense	Non- Interest Income

Specification of the Stochastic Cost Frontier Model

The choice of the approach adopted is a matter of convenience and is largely influenced by the data used in the analysis and ease of application. Consequently, this study chooses to use the stochastic frontier approach on the second stage.

The SFA model of measuring efficiency is an econometric method that can be used to measure efficiency in a similar way to DEA. This approach was first introduced simultaneously by Aigner Lovell and Schmidt (1977) and Meeusen and Van den Broeck (1977). SFA specifies the relationship between output and input levels and decomposes the error term in to two components, one to account for random effects and another to account for technical inefficiency. SFA has the advantages over DEA of accommodating data 'noise' and statistical tests, but has the disadvantages of requiring a functional form to be specified and it does not

provide the wealth of information on things such as peers and peer weights, which are provided by DEA.

Indeed, unlike DEA hypotheses testing can be carried out for the parameters estimated by parametric methods (SFA). This study is based on Stochastic Frontier Analysis (SFA) even with the limitations therein. Following previous empirical studies the study is based on Battese and Coelli (1995) SFA model. Battese and Coelli (1995) propose a stochastic frontier production function for panel data which has a firm effect which are assumed to be distributed as truncated normal random variables, which are also permitted to vary systematically with time.

Tobit regression. The Tobit regression is useful when the dependent variables are limited by a specific threshold, which is the case in this study. DEA efficiency measures obtained in the first step are then run as dependent variables with the restricted (0, 1) range. Estimation with OLS would lead to bias results for the efficiency parameter since it assumes normality and a homoskedastic distribution of the error term (Jackson and Fethi, 2000). The Tobit model used in this study follows the work of other studies (Stavarek, 2004):

$$y_0^* = \beta' x_0 + \varepsilon_0$$

$$y_0 = y_0^* \ \ \text{if} \ \ y_0^* \succ 0 \ \text{otherwise,}$$

$$y_0 = 0 \ , \ \varepsilon_0 \approx N(0, \sigma^2)$$

Where x_0 and β are the vectors of explanatory variables and its coefficients respectively, and y_0 and y_0^* are the vectors of the observed DEA efficiency score and the vector of the latent variable. Afterwards, a likelihood function is maximized in order to find the values for the coefficients and variance of the explanatory variables based on the observed values of the explanatory variables and the DEA scores:

$$L = \prod_{y_0=0}(1-P_o)\prod_{y_0^*>0}\frac{1}{(2\prod\sigma^2)^{\frac{1}{2}}}\times e^{-\left[1/(2\sigma^2)\right](y_o-\beta x_0)^2}$$

Where

$$P_0 = \int_{-\infty}^{\beta x_0/\sigma}\frac{1}{(2\prod)^{\frac{1}{2}}}\times e^{-t^2/2}dt$$

Determinants of Efficiency

Different factors may explain efficiency levels in a financial industry. Some of the factors may be inherent in the internal organizational structure of the bank, including managerial expertise, experience of workers and skill levels. Internal sources of (in) efficiency typically include carelessness, human mistakes, disruption of production technology or insufficient capacity to respond to changing incentives. Other factors may be external to the firm. These factors may include luck, regulatory constraints, macroeconomic shocks, real business cycles, labor disputes, and structure of the market in which the firm is operating. Taken together, these factors may account for a substantial amount of variability and differences across firms performance levels. Internal factors are firm specific and therefore within the control of the firm, external factors are outside the control of the firm (Musoda, 2008). Therefore, the inclusion of efficiency correlates in the stochastic frontier analysis is an important issue in the efficiency estimation. These variables are supposed to affect the distribution of inefficiency, which are usually neither the inputs nor the outputs of the production process. However, they affect the productivity performance of firms and these variables have been incorporated in a variety of ways: i) they may shift the frontier function and/or the inefficiency distribution; ii) they may scale the frontier function and/or the inefficiency distribution; iii) they may shift and scale the frontier function and/or the inefficiency distribution (Belotti, Gillardi and Atella, 2012). According to Pancurova and Lyocsa (2013), there are many variables which affect the efficiency of commercial banks. Thus to examine the determinants of bank efficiency 34 this study chooses the following explanatory variables. This includes size of the bank which is measured by the natural logarithm of total assets (lnTA), return on assets (ROA) which is measured by the ratio of gross profit to total assets to measure bank profitability, return on equity (ROE) which is measured by the ratio of profit to equity, capital adequacy ratio (CAR) which is the ratio of capital to total assets to measure capitalization and intermediation ratio (IR) which indicates the bank's ability to convert deposits into loans and measured as the ratio of deposits to loans. These variables are explained as follows.

