Analysis of Technical and Cost Efficiency of Co-Operative Financial Institutions in Ghana: An Application of Stochastic Frontier Approach

By

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DECLARATION

I hereby declare that this submission is my own work towards the Master of Philosophy. And that, to the best of my knowledge, it contains no material previously published by another person or material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in text.

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DEDICATION

This work is dedicated to my father Mr. Stephen Fosu and late Mother Leticia Amma Yeboah who continuously supported me in all my academic endeavours; and to you, My Wife Diana as well as my children Kwame and Amma, for the encouragement, love and timely assistance you have rendered to me.

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ABSTRACT

The aim of this study is to examine the technical and cost efficiency of cooperative financial institutions in Ghana using a Cobb-Douglas Stochastic frontier model. An unbalanced panel data from 2009 to 2012 for sixty six financial cooperatives was used in the study. To capture the dual roles of financial cooperatives production and intermediation approaches are used in the selection of inputs and outputs. The distribution of technical efficiency scores show an average of 53.40% and 57.96% across the sampled units for production and intermediation approaches respectively. On the other hand, the distribution of cost efficiency scores show an average of 92.44% and 70.67% across the sampled units for production and intermediation approaches respectively. The study reveals increasing returns is experienced in cost efficiency whiles approximately constant return is enjoyed in technical efficiency. The main conclusion is that the CFIs reduce cost to the detriment of technical efficiency. Management should continue to explore opportunities of economies of scale in production and by adopting efficient technology that improves productivity of staff . The primary societies focus more on reducing poverty of members rather than investments that yield low returns. At the firm level, management must also heighten the scope of social commitment to both staff and clients whilst improving on marketing strategies.

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CHAPTER ONE

INTRODUCTION

1.0 Background to the study

One of the fastest growing sectors of the Ghanaian economy, over the last decade has been the financial sector. As a result, many new banks have entered the market offering very competitive terms of credit retailing. The Non-Bank Financial Institutions have also adopted very innovative strategies of financial intermediation. Banks have been established with specific aims and objectives, but ultimately to satisfy the expectations and aspirations of their clients as well as the general public.

However, in view of the risks associated with bank finance, most banks are unable to satisfy the needs of citizens and households in respective countries. It is for this reason that Non-Banking Financial Institutions (NBFIs) have been established to reach out to the larger population that could not have access to banking facilities due to lack of requisite collateral security as well as other constraints. In spite of the flexible policies operated by NBFIs in an attempt to make funds available to the public with less restrictions, most households and Small and Medium Enterprises (SMEs) in particular, are unable to access funds adequately for exploitation of their full potentials.

The delivery of banking services in Ghana reaches about 30% of population .The rest of the population may not have any access to a formal financial service provider and "the majority of low income households, in all parts of the world, historically have not had access to formal financial services" (Chiumya, 2006: 29) because most formal financial service providers

regard low income earners and households as having no access to surplus fund money to either save with or borrow from their institutions.

1.1 Statement of the Problem

One of the fastest growing sectors of the Ghanaian economy, over the last decade has been the financial sector. As a result, many new banks have entered the market offering very competitive terms of credit retailing. The Non-Bank Financial Institutions have also adopted very innovative strategies of financial intermediation. Banks have been established with specific aims and objectives, but ultimately to satisfy the expectations and aspirations of their clients as well as the general public. However, in view of the risks associated with bank finance, most banks are unable to satisfy the needs of citizens and households in respective countries. It is for this reason that Non-Banking Financial Institutions (NBFIs) have been established to reach out to the larger population that could not have access to banking facilities due to lack of requisite collateral security as well as other constraints. In spite of the flexible policies operated by NBFIs in an attempt to make funds available to the public with less restrictions, most households and Small and Medium Enterprises (SMEs) in particular, are unable to access funds adequately for exploitation of their full potentials.

Despite the stiff competition, the credit union movement also continues to record a phenomenal growth in both the number of primary societies as well as membership. There are 446 Credit unions in Ghana having a membership of about 437,520 with USD 214,190,192worth of assets WOCCU, 2012). In every economy, both the developed and developing world, various avenues exist for addressing the financial needs or challenges of citizens and households. Nonetheless, the issue of efficiency arises; as it is believed that most

of the microfinance institutions including financial cooperatives in the country are operating below their efficient capacity or better still making productivity losses (Amanor, 2012).

The aim of microfinance including financial cooperatives according to Otero (1999) is not just about providing capital to the poor to combat poverty on an individual level, it also has a role at an institutional level. It seeks to create institutions that deliver financial services to the poor, who are continuously ignored by the formal banking sector. Littlefield and Rosenberg (2004) stated that, the poor are generally excluded from the financial services sector of the economy so cooperative financial institutions (CFIs) have emerged to address this market failure. By addressing this gap in the market in a financially sustainable manner, cooperative financial institutions can become part of the formal financial system of a country and so can access capital markets to fund their lending portfolios, allowing them to dramatically increase the number of poor people they can reach (Otero, 1999). It is in view of this that this research focuses on the cost and technical efficiency of cooperative financial institutions in Ghana using stochastic frontier analysis.

1.2 Research Objectives

In view of the above discussion, the objective of this study has been set as to measure the efficiency of co-operative financial institutions in Ghana. Indeed, the study shall be guided by the following specific objectives in the attempt to resolve the research problem. Here the effort would be:

1. to estimate the best practice efficiency frontier of co-operative financial institutions (CFIs) in Ghana.
2. to estimate the average efficiency scores of CFIs in Ghana.
3. to determine the drivers of efficiency in the CFI industry in Ghana.

1.3 Research Questions

1. What is the is the best practice efficiency frontier that account for the behaviour of Co-operative financial institutions (CFIs) using the available information?
2. What are the average efficiency scores of CFIs in Ghana?
3. What are the determinants of efficiency of CFIs in Ghana?

1.4 Relevance of the Study

The significance of this study is based on the score that many research works has been conducted in the area of efficiency for co-operative finance institutions across the globe for the progress of the programme across countries but such an undertaking has eluded cooperative financial institutions in Ghana; hence the reason for this study is to focus on Ghana and bring out the pressing issues that has engulfed the scheme over the years and how practitioners have been performing. Invariably, improving knowledge of the linkages and drivers of efficiency will on the management policy perspective, provide a benchmarking analysis to inspire co-operative financial institutions towards best practices. It will also help decision making units to know which strategies and methodologies are most efficient and can help improve their success story; this will help them reduce inefficiencies and embark on least cost activities that can better improve output levels and make their outfit self-sufficient.

Secondly, the government machinery will also acquire forehand information on the performance of the scheme and how scarce resources are being put to maximum use. This is important in the area of policymaking and decisions. Also whilst the relationship between external conditions and the economic efficiency of cooperative financial institutions are discussed, it will spark good policy discourse which can further renew interest in the field for further studies. To all practitioners in the sector, most especially the players, relative

efficiency scores will provide good platform to learn from the others and compare their performances. Invariably this learning effect will improve the general performance of the units in the sector.

1.5 Scope of the Study

The scope of this study shall cover a sample of sixty six (66) cooperative financial institutions (Credit Unions) across the country over the period of 2009 to 2012. The four year period is chosen not only to set analysis and understanding to current trends in the field of cooperative finance; but it is assumed that most of the institutions were in full operation and have consistent data for the sample periods.

1.6 Limitations

The major constraints are exposed in this study; *viz*, time constraints and financial constraints. For one, the scope of this study which is set to capture a number of observations across Ghana, demands ample time in order to construct a detailed work that is at best, more representative. However, the stretch of time available will not augur for all observations to be captured. Secondly, financial constraints will almost certainly also reduce the extent of travelling to acquire data and or check for consistency of gathered secondary information. Again, subject to the range of this research work, requires that primary sources of data are combined effectively, which presses for enough finances. As a result, the sampled size will obviously be reduced, in order not to throw the budget out of gear.

1.7 Organization of the Study

The study is organized in five chapters as follows. Chapter one provides general background issues to the study. It also provides the statement of problem in terms of research questions. Again, it sets out the objectives of the study and provides justification for the objectives.

Chapter two reviews the relevant literature on financial co-operatives and efficiency. The method of the study will then be given concrete exposition in chapter three whilst the presentation of results will be showcased in chapter four. The fifth chapter will then entail a summary of the main findings and policy recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter is in three broad parts. The first part will attempt to give a concise pictorial view of the financial co-operatives sector in Ghana and its components. The second part will try to bring out some of the conceptual issues pertaining to efficiency. A look will also be taken on the framework for measuring technical and economic efficiency and some of the limitations that crop up with the usage of any particular estimation technique; this will then be followed by an appraisal of some empirical studies on efficiency. The third major section of this chapter will look at the broad concept of financial co-operatives and its scope. This will then be followed by a review of research works that has been conducted in the area of financial institutions.

2.1 Theoretical Review of Efficiency

Fried; Lovell and Schmidt (2008) have defined efficiency as a comparison between observed and optimal value of output and input. Efficiency is improved if more outputs are generated without changing inputs, or if the same outputs are generated with fewer inputs. Measurement of efficiency starts with the description of production technology in the form of frontiers. Production technology can be represented by production functions, cost functions or profit functions. Therefore, technical efficiency, allocative efficiency and overall economic efficiency are studied in the frontier framework. This study deals with technical and economic efficiency. Efficiency consists of two main components; technical efficiency and allocative efficiency (Coelli, Rao and Battese 1998).