According to Pancurova and Lyocsa (2013), there are many variables which affect the efficiency of commercial banks. Thus to examine the determinants of bank efficiency this study chooses the following explanatory variables. These variables are explained as follows.

Variable	Description
EQTA	Degree of capitalization: total capital over total assets.
NIM	Net interest rate margin: interest rate income minus interest rate expenses over total earning assets.
NIE	Non-interest expenses over total assets.
NII	Non-interest income over total assets.
LOATA	Measure of loan intensity: Loans over total assets.
SIZE	Measure of bank size: logarithm of total assets.
CONC	Market concentration: Herfindahl Hirschman index (the sum of the squared market share in terms of assets of each bank).

Degree of capitalization (EQTA$_{it}$): Naceur et al. (2009) state that EQTA reflects the capital strength of banks and high levels of equity may mitigate the risk of insolvency and the cost of borrowed funds, thus suggesting a positive relationship with bank efficiency. According to Isik and Hassan (2003) well capitalized banks are more technically efficient, thus the expected sign of EQTA with bank efficiency is positive.

Net interest rate margin (NIM $_{it}$): Demirguc-Kunt and Huizinga (1999) suggest that wider margins imply lower banking competition which reflects a degree of lower bank efficiency. The expected sign between NIM and bank efficiency is negative.

Non-interest expenses (NIE$_{it}$): The variable NIE proxies operating expenses across the banking sectors; the literature has found that reduced operating expenses increase the efficiency of the financial institutions (Bourke, 1989), thus a negative sign is expected.

Non-interest income (NII$_{it}$): NII variable captures the effect of diversification of the bank´s activities and there is no a priori expected sign.

logarithm of total assets (SIZE$_{it}$): Hauner (2005) explains that larger banks could pay less for their inputs than their counterparts and that there could be increasing returns to scale through the allocation of fixed costs. Thus, the expected size between SIZE and EFF is positive.

Loan intensity (LOATA$_{it}$): the lending intensity of the banking sector and a positive relationship with EFF is expected since loans are the main source of bank profits; however, the quality of the loans may deteriorate under some circumstances, for example during an economic recession, in which case a higher degree of loan intensity may be detrimental to bank efficiency.

Market Concentration (CONC$_t$): some authors believe there is a negative relationship between CONC and EFF since in highly concentrated markets risk aversion may prevail (Sathye, 2001). Moreover, Naceur et al. (2009) suggest that greater market concentration might reduce competition and thus efficiency. However, if economies of scale drive bank M&As, then increased concentration may lead to efficiency improvements (Demirguc-Kunt and Levine, 2000; Casu and Girardone, 2009). Therefore there is no expected sign between CONC and EFF.

Model Specification

The used in this study including the DEA scores as the dependent variables is:

$$EFF_{it}=\alpha+\beta_1 EQTA_{it}+\beta_2 NIM_{it}+\beta_3 ROA_{it}+\beta_4 NIE_{it}+\beta_5 NII_{it}+\beta_6 CONC_t+\beta_7 SIZE_{it}+\beta_8 LOATA_{it}+\beta_9 GDP_t+\beta_{10} CPI_t+£_{it}$$

$$i=1....18; \ t=1.... \ N$$

Conceptual framework of the study

Microeconomic factor
- **Loan intensity**

Industrial factors
- **logarithm of total assets**
- **Market Concentration**

Bank specific factors
- **Degree of capitalization**
- **Net interest rate margin**
- **Non-interest expenses**
- **Non-interest income**

Efficiency
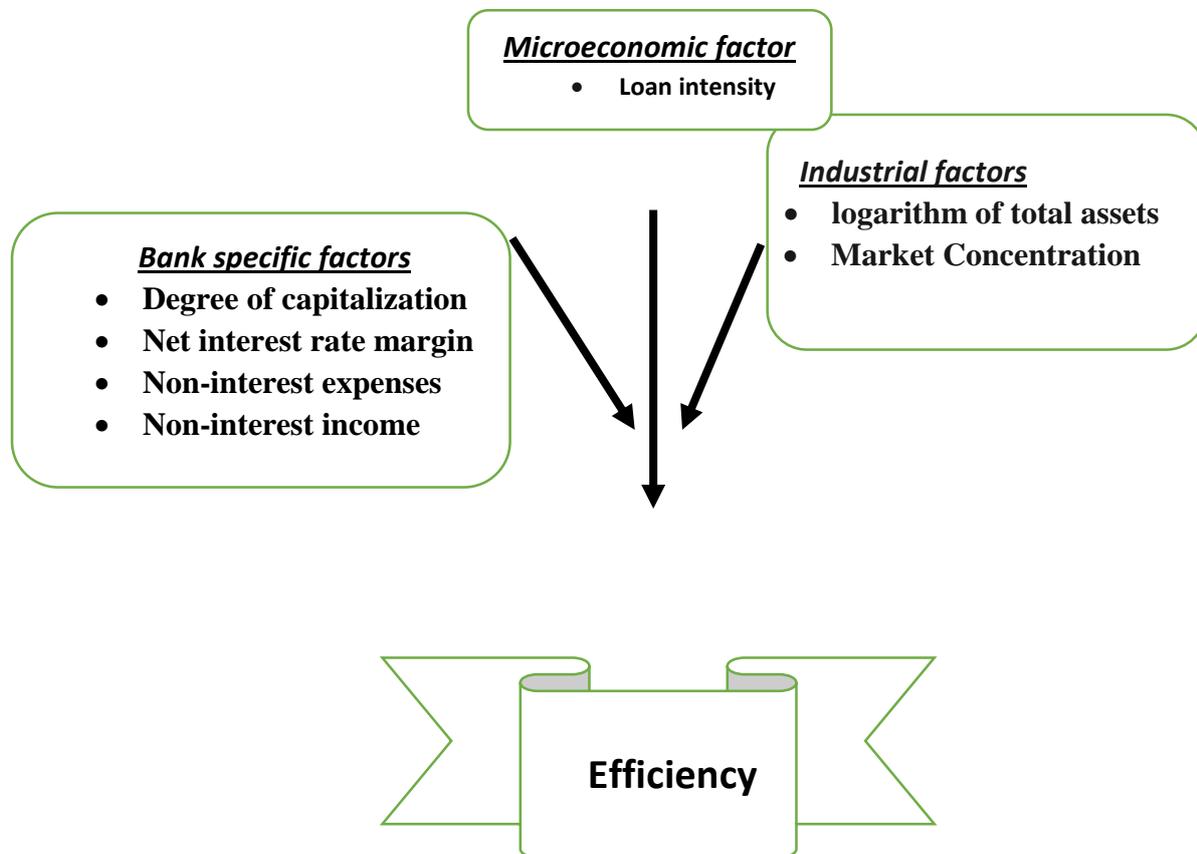
Source: Self extracted

CHAPTER IV: RESULTS AND DISCUSSION

This chapter presents the result of data analysis, interpretation and discussions made accordingly. The data were analysed by using DEAOS & Eviews 9. The descriptive statistics analysis was discussed. first set of results is the elaboration of the efficiency estimators obtained by applying the DEA. then Followed by the diagnostic test, which is necessary to fulfil the assumption of the Tobit regression model. Then, econometric analysis and discussion of the main finding of the study were presented. Finally, the results of the regression analysis were discussed by supporting empirical evidence.

Descriptive statistics of DEA

This section presents the descriptive statistics of input and output variables used in the study for the sample banks. The first set of results is the elaboration of the efficiency estimators obtained by applying the DEA methodology. The information interpreted by Data Envelopment Analysis (DEA). Data Envelopment Analysis (DEA) is a linear programming based model which evaluates the relative efficiency of decision making units (DMUs), with multiple inputs and outputs. It identifies a subset of efficient "best-practice" DMUs and for remaining DMUs, the magnitude of their (in) efficiency is measured by comparing to a frontier constructed from the efficient DMUs.