2.1.1 Technical Efficiency

Technical efficiency is defined as the ability to achieve a higher level of output given similar levels of inputs, (Ogunniyi, 2008). To measure technical efficiency the question of how much input could be proportionally reduced without changing output produced; or how much output could be enhanced without changing the combination of input; is unraveled. Hence when firms are able to employ less of at least one input and are still able to maintain the level of output or are able to increase at least one output using the same input, then an improvement in technical efficiency is said to be made, (Koopmans, 1951 cited in Murillo-Zamorano, 2004).

Firms that produce outputs on the production frontier are operating at maximum possible productivity and are recognised as technically efficient. Firms producing below the frontier line are considered to be technically inefficient (Coelli, Rao and Battese 1998). A shift outwards of a production frontier implies productivity growth (Coelli, Rao and Battese 1998). If productivity growth has been caused by advances of technology, the production frontier will shift upward to show a new set of efficient points (Coelli, Rao and Battese 1998).In the short run, a firm achieves technical efficiency by operating on the production frontier and, in the long run, may improve its productivity by exploiting the scale of operations. Thus, productivity growth may be attributed to improvements in technical efficiency, to technological improvements and to exploitation of scale of operation, or a combination of all three causes (Coelli, Rao and Battese 1998).

A production frontier can be specified by production functions and distance functions. A single output specification of the production frontier function is valid for cases when many inputs are used to produce single output. Distance functions are useful for cases when many inputs are used to produce many outputs. The parametric estimation of the stochastic distance

functions has proven to be very useful in estimating technical efficiency with multiple-output technologies, avoiding the major drawbacks of parametric methods associated with the single-output approach (Färe and Primont, 1995).

2.1.2 Allocative Efficiency

Allocative efficiency (AE) involves the selection of an input mix that allocates factors to their highest value uses and introduces the opportunity cost of factor inputs to the measurement of productive efficiency. Allocative efficiency occurs when a firm chooses the optimal combination of inputs, given the level of prices and the production technology (Coelli, Rao and Battese 1998; Rogers 1998). When a firm fails to choose the optimal combination of inputs at a given level prices, it is said to be allocatively inefficient, though it may be technically efficient (Coelli, Rao and Battese 1998). An example of an empirical work on allocative efficiency is presented by (Badunenko *et al*, 2005) who proposed that allocative efficiency can be estimated using information on input and output quantities and profit. This composition shows the ability of a financial co-operative institution to combine available inputs in optimal proportions given factor prices and available technology. It is concerned with the choice that best compare to the budget constraint among different possible combinations of input that yield the same amount of the desired output. In other words, it is the ability of economic agents to equate marginal cost with marginal benefit, (Guerrero and Negrin, 2005; Manjunatha et al., 2009). Allocative efficiency, therefore, measures how well firms combine inputs to minimize the cost of producing a given output level. (Radam, et al, 2010).

2.1.3 Cost Efficiency

The third measure of efficiency, called economic or overall efficiency, is the product of the technical and allocative efficiencies. From the discussion it is clear that production and cost functions subsume the concepts of technical and allocative efficiency. Cost functions assume the firms are both technically and allocatively efficient and then trace out the relationship between maximum levels of output and minimum prices. However, if the minimisation of costs is to be considered in efficiency and is to be achieved, costs of inputs must be taken into account. Technical efficiency and allocative efficiency combine to provide overall efficiency (Coelli, Rao and Battese 1998). When a firm achieves maximum output from a particular input level, with utilisation of inputs at least cost, it is considered to be an overall efficient firm. The assumption is that an organisation is already technically efficient; however, it may not choose the optimal mix of inputs produce at least cost.

2.2 Methodological Review

As an introduction, some items in the literature on approaches to measuring CFI efficiency are briefly presented here. Economic efficiency can be measured using Data Envelopment Analyses (DEA) or Stochastic Frontier Analysis (SFA) methods, which involve mathematical programming and econometric methods respectively (Coelli *et al.*, 2005). Farrell (1957) was the first in modern history to develop a means of measuring efficiency. His works, mainly non-parametric, attempted to estimate both technical and allocative efficiency assuming constant returns to scale in production. He estimated efficiency relative to a production possibility frontier. Recent extensions of his work relaxed the assumption of constant returns to include the assumption of variable returns to scale; and an application using parametric models as well. The current existing literature on efficiency therefore reveals two broad

categorical forms of estimation techniques: the parametric (the econometric approach) and the non- parametric (mathematical linear programming) techniques.

2.2.1 Econometric Methods

Since the stochastic frontier production function was independently proposed in Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977), there has been considerable research to extend and apply the model. The stochastic frontier production function postulates the existence of technical inefficiencies of production of firms involved in producing a particular output. Most theoretical stochastic frontier production functions have not explicitly formulated a model for these technical inefficiency effects in terms of appropriate explanatory variables. Early empirical papers, in which the issue of the explanation of these inefficiency effects was raised, include Pitt and Lee (1981) and Kalirajan (1981). These papers adopt a two-stage approach, in which the first stage involves the specification and estimation of the stochastic frontier production function and the prediction of the technical inefficiency.

The stochastic frontier analysis method can be performed on both cross-sectional and panel data. For cross-sectional data, the error representing statistical noise is assumed to be independently identically distributed whilst the inefficiency term is one-sided with a number of statistical distributive forms: half-normal, exponential and truncated from below at zero. Likelihood function can then be defined so long as the two error terms are assumed independent of one another and of the variable inputs; maximum likelihood technique can be used to find the input parameters. However, the use of cross sectional data to find conditional estimates of efficiency has been criticized as being not consistent although it yields unbiased estimators.

As a result of this technical difficulty and the fact that the distributive assumption used under cross-sectional stochastic frontier models are too rigid and yet yield inconsistent estimates, panel data stochastic frontier models is advised. Panel data frontier models include time invariant independent variables and therefore do not require a separate assumption of the independence of the inefficiency term and the input variables. More so, it does not require any rigorous estimation technique, the simple traditional estimation procedures for assessing panel data can be applied to yield consistent estimators of the inefficiency parameters as modeling does not entail any distribution assumption on inefficiency effect, (Schmidt and Sickles, 1984: Murillo-Zamorano, 2004). The use of fixed effect and random effect procedures in measuring estimates of a panel data are therefore useful. The fixed effect method applies OLS after the data has been transformed into a deviation form. Researchers on the other hand prefer the use of random effect procedure since it allows for time invariant regressors in the model as it assumes a randomized error term rather than a fixed one. With a two-stage generalized least squares parameters can be found using the random effect procedure.

Even though, the need for a distribution assumption on the inefficient effect is curtailed in panel data models, it is shown that if the form of inefficiency distribution is known maximum likelihood techniques or corrected ordinary least squares can be applied to attain more efficient estimates of the parameter vector and the inefficiency scores for each productive unit. Literature suggest either a normal-half-normal or a normal-truncated distributive forms. (Murillo-Zamorano, 2004).

With the use of either a cost or a production function under the application of the duality theorem, most contemporary empirical works states their stochastic frontier functions using a Cobb Douglas, a Fourier flexible or a translog function. Translog functions are nonetheless the most used. The snag is the correct choice of objective function in modeling; that is whether to utilize a cost function or a production function as instruments of measuring efficiency scores. However, researchers are guided by such factors as data obtainability, the nature of production sets and exogeneity assumptions to decide on which objective function to employ, (Murillo-Zamorano, 2004).

2.2.2 Mathematical Linear Programming Methods

This technique differs in structure and use from the parametric models. It assumes a zero absolute value for randomness, so that all unexplained variations are treated as inefficiency. The non-parametric approaches are simple and easy to use since it does not involve specification of functional form, (Coelli, 2004). Hence, in contrast to the econometric approaches which attempt to determine the absolute efficiency of firms against a formulated standard, the mathematical programming approach seeks to evaluate the efficiency of units relative to other entities in the same industry.

To evaluate the efficiency of cooperative financial institutions two DEA models are employed i.e. Charnes–Cooper–Rhodes (CCR) model and Banker–Charnes–Cooper (BCC) model. CCR model was proposed by Charnes et al. (1978) which is based on Farrell (1957) theory of piecewise-linear convex hull approach to frontier estimation. The model assumed constant return to scale (CRS) to measures the efficiency of each decision making unit (DMU) relative to the other DMUs in the sample with multiple-outputs and multiple-inputs. However, this model is appropriate when all DMUs are operating at an optimal scale. This

restriction was relaxed by Banker et al. (1984) since not all producers are operating at an optimal scale and regulation policies, imperfect competition and constraints of finance may cause the producer to be not operating at optimal level. Therefore, Banker et al. (1984) extended the CCR model to account for variable return to scale (VRS).

The efficiency measure estimated in CCR and BCC models are referred to as technical efficiency (TE) and pure technical efficiency (PTE) respectively. BCC model forms a convex hull of intersecting planes that envelop the data points more tightly than the CCR conical hull, therefore the technical efficiency score using the CCR model is always greater than or equal to those obtained using the BCC model (Coelli, et al., 2005). By dividing TE to PTE it is possible to derive the Scale efficiency (SE) which expresses how close the DMU is to the optimal scale. If there is a difference in the CRS and VRS technical scores for a particular DMU, then it means that the unit has scale inefficiency.

Assumptions regarding the functional form of the production function or distribution of error term are not needed in DEA (Coelli, 1996; Sarafidis, 2002; Andreu and Grunnewald, 2006; Cooper, Seiford and Tone, 2007). Thus, the question of miss-specifying the frontier does not arise, which is one of the advantages of DEA when compared to SFA. DEA can be applied for multi-output and multi-input data. Another advantage of DEA is that it works well with small samples (Pasiouras, Sifodaskalakis and Zopounidis, 2011). A disadvantage of the DEA approach is that it does not take into account the possible influence of measurement errors and other noise upon the frontier; all deviations from the frontier are assumed to be the result of technical inefficiency (Coelli et al., 1998; Sarafidis, 2002).

The limitation above can be overcome by applying the bootstrap procedure to correct the bias in DEA estimators of technical efficiency and establish their confidence interval (Simar and Wilson, 1998, 2000). The method of bootstrapping uses the efficiency scores produced by DEA as an a priori for inefficiency in a hierarchical Bayes estimation of a stochastic frontier, (Simar and Wilson, 1998: Green, 1993). The basic idea is that the estimated bootstrap distribution will simulate the unknown distribution of the efficiency parameters, (Worthington, 1999; Annim, 2010). This, however, can be estimated using the Tobit model or ordinary least square regression (Ajibefun, 2008; Gul, Koc, Dagistan, Akpinar and Parlakay, 2009; Binam, Sylla, Diarra and Nyambi, 2003; Hoff, 2007).

DEA is also sensitive to outliers. Outliers can cause problems in both DEA and SFA, but for different reasons: while with DEA it is probable to find too much inefficiency in the sample, SFA can fail to discover any inefficiency at all. The solution to this limitation in both approaches is to remove the outliers from the analysis and proceed without them.

DEA is ideal for analyzing the public service sector including non-profit organizations where the objective of profit maximization and cost minimization may not be considered a vital issue. It also gives useful peer information about identical units working under similar environmental conditions. This is captured by controlling for environmental factors during the estimation, (Izah, Sudin and Nor Mazlina, 2009; Charnes, Cooper and Rhoades, 1978; Hassan, Vivas, and Pastor, 2000). The main strength of DEA estimation is that it does not require any theoretical imposition of the form of which the economic behaviour of observed units should take. Nonetheless, it is criticized on the grounds that it does not provide for the possibility of accounting for statistical noise or measurement errors in the model; more so, efficiency results are very sensitive to outliers and shocks. Not providing for the possibility of

making statistical noise implies estimates cannot be used for any statistical inference, (Mester, 1997; Murillo-Zamorano, 2004).

Since both parametric and non-parametric techniques have their own merits and the true level of efficiency is unknown, the choice of a suitable estimation method has been quite controversial. Some researchers (e.g. Ferrier and Lovell, 1990; Bauer et al. 1998; Eisenbeis et al., 1999; Huang and Wang, 2002) argue that it is not necessary to have a consensus on which is the best method for measuring frontier efficiency. Instead, they recommend a checking process which uses more than one methodology to assess the robustness of results. This methodological cross-checking provides useful information and diagnosis for regulatory analysis and the decision maker.

2.3 Determinants of Efficiency

In the literature, the efficiency of a financial institution is usually expressed as a function of internal and external determinants. The internal determinants originate from accounts (balance sheets and/or profit and loss accounts) and therefore could be termed micro determinants of efficiency. The external determinants are variables that are not related to management but reflect the economic and legal environment that affects the operation and performance of financial institutions. A number of explanatory variables have been proposed for both categories, according to the nature and purpose of each study.

Studies dealing with internal determinants employ variables such as size, capital, age, and risk management (Casu and Molyneux, 2003; Casu and Girardone, 2004; Ataullah and Le, 2006; Ariff and Can, 2008). One of the most important questions underlying bank policy is which size optimizes bank efficiency. Generally, the effect of a growing size on efficiency

has been proved to be positive to a certain extent. However, for financial institutions that become extremely large, the effect of size could be negative due to bureaucratic and other reasons. The need for risk management in the banking sector is inherent in the nature of the banking business. Changes in credit risk may reflect changes in the health of a bank's loan portfolio (Cooper, et al., 2003), which may affect the performance of the institution, since poor asset quality is the single most important cause of bank failures. During periods of increased uncertainty, financial institutions may decide to diversify their portfolios in order to reduce their risk. However, the results of the existing literature are better described as mixed, with studies like Altunbas, et al., (2000) suggesting that efficiency is not very sensitive to credit risk, and others like Hughes and Mester (1993) reporting an opposite result. Variables that describe the macroeconomic environment, such as inflation, interest rates and gross domestic product, and variables that represent market characteristics, ratio of private investments to GDP, fiscal deficits to GDP (Ataullah and Le, 2006).

2.4 Efficiency and Outreach

Brown, et al., (2005) defines outreach as efforts made to extend microfinance services to unbanked people and can be measured in breadth or depth. Breadth measures the number of clients served and the provided volume of services, meanwhile depth measures the range of socioeconomic levels of the clients. Cooperative financial institutions can achieve an increase in depth of outreach by providing financial services to the most vulnerable individuals such as women and the poorest of the poor.

As discussed in Schreiner (2002), outreach may have several dimensions, such as the value a cooperative financial institutions loan has for the client (i.e. the worth of the loan), the cost of

the loan to the client, the breadth of outreach, length of outreach and the scope of outreach. Yet, as Schreiner (2002) concludes, many of these dimensions are difficult to measure. Second, Paxton (2003) correctly argues that loan size may be related to the term or type of the loan granted, and/or it may be related to the lending methodology of the cooperative financial institutions. Using average loan size as a measure of outreach means that cooperative financial institutions targeting service and trading activities will be classified as having better outreach than cooperative financial institutions focusing on manufacturing and agricultural activities, assuming that the latter types of activities require larger loans on average.

Reaching the poor and providing them with credit may be very costly. Making very small loans involves high transaction costs, in terms of screening, monitoring and administration costs, per loan. Several authors therefore argue that the unit transaction costs for small loans to the poor are high as compared to unit costs of larger loans (Hulme and Mosley, 1996; Conning, 1999; Paxton and Cuevas, 2002; Lapenu and Zeller, 2002). Thus, there may be a trade-off between efficiency and outreach, implying that the shifting focus towards increasing sustainability and efficiency reduces the scope for the more traditional aim of many cooperative financial institutions, which is lending to the poor.

2.5. Economies of Scale

Economies of scale (or returns to scale) refers to the rate at which output changes as all factor quantities are varied and measures whether firms with similar production and managerial technologies are operating at an optimal size (Molyneux, et al. 1996). Specifically, economies of scale (or increasing returns to scale) exist, over a given mix of outputs, if a proportionate increase in firm's outputs would lead to a less than proportionate increase in its total costs.

Conversely, diseconomies of scale (or decreasing returns to scale) arise if a proportionate increase in a firm's outputs would lead to a more than proportionate increase in its total costs. Constant returns to scale occur if a proportionate increase in a firm's outputs would lead to the same proportionate increase in its total costs.

Economies of scale actually are based on the shape of the average cost curve. Each short-run average cost curve represents the average cost of different-size firms during a short period of time. The firm will choose the size that yields the lowest average cost for that particular level of output. The long-run average cost curve is traced out from the SACs where each point of the LAC is to a point of tangency with a corresponding short run cost curve and it shows the least cost method of production for any level of output. Scale economies appear as the slope of an average cost curve indicating how costs vary with output (Humphrey, 1990). The downward-sloping LAC reflects economies of scale, because average costs of production decline as output increases. This cost characteristic exists only up to a certain firm size known as the minimum efficient scale (MES). The upward-sloping LAC indicates diseconomies of scale, because the average cost of production increase as output increases. In general, technical efficiency can be further decomposed into measures of pure technical efficiency (PTE) and scale efficiency (SE).

2.6 Inputs and Outputs of Financial Institutions

There are different ways of modeling inputs and outputs for efficiency analysis in the production process. The commonly used in bank efficiency analyses are the production approach (Benston, 1965; Berger and Humphrey, 1991) and the intermediation approach (Sealey and Lindley, 1977).

2.6.1 Production Approach

The production approach was first introduced by Benston (1965) and Bell and Murphy (1968) and further advanced by Berger and Humphrey (1991). It views banks as producing diverse categories of deposits (e.g. savings) and loans (e.g. consumer and commercial) and other services for account holders using physical inputs such as physical capital (K), labour (L), materials, floor space etc. (Mester, 1987; Colwell and Davis, 1992). The outputs are best measured by the number and type of transactions processed within a specified period. This model highlights banks' commercial behaviours where they provide services for account holders, making this approach to be also called service provision approach (Bergendahl, 1998). The production approach emphasizes the operational activity of the bank, and thus banks are primarily viewed as providers of services to customers.

In relation to the input set, only physical inputs such as labour and capital or their associated costs should be included, since only physical inputs are needed to perform transactions, process financial documents or provide other types of services to customers. Interest costs are excluded from this approach on the grounds that only the operational process is of interest. Benston, et al., (1982, p.9) noted that "while interest is an important outlay to the bank, it is determined by market forces that reflect alternative investments available to depositors. Thus, interest is not an operating expense for purposes of measuring banks' efficiency". The output of this approach represents the services provided to customers and is best measured by the number and type of transactions or documents processed over a given time period. It is common to group the transactions according to the level of resource consumption, to their complexity or to their purpose, which can help the interpretation of the efficiency results.

However, such detailed transaction flow data is not generally available, and data on the stock of deposit and loan accounts is often used instead, as a proxy for the level of services provided. In addition, there is a lack of consensus on the output definition as the number and/or value of accounts (whenever data on the number of transactions is not available).

Most analysts argue that although the value of the accounts may affect to some extent the operational costs, the number of accounts dealt with determines primarily the operational costs. The main drawback of using as output the number of accounts is that the banks can have a significant number of so called 'dead accounts', which are not used and almost do not have deposited funds. This situation can arise when the depositors work with two or more banks. Different arguments have been put forward for using the value of accounts as the output measure: banks compete to increase their market share regarding the monetary value intermediated, as opposed to the number of accounts, and large accounts can be more costly than small accounts since they tend to be more active.