The DEA approach is based on Farrell and on the extensions of his work by Charnes et al. and Banker et al. Now-a-days, DEA is at the service of the managers and efficient tool for evaluating the performance of DMUs.

Year	TE
2005	0.975337
2006	0.993499
2007	1
2008	0.993307
2009	0.979263
2010	0.98275
2011	0.967861
2012	0.980842
2013	0.977234
2014	1
2015	0.990389
Mean	**0.985498**

Table 1. Efficiency estimators: TE of Commercial bank's

Notes: The efficiency estimators are the average efficiency scores for all banks for a given year.
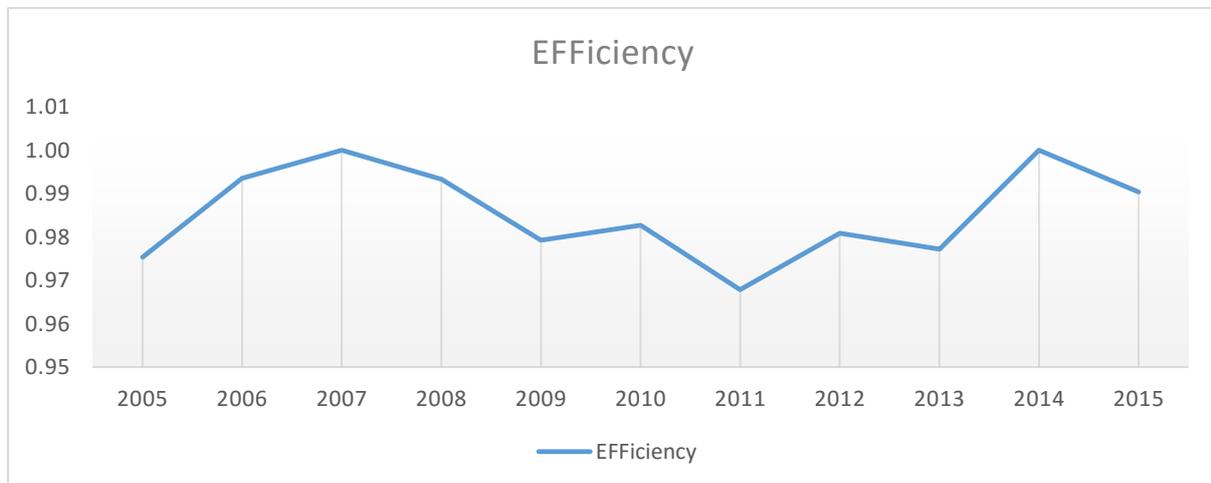
Fig. 1. Technical Efficiency

Source: Elaborated with data from NBE.

Notes: The efficiencies reported are the yearly averages of all bank yearly efficiency scores.

The efficiency scores present and average of 98 % of technical efficiency and inefficiencies in the system of around 2% during the sample period. The efficiency trend can be observed there is clear evidence of an increased period of bank efficiency from 2005 to 2015. In particular, they observed a constant increase in the efficiency estimators from 2005 to 2007, a period

where the banking sector experienced clear downward trend in the level of bank efficiency. The above table shows that after 2007 there is a clear onward trend in the level of bank efficiency.

Test results for the Tobit regression model assumptions

A diagnostic tests were carried out to confirm that the data fits the basic assumptions of Tobit regression model. Hence, the results for model misspecification tests are presented as follows:

Pseudo R^2 test

Pseudo R-squareds	
McFadden	0.056770
Adjusted Mcfadden	0.024311
Cox-Snell	0.272394
Nagelkerke	0.273403

The conventional measure of goodness of fit, $R2$, is not particularly meaningful in binary regressand models. Measures similar to $R2$, called **pseudo $R2$,** are available, and there are a variety of them. Eviews presents one such measure, the McFadden R^2, denoted by RMcF [2,] whose value like R^2, RMcF ^{2} also ranges between 0 and 1. In this study as shown in above, pseudo R^2 of the test statistic gave value is 0.056 which implies that the model fitted.

Likelihood Ratio Test

Redundant Variables Test				
Null hypothesis: CONC EQTA LOATA NIE NIM NII SIZE are jointly insignificant				
Equation: UNTITLED				
Specification: EFF C CONC EQTA LOATA NIE NII NIM SIZE				
Redundant Variables: CONC EQTA LOATA NIE NIM NII SIZE				
	Value	**df**	**Probability**	
Likelihood ratio	27.98357	7	**0.0002**	
LR test summary:				
	Value	**df**		
Restricted LogL	-246.4662	86		
Unrestricted LogL	-232.4744	79		
Restricted Test Equation:				
Dependent Variable: EFF				
Method: ML - Censored Normal (TOBIT) (Newton-Raphson / Marquardt steps)				
Date: 06/14/16 Time: 20:12				
Sample: 1 88				
Included observations: 88				
Left censoring (value) at zero				
Convergence achieved after 3 iterations				
Coefficient covariance computed using observed Hessian				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	98.54886	0.424495	232.1554	0.0000
Error Distribution				
SCALE:C(2)	3.982119	0.300164	13.26650	0.0000
Mean dependent var	98.54886	**S.D. dependent var**		4.004939
S.E. of regression	4.028157	**Akaike info criterion**		5.646960
Sum squared resid	1395.440	**Schwarz criterion**		5.703263
Log likelihood	-246.4662	**Hannan-Quinn criter.**		5.669643
Avg. log likelihood	-2.800753			
Left censored obs	0	**Right censored obs**		0
Uncensored obs	88	**Total obs**		88

The redundant variables test allows you to test for the statistical significance of a subset of your included variables. More formally, the test is for whether a subset of variables in an equation all have zero coefficients and might thus be deleted from the equation. The redundant variables test can be applied to equations estimated by linear LS, TSLS, ARCH (mean equation only), binary, ordered, censored, truncated, and count methods. The test is available only if you specify the equation by listing the regressors, not by a formula. Independent variables simultaneously against influential dependent variable (likelihood ratio test) probability range 0.0000<0.05. In this study as shown in table above of the test statistic gave value is 0.0000 which implies that the model fitted and no redundant .

Wald Test

Wald Test:			
Equation: Untitled			
Test Statistic	**Value**	**df**	**Probability**
F-statistic	358.6890	(7, 79)	**0.0000**
Chi-square	2510.823	7	**0.0000**
Null Hypothesis: C(1)=0,C(2)=0,C(3)=0,C(4)=0,C(5)=0,C(6)=0,C(7)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)	**Value**	**Std. Err.**	
C(1)	75.09065	5.106062	
C(2)	12.56038	5.070267	
C(3)	0.241832	0.058556	
C(4)	0.200100	0.043499	
C(5)	-1.096782	0.545855	
C(6)	1.441809	0.417029	
C(7)	0.430881	0.390781	

The test is performed in two different ways, but results suggest that the null hypothesis should clearly be rejected as the *p*-value for the test is zero to four decimal places. Independent variables simultaneously against influential dependent variable Chi-square test probability range 0.0000<0.05. The result of this equal likelihood ratio test. In this study as shown in table

above of the test statistic gave value is 0.0000 which implies that the model fitted and no redundant.

Descriptive statistics of Tobit model

This section presents the outcomes of the descriptive statistics for main variables involved in the regression model. Key figures, including mean, median, standard deviation, minimum and maximum value were reported. This was generated to give overall description about data used in the model and served as data screening tool to spot unreasonable figure.