The production approach is the most widely used in the analysis of bank branches' efficiency. One of the reasons why the production approach has rarely been used for efficiency studies at the bank level is the difficulty encountered in collating accurate data. The type of data needed for this approach is not openly available in the majority of countries, as the information required by supervision authorities and published by the banks is mainly financial. In this approach, the total costs of the bank include only operating expenses neglecting interest expenses paid on deposits and revenues since deposits are regarded as outputs anyway, and only physical inputs are required to carry out transactions or offer other types of services (Camanho and Dyson,1999).

2.6.2 Intermediation Approach

The intermediation model of Sealey and Lindley (1977) views financial institutions as agents, liaising funds between demand sources (investors) and supply sources (savers), by using inputs such as labour and physical capital (and sometimes equity capital) to convert financial capital such as deposits and other funds/liabilities into loans, securities, investment and other earning assets. In this sense, the bank is producing intermediation services. The currency (monetary) units of the bank's assets in various categories of loans and investments represent outputs, while inputs accounts for the financial costs involved in liabilities. Both operating and interest costs combine to form total cost of the bank (Ferrier and Lovell, 1990). There are variant subdivisions of the intermediation approach such as the asset approach (Sealey and Lindley, 1977), the user-cost approach (Hancock, 1985, 1991) and the value-added approach (Berger et al., 1987; Berger and Humphrey, 1992). The intermediation approach may be the most relevant technique for analyzing overall institutional efficiency since it accounts for interest expense and may be superior at evaluating profitability (Berger and Humphrey, 1997). Classification of inputs and output variables in the intermediation approach are done below.

2.6.2.1 Inputs

In standard microeconomics, labour is commonly considered a resource to the production of an output. Labour is here represented by staff (personnel) expenses and includes wages and salaries, social security fund contributions (benefits), pension expenses, training and other staff costs (provident fund contributions, medical expenses, retirement benefits). An alternative measure of labour is the average number of full-time employees on payroll during a year, as used, for instance, by Luo (2003). Labour expenses are commonly used in the literature (Kenjegalieva, et al., 2009a; Murillo-Melchor, et al., 2009).

Physical capital, also a standard input in microeconomics, is represented by the value of fixed assets (FA) which is the book value of all property, plant, machinery, equipment, fixtures and premises purchased directly by the bank or acquired by means of a capital lease measured at cost, less accumulated depreciation and impairment losses. The fixed assets have been used by several authors to proxy physical capital: Havrylchyk (2006), Kenjegalieva, et al., (2009a), Chiu et al. (2009) and Assaf, et al., (2011a).

Deposits involve all customer demand deposits, savings deposits and call deposits as well as current accounts from individuals and corporations. As aforementioned, there is a controversy as to whether deposits are inputs or outputs (Berger and Humphrey, 1997). Deposits are here considered as an input following Hughes and Mester (1993).

2.6.2.2 Outputs

Loans and advances (shortened as loans) are earning assets that reflect the lending activity of banks, including credits to both businesses and households. Loans, as used in this study, me individual loans, residential-mortgage loans and staff loans as well as other loans, less provision for impairment. To account for loan quality, loans and advances are stated at the amount of principal and interest outstanding less any provision for bad and doubtful debts and interest held in suspense.

Other Earning Assets (OEA) is an aggregate for fees and commissions, derivative assets, trading assets, pledged assets, shares, short-term Government securities (treasury bills or government bonds and other eligible bills), medium-term investment in other securities, investment-in-associated companies (or equity investments), investments in property,

investment securities available-for-sale and other investments. These variables have output characteristics because they are generated using the resources available to the bank.

2.7 Empirical literature Review of Efficiency

The empirical literature review is grouped as follows: commercial banks, microfinance, and cooperative financial institutions.

2.7.1 Commercial Banks

Kyj and Isik (2008) investigate the x-efficiency and scale efficiency of commercial banks in Ukraine over the period from 1998 until 2003 using the DEA technique. They estimate both a common efficiency frontier for all banks and separate efficiency frontiers for each bank size group (small, medium and large). They find that efficiency scores are significantly correlated between the common and separate frontier results. Their results also show that the average technical efficiency is only 47% and that the dominant source of inefficiency is driven by poor management decisions (pure technical efficiency) rather than there being any scale inefficiencies. They also examine the impact of size and ownership location factors on the efficiency of the Ukrainian banking sector. Here they find that large banks tend to be more pure technically efficient but less scale efficient than small banks. Moreover, the results suggest that joint venture banks with majority foreign ownership appear to be the most efficient and that a bank's geographic location is also an important determinant of its relative efficiency.

Frimpong (2010) also examined the relative efficiency of banks in Ghana during the year 2007 using input oriented intermediation-based approach of DEA estimation technique. The author employed the Charnes, Cooper and Rhodes (CCR) model to highlight average

efficiencies across the surveyed Ghanaian banks; both overall and by group. The results of the survey showed that only four out of a total of 22 banks were efficient, implying 18% of the banks studied; of which three were relatively new and small domestic private banks and the other being a foreign entity. The study found the overall mean technical efficiency score to be 74% whilst domestic private banks were portrayed to be the most efficient group of banks with an average of 87% efficiency score followed by the 72% of foreign banks. The overall average technical inefficiencies, according to the author, ranged between 12.36 and 90 percent, implying that average banks consumed 12.36 - 90 percent more resources than was needed to get to the same levels of output if they had been efficient. The lowest performing banks were found to be state-owned banks which according to the author can be attributed to lower tendencies of achieving efficiency by management of state-owned banks.

Ferrier and Lovell (1990) analysed the cost structure of 575 U.S. banks by applying both the SFA and DEA methodologies. They find that both DEA and SFA methodologies generally draw similar conclusions on the level of average cost efficiency. One interesting result they find is that the DEA cost efficiency score is usually higher than the SFA efficiency score. This result seems to contradict the expectation that the DEA model generally returns higher inefficiency scores than the SFA model (Coelli, et al., 2005).

Ferrier and Lovell (1990) explain this outcome by suggesting that the DEA frontier is sufficiently flexible to envelop the data more closely than the translog cost frontier. When they decompose cost inefficiency into technical inefficiency and allocative inefficiency, both techniques lead to different conclusions on the magnitudes of the above two inefficiency scores. Furthermore, the rank correlation coefficients between DEA and SFA technical efficiency and cost efficiency are 0.014 and 0.017, respectively, and are not significantly

different from zero. Thus, the efficiencies derived from DEA and SFA do not lead to consistent rankings. Ferrier and Lovell (1990) argue that the linear programming model and stochastic frontier model differ both in structure and in implementation and that the debate over the attractiveness of the two approaches will be substantial and will continue for some time.

Resti (1997) provides further evidence on European banking efficiency. He examines cost efficiencies for a panel sample of 270 Italian banks using multiple frontier techniques. He shows that the mean efficiency scores range from 66% to 76% under both DEA and SFA, and also that there is a very high positive correlation for score rankings between the two approaches. Based on these similarities, Resti (1997) argues that results obtained from DEA and SFA do not differ substantially. Moreover, he reports that efficiency gaps exist when efficiency values are grouped by geographic areas and bank size. Specifically, DEA and SFA generate very similar results grouped by geographic area classes but the results grouped by size classes are not consistent. Resti (1997) also reports that for the Italian banks he studied DEA scores (variable returns to scale model) increase as bank size increases. In contrast, the econometric approach yields results in the opposite direction; namely, that the efficiency of Italian banks declines with the size of the affected banks.

Eisenbeis, et al. (1999) estimate the cost efficiencies of a sample of 254 large US bank holding companies over the period 1986-1991. In order to compare the robustness of the results obtained, they employ both a stochastic frontier approach and a linear frontier approach. They find that DEA inefficiency scores are two or three times larger than those generated by SFA, averaging 30% for DEA as against 15% for SFA. After banks are classified into size-based quartiles, they find that the level and variation of smaller banks'

inefficiency scores on average are higher than those of larger banking firms. Moreover, the inefficiencies seem to persist over time. However, the persistence results are significantly greater for the linear programming estimates than they are for the econometric estimates. Furthermore, the efficiency rank-order correlations between the two approaches range from a low of 0.44 to a high of 0.58. Eisenbeis *et al.* (1999) conclude from this that significant differences may arise in the efficiency measures provided by the DEA and SFA techniques. Another contribution of Eisenbeis, et al., (1999) is to explore the "informativeness" of the efficiency scores estimated by the DEA and SFA techniques. For both techniques they examine the relationship between bank efficiency and their risk-taking behaviour, managerial competence and stock returns. They find that the SFA estimates have more explanatory power than the DEA estimates in explaining banks' risk-taking behaviour, managerial competence and stock price return behaviour. Summing up, they conclude that both parametric and non-parametric efficiency estimates produce reasonably well and "informative efficiency scores". However, the SFA estimates should be given more weight in assessments of banking efficiency than those provided by the DEA methodology.

Delis and Papanikolaou (2009) measure the cost and profit efficiency for 28 Greek commercial banks over the period from 1993 until 2005. Their results show that the DEA average cost efficiencies are much lower than those of SFA. Both approaches indicate that there is a positive relationship between cost efficiency and size, but the findings regarding the effect of ownership status are contradictory between the two approaches. Finally, they conclude that the efficiency scores obtained from the various methods are substantially different over time.

2.7.2 Microfinance Institutions

Quayyum and Ahmad (2006) used DEA to estimate the efficiency and sustainability of microfinance institution working in the South Asian countries of Bangladesh, Pakistan and India. They considered both inputs oriented and output oriented methods by assuming both constant returns and variable returns to scale technologies. The variables selected were divided into different groups based on location, basic characteristics – age and size, financial management and performance to estimate variants of efficiency – technical efficiency, pure technical efficiency and scale efficiency. They assumed that the large and more experienced firms may perform better than those having less experience and with smaller size whilst higher debt-equity ratio (as a proxy for financial management) represented a reduction in firms' efficiency. Assuming both constant returns to scale (to measure technical efficiency) and variable returns to scale to estimate pure technical efficiency, the authors applied both correlation and regression analysis in the study and the result showed that the size of the MFI is significant in determining both Technical and Pure Technical Efficiency levels. Some other interesting findings were made concerning intra and inter-country comparisons. In Pakistan, for instance the results showed that three MFIs were efficient when constant returns to scale was assumed whilst estimating under the assumption of variable returns to scaled showed that eight MFIs were efficient frontier. The average input oriented efficiency scores were technical efficiency, 39.5%, pure technical efficiency 82.3% and scale efficiency 51.8%. For the output oriented measures, 39.5% was estimated for technical efficiency, 71.3% for pure technical efficiency and 56.8% for scale efficiency.

In Bangladesh estimates show that the average input oriented and output oriented measures were equal for the technical efficiency, 8.7% which implies that the microfinance units were operating under constant returns to scale. In India, average input and output oriented

measures were also close. It was also concluded that Bangladesh could best minimized the use of input without affecting the existing output level of loan portfolio followed by India and Pakistan. However, under the output oriented measures the Indian MFIs could improve their output level more than those in Bangladesh and Pakistan (58.7%, 44.5 and 28.7 % respectively) with the existing level of input.

2.7.3 Co-Operative Financial Institutions

Worthington (1998) and Esho (2001) utilised the parametric stochastic frontier approach to analyse 150 credit unions in Australia for the year 1995. He notes that large well capitalised credit unions with small branch networks are more efficient. Esho (2001) analysing 80 credit unions located in New South Wales notes that there is little improvement in average efficiency over the period 1985 to 1993.Furthermore cost efficiency is positively correlated with average loan size and capital strength. No significant relationship emerges between asset size and efficiency.

Frame and Coelli (2001) employ a stochastic cost frontier to investigate US corporate credit unions for the period 1992- 1997. They find that 91% are cost efficient, with those credit unions investing a greater proportion of their assets in a centralised fund (US Central Credit Union)being most efficient. Furthermore, cost efficiency declines after the imposition of safety and soundness measures introduced by the regulator in 1995.

Mester (1993) investigated the differences in efficiency of mutual and stock savings and loan industry in U.S. by using stochastic cost frontier with a specification of translog cost function. A total of 1015 samples of savings and loans for analysis were obtained from the Federal Reserve Board for the year 1991. The study identified that stock savings and loans

were less efficient than mutual savings and loans. The study also revealed that higher capital-asset ratio was correlated with greater efficiency in both mutual and stock savings and loans and uninsured deposits was correlated with lower efficiency.

2.8 The Concept of financial Cooperatives

In its statement on co-operative identity, the International Co-operative Alliance defined co-operatives as autonomous associations of persons united voluntarily to their common economic and social needs through jointly-owned and democratically controlled enterprise. Cooperative societies are community based, self-controlled and self-funded cooperative financial institutions (Simkhada, 2004) because they are meant to operate at the micro level in most cases to serve the low level strata of the economy, to people who in most cases lack access to formal banking system. Financial Co-operatives are financial organizations that are owned and controlled by the members and they provide savings and credit services to their members in the community (Sharma, et al., 2005). Co-operatives are a form of microfinance institutions owned by group of people who are the members and they provide small scale financial services – majorly savings and loans – just like any other microfinance institutions to their members. Co-operative societies, also known as credit co-operatives, credit unions, financial cooperatives, and savings and credit co-operatives could be government sponsored, members sponsored or program sponsored (Ghosh and Maharjan, 2001; Simkhada, 2004).

Depending on the phase of development of financial cooperatives in a country, they may range from formal cooperative banks to semiformal financial cooperatives and credit unions to informal village-based savings and loan entities. They are owned by members and follow a one-member one-vote principle as provided for by. The higher-level financial cooperatives at the regional or state and national levels are owned by member cooperatives and voting is

often according to share capital invested by the member organizations. Small local cooperatives are usually managed by voluntary members on a part-time basis. Bigger cooperatives have paid managers and staff, but the members still elect among themselves the management organs of the cooperative. In their original form and still nowadays, locally-based small financial co-operatives provide only basic products, that is, loans and savings. These products are often the most important financial services for low-income households. However, the range of services needed by the membership, and provided by more advanced financial cooperatives even in developing countries, can be much larger, including payment services, such as money transfers and remittances, insurance, and term savings. Although financial cooperatives were originally established to facilitate credit for poor households, savings services are also very important. Financial co-operatives provide safe facilities for savings, enabling savers to smooth consumption, prepare for emergencies, gradually accumulate financial resources, self-finance the purchase of durable goods, and make investments (Turtiainen, 2008).

Financial c-operatives can be divided into two distinct groups, that is, (a) savings and credit co-operatives and their networks (also referred to as cooperative banking), and (b) credit unions (Turtiainen, 2008). Both are member-based organizations, but they have differences arising from their historical origins and main target groups. They also have associated themselves into different national and international organizations. However, as these organizations have aged, become larger, and developed nearly the same services as ordinary banks, the differences between them have become more blurred (Makori, etal., 2013).

2.8.1 A Brief Overview of the Financial Cooperatives Sector in Ghana

This section discusses the various categories of cooperative financial institutions in the semi-formal and informal sectors in Ghana. These institutions are required to register as legal entities but are not licensed by the Bank of Ghana. Since Credit Unions (CUs) are better organanised than other cooperative financial institutions, it would be the main focus of this study.

2.8.1.1 Semi-formal institutions

In September 1955, the first credit union in Africa was formed at Jirapa in the North-West now the Upper West Region of Ghana. The idea was introduced by Reverend Father John McNulty, an Irish Canadian. Credit unions are registered by the Department of Cooperatives as thrift societies that can accept deposits from and give credit to their members (Jean et al., 2005; 5). Credit Unions were initially established as institution-based organizations or aimed towards people on regular incomes. In recent times however, CUs have opened up to a wider variety of clients in the community where they are based. The apex body of the CUs, the Ghana Cooperative Credit Union Association (CUA) regulates the interest rates that CUs have to pay on members savings and charge on loans, perhaps reflecting the initial welfare nature of credit unions (Andah, 2005).

Ghana Co-operative Credit Unions Association (CUA) established in 1968 as an apex body of the cooperative credit unions, the Ghana Co-operative Credit Unions Association (CUA) Limited regulates and supervises credit unions in the country on behalf of the Bank of Ghana. CUA also provides financial and technical assistance to its members including services such as education and training, auditing, bookkeeping, computer related services, general supervision and risk management insurance. There is a requirement for credit unions to

deposit a percentage of their funds in statutory reserves and deposit guarantee schemes with the CUA. Credit unions in Ghana are faith-based, work- based or community- based organizations. There are 446 Credit unions in Ghana having a membership of about 437,520 with USD 214,190,192 worth of assets (WOCCU, 2012).

2.8.1.2 Informal Financial Co-operative Systems

The informal financial sector is made up of organizations or persons engaged in financial services beyond the scope of banking and formal financial institutions (Aryeetey, 1994). They are neither licensed nor regulated by the financial regulators and their transactions hardly ever involve any legal documentation, Transactions are usually based on verbal and oral agreements (Ashley, 1986; Steel et al., 1997). Consequently, informal financial systems are usually physical proximity and relationship-based. This helps to reduce information asymmetry, default and enforcement costs which are applied through social sanctions, peer pressure and interlinked transactions (Onumah, 1998). Informal financial systems encompass a wide range of financial activities; itinerant deposit (susu) collectors, rotating savings and credit associations (ROSCAs).

An association called the Ghana Co-operative Susu Collectors Association (GSCCA) made up of individual susu collectors has been set up and it is gradually spreading its influence nationwide. Ghana Cooperative Susu Collectors Association (GCSCA) otherwise known as Susu, are groups of organized individuals, households and any members of the community alike who have mutually agreed to save their money either on a daily or weekly basis depending on the sale of their produce or commodities or incomes. The GCSCA was established in 1994 as an overall organization to look after the activities of Susu's. Its head office is in Accra, Ghana with regional offices and branches all over the ten regions of the

country. The mission of the Association is to continuously protect the interest of susu collectors by promoting the cooperative concept of the association, standardizing their operations maintaining and improving the business of the members and by becoming professional financial service providers particularly the informal sector of Ghana (Onumah, 1998).

2.8.2 Savings and Credit Co-operative Societies (SACCOs)

Savings and credit cooperatives are the far most common financial cooperatives in rural areas both in developed and developing countries. They belong to a group of co-operatives that are commonly called Raiffeisen cooperatives due to the German originator of this movement in the 1800s (Tache, 2006). Their original purpose was to provide small loans to poor farmers or small entrepreneurs, but especially in the developed world they have grown to become banks.

Although originally serving only their members, they now are open also to non- members. Borrowers must, however, usually become members and buy at least one share. In this respect then SACCOs as they are commonly referred to act as intermediaries as observed by Magill (1994) between surplus and deficit members which proposition is also shared by Cox (1996). While savings and credit co-operatives in developing countries often are small and village-based, their counterparts in advanced countries have grown from village-based organizations to full-scale banks.