Dependent Variable: EFF				
Method: ML - Censored Normal (TOBIT) (Newton-Raphson / Marquardt steps)				
Date: 06/14/16 Time: 16:26				
Sample: 1 88				
Included observations: 88				
Left censoring (value) at zero				
Convergence achieved after 4 iterations				
Coefficient covariance computed using observed Hessian				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	75.09065	5.106062	14.70618	0.0000
CONC	12.56038	5.070267	2.477261	0.0132
EQTA	0.241832	0.058556	4.129908	0.0000
LOATA	0.200100	0.043499	4.600069	0.0000
NIE	-1.096782	0.545855	-2.009292	0.0445
NII	1.441809	0.417029	3.457333	0.0005
NIM	0.430881	0.390781	1.102616	0.2702
SIZE	0.684023	0.339794	2.013051	0.0441
Error Distribution				
SCALE:C(9)	3.396741	0.256039	13.26650	0.0000
Mean dependent var	98.54886	S.D. dependent var		4.004939
S.E. of regression	3.585009	Akaike info criterion		5.488056
Sum squared resid	1015.331	Schwarz criterion		5.741420
Log likelihood	-232.4744	Hannan-Quinn criter.		5.590130
Avg. log likelihood	-2.641755			
Left censored obs	0	Right censored obs		0
Uncensored obs	88	Total obs		88

	Technical Efficiency (TE)
EQTA	0.0000*
NIM	0.2702
NIE	0.0445**
NII	0.0005*
CONC	0.0132*
SIZE	0.0441**
LOATA	0.0000*
CONST	0.0000*
Pseudo R2	0.567
Wald test	0.000
Log likelihood	-232.474
Observations	88

*Notes***: *,**,*** represent significance at 1and 5, 10 % confidence intervals.**

EQTA is the degree of capitalization, NIM is the net interest rate margin, , NIE are non-interest expenses, NII are non-interest income, SIZE is the logarithm of assets, LOATA is a measure of lending intensity, CONC is the Herfindahl Hirschman Index.

Discussion of the Results

Based on the regression result, each variable is described in detail under the following sections.

H1: Degree of capitalization is positively significant relationship related to commercial banks efficiency;

EQTA is positive and significant with regards to efficiency. Similarly, other studies have found a positive relationship between the degree of capitalization and efficiency (Pasiouras *et al.*, 2007; Hassan and Sanchez, 2007; Naceur *et al*., 2009). Therefore, based on the regression result from the study, the study failed to reject the hypothesis namely *EQTA* has positive relationship

with efficiency of Ethiopian commercial banks which was formulated to show the significant relationship between *EQTA* and efficiency of Ethiopian commercial banks.

H2: Net interest rate margin is positively significant relationship related to commercial banks efficiency;

NIM is positive and insignificant with regards to *efficiency*. similarly, other studies have found a positive relationship between the NIM and efficiency (Tahir et al., 2010, Shen 2008). Therefore, based on the regression result from the study, the study rejects the hypothesis namely NIM has positive relationship with efficiency of Ethiopian commercial banks which was formulated to show the insignificant relationship between *NIM* and efficiency of Ethiopian commercial banks.

H3: Non-interest expenses is negatively significant relationship related to commercial banks efficiency;

NIE is negative and significant with regards to e*fficiency*; expenses other than interest rate expenses are the most controllable and an increase in them reduces overall efficiency levels. This result is consistent with other studies (Demir *et al*., 2005; Kalluru and Bhat, 2009; Delis and Papanikolaou, 2009) arguing that reduced efficiency in banks can be a result of large amounts of non-interest expense. Therefore, based on the regression result from the study, the study failed to reject the hypothesis namely *NIE* has negative relationship with efficiency of Ethiopian commercial banks which was formulated to show the significant relationship between *NIE* and efficiency of Ethiopian commercial banks.

H4: Non-interest income is positively significant relationship related to commercial banks efficiency;

NII is positive and significant with regards to *efficiency*. This result is consistent with other studies B.S. Badola *et al*. (2006) the variables non-interest income have a positive significant relationship with efficiency. Therefore, based on the regression result from the study, the study failed to reject the hypothesis namely *NII* has positive relationship with efficiency of Ethiopian commercial banks which was formulated to show the significant relationship between *NII* and efficiency of Ethiopian commercial banks.

H5: Bank size is positively significant relationship related to commercial banks efficiency;

SIZE is positive and significant coefficient with regards to *efficiency*; Sufian and Noor (2009), Pasiouras *et al.* (2007) & Hauner (2005) they find that the size of the bank is positively associated with greater bank efficiency. Finally, the results report no significance between NIM and *EFF*. Therefore, based on the regression result from the study, the study failed to reject the hypothesis namely *SIZE* has positive relationship with efficiency of Ethiopian commercial banks which was formulated to show the significant relationship between *Size* and efficiency of Ethiopian commercial banks.