These institutions generally furnish their members with convenient and secure means of saving money and obtaining credit at reasonable rates of interest (Kabuga and Batarinyebwa 1995). This observation is further supported by Bailey, (2001) .These banks now are in most developed countries under central bank supervision although supervision is usually delegated

to the national level federation or apex bank. This role, sometimes seen as a burden by the financial cooperatives, has been accompanied by broad authorization to enter the financial markets. Cooperative banks can now provide almost all financial services, and they are especially strong in collecting savings, which are the principal source of their funds for lending operations, so much so that they manage in some countries from 20-40 percent of the funds in the deposit markets (Germany, The Netherlands, Ireland, Finland, etc.). The co-operative banks are nearly always federated and/or have joined an apex bank in their respective countries (such as DZ Bank in Germany, Rebo bank in the Netherlands, Credit Agricole in France, and Desjardins in Canada.) Internationally they belong to the International Cooperative Banking Association, a Raiffeisen organization based in Switzerland (Balkenhol, 2007).

An apex bank is typically a national level cooperative bank, owned by the primary financial cooperatives and occasionally also by other shareholders. In federated countries, secondary-level co-operatives may appear at the state level. An example of the expansion of activities is the Finnish cooperative banking movement. In the early 1960s, it consisted of some 450 cooperative savings and credit societies and their apex bank. The societies transformed into cooperative banks in the mid-1960s, expanding their operations into all activities allowed for banks. The movement now controls about 32 percent of financial markets in Finland. Having met all the prudential and legal requirements of the banking law and being very profitable, the movement even purchased the largest insurance company in the country in 2005 (Makori, etal, 2013).

2.8.3 Credit Unions

Credit unions are defined by Berthoud and Hinton (1989) as being co-operative societies that offer loans to their members out of the pool of savings that are built up by the members themselves. This is a descriptive definition that does not refer to the purpose of credit unions. However, it does describe them as being co-operatives; therefore co-operative principles could be inferred as being the purpose of credit unions. The unique ownership status implicit in this definition (member run, owned and used) led to them being described by Croteau (1963) as being the purest form of co-operative.

Credit unions are entirely member-based organizations, only serving people who do belong to the credit union. The common bond, that is the basis for a credit union, ties members together and is expected to make them more responsible for their own and their peers‟ affairs. This bond is usually the place of employment or a profession (large companies, teachers, etc.), but it can also be a geographic area, though this has been quite rare until recently. Although savings and credit cooperatives also talk about having a common bond, it is usually based geographically on a village, group of villages, or a town and its surroundings (Kabuga and Batarinyebwa, 1995).

Again, World Council of Credit Unions (WOCCU) defined credit unions as non-bank financial institutions owned and controlled by members. It is also a democratic, member-owned financial co-operative. Each member, regardless of account size in the credit union, may run for the board and cast a vote in elections. As financial intermediaries, credit unions finance their loan portfolios by mobilizing member savings and shares rather than using outside capital, thus providing opportunities for generations of members. Credit unions exist to serve their members and communities. As not-for-profit cooperative institutions, credit

unions use excess earnings to offer members more affordable loans, a higher return on savings, lower fees or new products and services. They serve members from all walks of life, including the poor and disenfranchised (Balkenhol, 2007)).

Ferguson and McKillop (1997) contrasted credit unions to other similar types of financial institution. They stand in stark contrast to the more dominant form of organisation found in industrial societies that is based on speculative gain of a private or corporate kind. These dominant forms of organisation include banks, building societies and other mutuals. Credit unions are not only different to other financial/mutual institutions but are also quite different to the normal type of cooperative. They collect savings from members by issuing shares, and use these funds to make loans to the members. Therefore, the credit union not only acts as a 'purchasing' but also as a 'marketing' co-operative. The main difference between credit unions and other cooperatives is that cooperatives either purchase from external entities for the members, or sell to external entities for the members, whereas the users, management and benefactors of credit unions can only be its members.

All transactions are effected for members by members, no external party can transact with the credit union (unless members become non-qualifying then restrictions are placed on the transactions that can occur with that body). It is for this reason that Croteau (1963) described credit unions as being the purest form of co-operative.

Because credit unions in developing countries have not been controlled by the central banks (any more than savings and credit societies), they do not need to comply with prudential ratios enforced on formal financial institutions, their product scope, that is, the services they have been allowed to offer, has been limited, usually to one or two forms of savings (besides

shares all members have to buy) and, similarly, to one or two types of loans. Particularly in developing countries, the credit unions have had simple but clear internal regulations, including rules for the minimum deposit a borrower must have and how long he/she must have been a member before being entitled to a loan. For the sake of simplicity the interest rates were originally uniformly determined, and for instance for loans they were one percentage point for each month. This internal regulation or guideline had to be changed when high-level inflation hit most countries in the 1970s and 1980, and since then the credit unions have determined their interest rates according to their profitability targets (Bailey, 2001).

In countries where there are a substantial number of credit unions, they are affiliated to their own apex organizations, such as the Credit Unions National Association in the United States. Internationally nearly all credit unions are affiliated to the World Council of Credit Unions (WOCCU), usually through their national federations. It is important to note that larger credit unions, especially in the developed countries, have been able to expand their operations and services to resemble those provided by banks, including the cooperative banks (Balkenhol, 2007).

2.8.4 Trends in the Development of Credit Unions

The observations on co-operative development show how market conditions have led to changes in the development of co-operatives. In Credit Unions, in particular, similar development trends and problems can be observed. These include:

- Co-operatives start as local institutions operating in a given community or radius. At this stage the organizational principle is based on the common bond between members. This common bond is based on parish, community, occupation and ethnic

membership. Business at this stage is strictly membership trading. At this stage the Credit Union is highly competitive, because members offer voluntary services and are highly motivated.

- A further stage in the development of the Credit Unions is the interaction between primary Credit Unions. This is the basis for developing secondary or tertiary Credit Union organizations. Through this a central fund is set up and cooperation with other institutions is further developed (Kirsch and Goricke, 1977).Another growth pressure is the decision as to the type of business in which to engage. In Canada for instance, the credit co-operatives had to decide to stay as savings and loans institutions with only membership trading and limited services or as financial institutions providing full financial services. This was because of strong competition from other financial institutions (Jordan 1980).

McKillop, et., al. (1997) have also chronicled a three-stage Credit Union industry development. According to them, Credit Unions move through three industry stages of development "nascent" through "transitional" and finally to a "mature" stage of development. The nascent industry represents a stage of development in which Credit Unions are seen as self-help organizations. Hence, they are not just financial oriented but organizations with a strong social purpose. Key attributes of this stage include small asset size, tight common bond between members and emphasis on voluntarism. Transition Credit Union industries mark the stage in which the seeds of change within Credit Unions are sown. The characteristics of the industry show a relaxation of co-operative philosophy and ideals. This is caused by the need to achieve cost efficiencies and scale economies owing to asset growth and competition in the market. The mature stage brings to an end the development path of Credit Unions. According to McKillop, et al., (1997), the key attributes of this stage indicate

a Credit Union with large asset size and a less restrictive interpretation of the common bond requirement for members. There is a trend toward a well organized central services and diversification of products, professionalism of management instead of voluntarism. There is tendency for Credit Unions to adopt the features of the main stream financial institutions.

2.8.5 Distinguishing Features of Financial Cooperatives (SACCOs)

Cooperative organizations are a special type of economic entities whose objective is to maximize the members' welfare/benefits. In a typically co-operative organization, members are also users of the service(s). For example in a credit co-operative, the services may be exclusively for members, who have a common bond through an associational, occupational or residential relationship. Prospective clients need to be a qualified member first before they can take advantage of saving or borrowing services from the co-operative (Fried, Lovell and Eeckaut, 1993). The implication of this unique and voluntary model is that the objective of a typical cooperative may not necessarily reflect the standard neoclassical assumption of profit maximization in the theory of a firm. Instead, the objective of the co-operative is to pursue both economic and social objectives.

In its simplest form, a financial co-operative is both a producer co-operative and a consumer cooperative. It is a producer co-operative when accepting savings from the members, and a consumer cooperative when it is providing loans to the members. This suggests that profit maximization may not be an appropriate objective function since there are no non-members to exploit (Fried et al., 1993). As such, SACCOs are treated as if they are seeking to maximize benefits to the members, where the maximum benefit is defined as service provision (loans and deposits mobilization) subject to resources available and given operating environments.

SACCOs are responsible to provide savings services to the depositors and loans services to the borrowers. In providing these services, SACCOs incur costs in hiring and retaining human resources, office space and other operating expenses. On the other hand, because of the social objective orientation of the SACCOs, they occasionally receive voluntary services in terms of free labour and sponsorship or donations from the government, community and other philanthropical organizations. While the first set of inputs may be relatively easier to quantify, voluntary services and subsidies are tricky to capture and are not reflected in the audited financial statements of SACCOs. We acknowledge that the prevalence and depth of the voluntary services and subsidies if they are not included in modeling process may lead to upward bias of the empirical estimate of the performance. However, for this study it was not possible to capture the value of voluntary labour and subsidies, which may or may not affect our estimates depending on their actual prevalence (Balkenhol, 2007).

2.8.6 Co-operative Finance and Best Practices

Efficiency in CFI is a question of how well a CFI allocates inputs such as staff, assets and subsidies to produce the maximum output such as number of loans, financial self-sufficiency and poverty outreach. The level of efficiency can be established on the basis of inputs and output.

Based on theoretical and empirical research, financial soundness has a close relationship with the efficiency of financial institutions (Berger and Young 1997; Das and Ghosh 2006). Many risk methodologies for financial institutions show that capital adequacy, liquidity, asset quality, maintaining effective financial structures, profitability, and efficiency of management are key indicators of financial soundness. These indicators have an effect on the efficiency of financial institutions Das and Ghosh 2006). Although, interpretations of indicators and

categories vary between studies, these indicators are important for maintaining financial strength with risk management processes.