H6: Loan intensity is positively significant relationship related to commercial banks efficiency;

LOATA is positive and significant in every case, thus an increase in loans increases the efficiency of banks. Isik and Hassan (2003) argue that more efficient banks may have lower costs and consequently more and better quality loans. Therefore, based on the regression result from the study, the study failed to reject the hypothesis namely *LOATA* has positive relationship with efficiency of Ethiopian commercial banks which was formulated to show the significant relationship between *LOATA* and efficiency of Ethiopian commercial banks.

H7: Market concentration is positively significant relationship related to commercial banks efficiency;

CONC presents a positive and significant coefficient with regards to *efficiency*; Casu and Girardone (2009) explain that higher concentration may lead to greater bank efficiency when economies of scale drive M&As. Therefore, based on the regression result from the study, the study failed to reject the hypothesis namely *CONC* has positive relationship with efficiency of Ethiopian commercial banks which was formulated to show the significant relationship between *CONC* and efficiency of Ethiopian commercial banks.

CHAPTER V: CONCLUSION AND RECOMMENDATION

Based on the finding of the study conclusions were drawn and possible recommendations were forwarded. Accordingly, the first section presents the conclusion part and the second section presents the possible recommendation.

Conclusion

Ethiopia is one of the fastest growing economies in the world, with its economy growing at a phenomenal rate in the past decade. This economic boom meant its banking sector had to keep up to sustain the accelerated growth. However, given the lack of publicly available reliable financial data, the study and analysis of the Ethiopian banking sector has been limited, although growing. This study was thus, a step in this direction and took on to analyse the technical efficiency of the banking sector in Ethiopia. The present study analysed a sample set of 8 commercial Ethiopia banks, from the period of 2005-2015. The technique of Data Envelopment Analysis (DEA) was used to estimate the technical efficiency scores of banks through the sample period, with the help of 4 input and 4output variables that were selected. Based on the set of sample banks and their technical efficiency scores, it was found that the Commercial bank of Ethiopia, Wegagen Bank, United Bank and Nib Bank has been consistently technically efficiency through the period which were all efficient in 11 of the 11 sample years. The trend of efficiency scores from 2005-2015 was constant in the period saw an average 98% in all years except in 2011. This can be explained by the economic boom of the Ethiopia that began in the last decade. however, efficiency scores as the number of technically efficient banks dropped by 3% from 2008-2011 and there have change in the number of technically efficient banks from 2012-2015. In this way, it can be concluded that a sharp decline of efficiencies was observed in 2011, and banks were conservative and playing safe to avoid any further dips, thereby bringing about no further decline in efficiency scores in 2012. Further, the efficiency scores that were computed in the first stage of the analysis were used in the second stage of the analysis, where the Tobit censored regression test was used to regress the dependent variables (the efficiency scores) against 7 selected independent variables, to understand if the independent variables have any influence on the efficiency scores of banks. The evidence gathered as per the regression test indicated that

degree of capitalization, non-interest expenses, non-interest income, loan intensity, market concentration & bank size is an influencing factor into efficiency a bank's operations. bank size, larger the bank, better the efficiency score. It was also observed that profitability or a higher net income also results in improved efficiency. However, a caveat as highlighted by Budd and Budd (2006) suggests that profitability cannot be wholly credited for improved levels of efficiency. The authors state that it is not profitability alone but the ability of banks to sustain efficient operations in the current globally challenging times that will result in higher levels of efficiencies. Ethiopian banks in the market as well as total equity (or bank capitalization), loan intensity, net interest income, non-interest income, size and non-interest expenses were also found to be influencing factors when it came to efficiency of banks. It was noted that banks which are able to capture larger amounts of the market perform more efficiently while banks with lower levels of capitalization have higher levels of efficiency. Another explanatory variable that is found to have significant impact on the financial performance of the banks is the ratio of non-interest income to total income. The ratio of non-interest income to total income measures a bank's level of diversification and is found to have a positive and statistically significant impact on the efficiency of the banks. The other key determinant of bank profitability found by the study is Bank size. Bank size is proxied by log of total assets of a bank. Bank size is found to have statistically significant and positive impact on the profitability of the banks. The positive coefficient indicates that larger commercial banks tend to earn higher profits than smaller commercial banks. This is consistent with the relative market power hypothesis. The relative market power hypothesis states that only larger banks are able to exercise market power in pricing their products to earn above normal profits. The ratio of net loans to total assets, a proxy for loan intensity, is also one of the variables that influence the efficiency of the banks. The variable is found to have a positive and statistically significant association with bank.

It must be noted that the present study suffered some limitations in the form of availability of reliable, accurate and uniform financial data for Ethiopian banks. This limited the data set that was used for the analysis, however, the application of DEA, the Tobit censored regression test and its results are a good indication of how the Ethiopia banking sector behaved in the period.

Recommendation

The findings of the study have significant policy substance. If Ethiopian commercial banks are to play the key intermediary roles in terms of augmenting the rapid and sustainable development accomplishments of the country, promoting private investment, facilitating trade and commerce, and offering more new products and services to their clients at the right time and fair prices with better quality, they need to be efficient and profitable. In light of this, bank managers and policy makers are required to take measures and frame policies aimed at enhancing the efficiency and profitability of the country's banking sector.

In a bid to enhance the efficiency of the banks, the role of technology advancement is particularly important given that a bank with relatively more advanced technologies may have an added advantage over its competitors. Furthermore, liberalizing the banking sector more will increase competition among the banks. In view of increased competition, managers of banks, bank regulators and policymakers will be more conscious to look for better ways to obtain the optimal use of their resources. To ensure the competitiveness of the banking sector, bank managers should have the ability to sustain stable and competitive returns. Thus, from a regulatory perspective, the banking sector should be based on its efficiency. The policy direction has to be directed towards enhancing the efficiency of the banks with the aim of intensifying the robustness and stability of the banking sector. More specifically, the study extends the following suggestions:

➢ Bank managers need to exert their utmost efforts to improve their input utilization as well as adjust their scale of operation. Particularly, the state owned commercial banks and private commercial banks can have efficiency gains through better use of resources. To this end, upgrading the skills of bank employees and enhancing their capacity through the provision of short-term and long-term trainings geared towards better utilization of resources are warranted.

➢ Managers of commercial banks particularly that of the private banks could reap more efficiency gains if they increase their scale of operation, and enhance their equipment, staffing and branch locations.

- Bank managers of both state owned banks and private banks should employ optimum combination of inputs taking into account the price of the respective inputs apart from minimizing the quantity of the inputs.

- Since higher levels of inefficiency are found on the non- interest expense side, managers of the commercial banks need to focus much on controlling operating costs.

- managers should frame policies aimed at enhancing the profitability of the banks through improving the banks' capital structure (strengthening the bank's capital base), implementing risk management practices, devising mechanisms to better control bank operational costs, diversifying banks' sources of income and utilizing bank assets more productively and managing the liquidity position.

- On the external factors, market concentration is found to significantly and positively influence the financial performance of the commercial banks. The positive and significant association between concentration and profitability evidences the prevalence of collusion among the banks, making some banks to earn monopoly profits by charging higher rates on loans and paying lower interest rates on deposits. This may imply that the banking sector in Ethiopia is not competitive enough. Thus, policy makers and bank regulators should give attention to formulating policies aimed at making the banking sector more competitive through liberalizing the sector further.

Future research:

This study could be extended in many ways. In terms of methodology, Future research can focus on using larger data sets as well as longer sample periods to provide more insight into efficiency scores. The of parametric and non-parametric methods, i.e. SFA and DEA is another area which can be used to better understand the drivers of banking efficiency.

Another possible extension could be the examination of the productivity of the banks using the DEA Malmquist model. Future research could also include more Macro & Micro variables such as GDP, inflation, taxation and regulation indicators, exchange rates, and indicators of quality of bank services in examining the determinants of efficiency of the banks.

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