The above argument also applies to CFIs. Although they are small, transparency is necessary to build the confidence of customers (Llewellyn 1998). With respect to SFIs, inadequate management that results in deficiencies in control of activities creates programmes that do not provide efficient services in developing countries and these may be unsustainable (Hulme and Mosley 1996). In Sri Lanka, the recent financial institution collapses could signal that ineffective financial practices were applied within these institutions.

The level of efficiency can be established on the basis of inputs and output variables: number of clients, number of loan officers, number of staff members, administrative expenses, number of loans, loan sizes and composition of overall loan portfolio and so on, (Balkenhol, 2007). The pursuance of best practice connotes the pursuance of efficiency; as a matter of fact, best practice and efficiency has been used interchangeably in literature.

According to Nghiem, et al., (2006), an efficient co-operative finance institution, and for that matter, a best practice CFI is the one that is able to meet both objectives of poverty reduction and financial sustainability requirements. Literature attests to the fact that the pursuit of efficiency has become more imperative due to recent competition in the microfinance sector. Whilst the debate ensues as to whether a focus on efficiency may or may not result in mission drift which could spell doom for the poor and the disadvantaged; this study follows the path of others who toll the middle contours to assert that efficiency should rather enhance mission, (Brau and Woller, 2004).

For most that are not in agreement with the pursuit of economic efficiency, the focus on efficiency will almost certainly crowd out scarce means from the less privileged and will only shift resources into the hands of the well-to-do. In effect, the focus on economic efficiency is most certainly income bias (Tariq, et al., 2008; Hermes, 2009). Even though, the trade-off between equity and efficiency is widely recognized, the argument is that its pursuit (cost efficiency) in co-operative finance should rather make resources readily available to the overall society. This is because inefficient co-operative finance institutions either engage in incorrect methods that does not yield the needed result, serve loans to very risky clients, take high interest charges on loans served (which discourages further borrowing), or engage in inappropriate management practices such as embezzlement, and or simply do not monitor activities to ensure full scale impact. These bring about high transactionary costs which are borne mostly by the active clients.

For instance, Vega, (2003) cited in Martinez-Gonzalez (2008) suggest that because there are potentially few technically trained staff in the field of microfinance, available funds may be misapplied. The lack of incentive packages could also influence the behaviour of staff and managers while, lapses in decision making and policy implementation, incorrect regulation and inappropriate intervention by donors, incorrect product designs and methodologies all create massive wastes.

Inefficiency can also come as either, through misappropriation of inputs or when large firms engage in operations best suited for smaller firms and vice versa, and or when there is favouritism in the choices of market agents, (Baumol and Blinder, 1994). The improvement of the microfinance sector will not be made possible when wastes persist, Martinez-Gonzalez, (2008).

2.9 Summary

Overall, the empirical evidence from the recent literature generates mixed results for the comparison of frontier efficiency techniques. Some studies find a strong relationship between the findings of the different techniques, whilst others report a lack of consistency between the parametric and non-parametric approaches. But there are nonetheless some consensuses in the literature. First, these articles demonstrate that neither the nonparametric nor parametric method have an absolute advantage over the other.

Nevertheless, in certain specific situations, depending on the number of units in the sample or on the amount of noise and inefficiency in the data, some estimation techniques may outperform others. Second, because each approach has specific advantages and disadvantages in comparison to other approaches and the efficiency measures derived from different methods offer valuable information, it is advisable to use the parallel application of competing methods to cross check results. The robustness or otherwise of the results should give the decision maker more useful and reliable information. Third, the comparison of different methods within the same categories shows more consistent results than that between different categories. Given the above conclusions, this study proceeds with an empirical analysis which uses both parametric and non-parametric techniques applied to Chinese banks over an extended period of time in order add to the empirical evidence which is available in the area.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter focus on how the various questions posed by the study are going to be answered: the method of estimation, the procedure for measuring scores of efficiency and the mode of analysis are considered in this section. A look will also be taken on the source of data collection and the sample period that will be captured by the study.

3.1 Theoretical Stochastic Frontier

Stochastic production frontier may be seen as an answer to the deterministic parametric frontier models, where deviations of a producer from the theoretical maximum are allocated exclusively to inefficiency. The type of efficiency that can be measured using a production frontier is technical efficiency. At this stage, the main advantage of the stochastic frontier is that it can decompose the deviation from the frontier into stochastic noise and technical inefficiency in production. The maximum output which producers can obtain is determined by two parts: the production function as well as random external factors. Thus, deviations from the production frontier might not be completely under the control of producer (Greene, 2007a).

3.1.1 Technical efficiency

The stochastic frontier model or production function in efficiency studies is used in this study to estimate the technical and cost efficiency of financial cooperatives. Econometricians have estimated average production function for a very long time. However, with the pioneering but independent work of Farrell (1957), serious considerations have been given to the possibility

of so-called frontier production and cost functions in an effort to bridge the gap between theory and empirical work (Aigner, Lovell and Schmidt, 1977).

The modeling, estimation and application of stochastic frontier production functions to economic analysis assumed prominence in econometrics and applied economics analysis during the past two decades (Ojo, 2003). Battase and Corra (1977) applied this technique to the pastoral zone of Eastern Australia. This study followed Battese (1992) and Battese and Coelli (1995) models to specify a stochastic frontier production function. The stochastic frontier model was originally proposed independently by Aigner *et al*., (1977) and Meeusen and Van dar Broeck (1977) and it is specified as follows;

$$Yi = f(Xi;\beta)\exp(Vi - Ui) \quad (1)$$

Where $i = 1, 2, 3, ...n$

Where Y_i is the output of the i^{th} CFI, X_i is the Kx1 vector of the input quantities, $f(X, \beta)$ is an appropriate production function like Cobb Douglas or Translog, β is the coefficient vector of X_i, V_i is the random error having zero mean (associated with random factors like measurement error, weather, animal destruction) not under the control of CFIS' control. U_i is a one sided error term called the inefficiency. The two components of V_i and U_i are assumed to be independently distributed. U_i is the non- negative random variables which are assumed to be identically independently distributed with half or normal truncations in mean and variance δ^2_u, $U_i \sim N(\mu, \delta^2_u)$. The inefficiency ($U_i$) determinant function is as specified as

$$\mu = \gamma_0 + \gamma_1 R_i + w_i \quad (2)$$

Where R_i is the vector of factors affecting the efficiency level, γ is the vector of parameters, and w_i is the error term. Early studies estimated using a two-step procedure (Pitt and Lee, 1981, Kalirajan, 1981), however, this method has been criticized that it violates the assumptions of error term. The common and widely used procedure is to estimate both

equations in a single stage procedure using the frontier programme (Battese and Coelli, 1995).

Selection of the functional form to represent the data and the distributional term of the error depends on imposition of restrictions (Coelli, 1992). Log likelihood test are conducted to select the appropriateness of the model to represent the data. The Null hypothesis forms the restricted version and alternative is the unrestricted form; the results are compared with critical values (Kodde and Palm, 1986).

Following Jondrow *et al*., (1982) technical inefficiency (TI) for individual cooperative financial institutions(observation) is given by the expected value of Ui (inefficiency) conditional on $\varepsilon = (V_i - U_i)$ this is defined by;

$$TI=E\left(\frac{U_i}{\varepsilon}\right)=\frac{\sigma_u\sigma_v}{\sigma}\left(\frac{f(\varepsilon_i\lambda/\sigma)}{1-F(\varepsilon_i\lambda/\sigma)}-\frac{\varepsilon_i\lambda}{\sigma}\right) \quad (3)$$

Where E is the expectation operator, f (.) and F (.) are the standard normal density and distribution functions, respectively evaluated at $\frac{\varepsilon_i\lambda}{\sigma}$. Whiles $\sigma_u^2 = \sigma_u^2 + \sigma v^2$ and $\lambda = \frac{\sigma_u}{\sigma_v}$,

U_i represents the inefficiency term associated with given and ε; is the error term associated with both random and CFIs specific inefficiencies. Technical efficiency of a given CFI is defined to be the ratio of observed output (Y_i) to the corresponding frontier output (Y_i*) using the available technology and so the technical efficiency of the CFI is denoted by;

$$TE = \frac{Y^*}{Y}$$

$$TE = \frac{Yi = f(Xi;\beta)\exp(Vi - Ui)}{Yi = f(Xi;\beta)\exp Vi}$$

$$TE = E[\exp(-U_i)] \quad (4)$$

For technical efficiency to occur exp $V_i = 1$ and $U_i = 0$ since exp (0) = 1. Thus TE has values that range between 0 and 1, with 1 defining efficient CFIs and 0 inefficiency CFIs. It should be noted that the larger the U_i, the less the technical efficient the co-operative financial institution.

3.1.2 Cost Efficiency

In line with Berger and Mester (1997), we measure cost efficiency as how close a co-operative financial institutions cost is to what a best practice CFI's cost would be for producing the same output bundle under the same conditions. We use stochastic frontier and more specifically, we use the Battese and Coelli (1995) SFA model. Moreover, the cost function can be derived from a product function and input prices, see e.g. Sheppard (1970). The cost-function approach is the dual of the production function approach. Moreover, the cost function approach assumes that banks minimize costs, while the production-function approach assumes that banks maximize output. The cost function approach is more appropriate in a competitive environment where input prices are given and demand determines output.

The precise specification of the cost-function of a CFI is debatable. Several models have been used in the literature (e.g. Benston, 1965 and Sealey and Lindley, 1977).The general BC model specifies stochastic cost frontier with the following properties

$$\text{Ln } C_{it} = C(y_{it}, w_{it}, qt; \beta) + u_{it} + v_{it} \qquad (5)$$

Where $C_{i,t}$ is the total cost CFI i faces at time t and $C(y_{i,t}, w_{i,t}; \beta)$ is the cost frontier. In this model cooperative financial institutions efficiency is measured relative to a global best practice frontier. Within the cost frontier, $y_{i,t}$ represents the logarithm of output of cooperative

financial institutions i at time t, $w_{i,t}$ is a vector of the logarithm of input prices of CFI i at time t, q are country specific variables and β is a vector of all parameters to be estimated. The term $u_{i,t}$ captures cost inefficiency and has a truncated normal distribution. $v_{i,t}$ captures measurement error and random effects, e.g. good and bad luck, and are distributed as a standard normal variable. Both $u_{i,t}$ and $v_{i,t}$ are time and cooperative financial institution specific. The stochastic inefficiency term is defined as

$$U_{it} = \delta_0 + \sum \delta_n Z_{nit} \qquad (6)$$

Where, *z* represents the vector of *n* variables that determine the inefficiency of MFI *i* at time *t*. δ's represent the coefficients to be estimated. The inefficiency term is posited generally as having either a half normal distribution, truncated normal, exponential or a gamma distribution, (Murillo-Zamorano, 2004 Hermes, et al. 2009). In this study, it is assumed that the inefficiency term follows a half normal distribution as typified in most econometric works. The expected value of the u_i*'s* conditional on the composed error term is measured as follows:

$$E\left[\frac{U_i}{\varepsilon_i}\right] = \frac{\sigma\lambda}{1+\lambda^2}\left[\frac{f_s(\varepsilon_i\lambda/\sigma)}{F_c(-\varepsilon_i\lambda/\sigma)} - \frac{\varepsilon_i\lambda}{\sigma}\right] \qquad (7)$$

Where *fs* (.) is the density of the standard normal distribution and *Fc* (.) is the cumulative density function, (Murillo-Zamorano, 2004). To yield consistent parameters of the above equations, the maximum likelihood estimation procedure will be used as it is also typified in most research works. The restrictions imposed by the model leads to various interesting results; such as the value of $\sigma = \left(\sigma_u^2 + \sigma_v^2\right)^2, \lambda = \frac{\sigma_u}{\sigma_v}, \gamma = \frac{\sigma_u^2}{\left(\sigma_u^2 + \sigma_v^2\right)^2}$

σ = total variation

σ_u^2 = variation due to inefficiency

σ_v^2 = variation due to noise

λ = the ratio of the standard deviation of the inefficiency component to that of the noise component. How high the value of lambda is, expresses how strong the evidence of the presence of inefficiency in the data is.

γ = specifies the ratio of the variation due to inefficiency to the total variation. With a parametric restriction between 0 and 1, a high gamma also represents the explanatory power of inefficiency in total variation. (Radam et al, 2010).

Additionally, a log-likelihood ratio test is also conducted to ascertain whether the estimated frontier model is robust. This is a test to show the significance or otherwise of the inefficiency component. The null hypothesis; which states that there is no inefficiency (*H0: $\mu=0$*) is tested against the alternative hypothesis; *H1: $\mu>0$*. If the null hypothesis is true the stochastic frontier model reduces to an OLS model with normal errors.

3.2 Specification of Variables

Variables to be selected for this study have been grouped into three; namely, input variable, output variables, and control variables. The intermediation and production approaches are used as guide in the selection of inputs and outputs. The variables are shown on table 1below.

Table 1: Input and output variables for SFA technical and cost efficiency estimation

PRODUCTION APPROACH	
Variable	**Definition**
INPUTS	
Number of Staff (ST)	It is made of total number of full time employees
Materials (CB)	Total expenses less personnel and interest expenses
Outputs	
Number of loans(NL)	Total number of borrowers for each co-operative.
Deposits (D)	Total deposits of members

Table 1 Continued

Prices	Definition
Salary of staff(SA)	It is measured as total expenses on personnel divided by the total number of full time employees.
Price of (PCB)	Total expenses less personnel and interest expenses divided by deposits
INTERMEDIATION APPROACH	
Variable	**Definition**
Inputs	
Number of Staff (ST)	It is made of total number of full time employees.
Volume of deposits(D)	Total deposits of members of a particular co-operative
Materials (CB)	Total expenses less personnel and interest expenses
Outputs	
Gross loan portfolio (GLP)	Volume of loans granted to members in a particular year.
Number of borrowers (BRW)	Total number of borrowers for each co-operative.
Total income (TY)	Income from traditional and non-traditional activities.
Volume of investment(INV)	Investment in shares, treasury bills and CUA house bonds.
Prices	
Salary of staff(SA)	It is measured as total expenses on personnel divided by the total number of full time employees
Interest expenses (R)	It is total cost of funds divided by deposits held.
Price of materials (PCB)	Total expenses less personnel and interest expenses divided by deposits.

3.3 Control Variables

The control variables selected for this study are mainly micro based variables. The micro-institutional variables used in this research are shown below.

Table 2: Control variables

Control Variable	Definition	Apriori Expectation
NIM	Net interest margin measured as interest income less interest expenses divided by total assets.	-
ALB	Average loan balance measured as total volume of loans divided by number of borrowers.	-
SZ	Size measured as logarithm of total assets.	+
LI	Loan intensity measured as total volume of loans divided by total assets.	+

Table 2 Continued.		
LD	Loan deposit ratio measured as total volume of loans divided deposits.	-/+
BPS	Borrower per staff measured as number of borrowers divided number of full time employees.	+
IYTY	Interest income total income ratio measured as total volume of loans divided by total income.	+
DPS	Deposit per staff obtained by dividing deposits by number of full time employees.	+
ln D	Growth in deposits measured as natural logarithm of deposits.	-/+
AG	Age	+
ROA	Return on assets	+

3.4 Empirical Model Estimation

The empirical estimation framework of this study is as follows:

3.4.1 SFA Technical efficiency

There exist a number of functional forms in literature for estimating the production and cost function. This includes the Cobb-Douglas, translog, quadratic and transcendental production functions. The Cobb-Douglas functional form is simple, popular and is frequently used to estimate cooperative financial institutions efficiency despite its known weaknesses (Dawson and Lingard, 1991; Kalirajan and Obwona, 1994). However, it imposes a severe prior restriction on the cooperative financial institution's technology by restricting the production elasticities to be constant and the elasticities of input substitution to unity (Wilson et al, 1998). The translog functional form is more flexible in permitting substitution effects among inputs and is said to be relatively dependable approximation to reality (Giulkey, Lovell, and Sickles, 1983). Some of the weaknesses of the translog model are its susceptibility to multicollinearity and potential problems of insufficient degrees of freedom due to the

presence of interaction terms. The interaction terms of the translog also do not have economic meaning (Abdulai and Huffman, 2000).

In this study, the Cobb-Douglas frontier model is estimated for analysis notwithstanding its well-known limitations (Bravo-Ureta and Pinheiro, 1993; Battase and Hassan, 1999; Hassan, 2004) since it is not difficult to estimate and manipulate mathematically. Besides, Kopp and Smith (1980) have indicated that functional form has a distinct but rather very small impact on estimated efficiency. The specific models estimated are given by:

Production Approach :

$$\ln QP_{it} = \beta_0 + \beta_1 ST_{it} + \beta_2 \ln CB + V_{it} - U_{it} \quad (8)$$

Where $lnQP_{it}$ is the log of number of loans and deposit of i^{th} cooperative financial institution at time t, *lnST* is the log of number of staff, and *lnCB* is the log of materials, and β's are the parameters to be estimated.

Intermediation approach

$$\ln QIit = \beta_{0it} + \beta_{1t} \ln ST_{it} + \beta_{2t} \ln CB_{it} + \beta_{3t} \ln D_{it} + V_{it} - U_{it} \quad (9)$$

Where $\ln QI_{it}$ is the log of the volume of loans plus investments, number of borrowers and total income in a cooperative financial institution unit, lnST is the log of the value of staff, lnCB is the log of materials, lnD is the log the volume of Deposits, the β's are the parameters to be estimated.

3.4.2 Cost Efficiency

Production Approach

$$\ln TCP_{it} = \beta 0 + \beta_1 \ln D_{it} + \beta_2 \ln NL_{it} + \beta_3 \ln SA_{it} + \beta_4 \ln PCB_{it} + V_{it} + U_i \quad (10)$$

$TC_{i,t}$ represents total costs cooperative financial institution *i* faces at time *t*, *D* represents the deposits ,*NL* is number of loans, *SA* is the price of labour, and *PCB* is price of cost per borrower. *TC* is measured as the total expenses of a cooperative financial institution.

Intermediation Approach

$$\ln TCI_{it} = \beta 0 + \ln\beta_1 GLP_{it} + \beta_2 \ln BRW_{it} + \beta_3 \ln TY_{it} + \beta_4 \ln INV_{it} + \beta_5 \ln SA_{it} + \beta_6 \ln R_{it} + \beta_7 \ln PCB_{it} + V_{it} + U_{it} \quad (11)$$

TC represents total cost i^{th} CFI faces at time t, BRW represents the number of borrowers, TY is total income, INV is investment SA the price of one unit of labour for one year, R_{it} is the interest payment per deposits held, and PCB is the price of materials. *TC* is measured as the total expenses of a CFI.

3.5 Determinants of technical efficiency models

Once the relative efficiencies have been calculated, the determinants of the SFA efficiency scores can be investigated into. It is customary that SFA efficiency scores are regressed on the relevant control variables (Luoma et al., 1998; Fethi, et al., 2000; Chilingerian, 1995; Hwang and Oh, 2008). Since the SFA efficiency score lies in the interval 0 and 1, the dependent variable is 'a limited dependent variable'. Therefore, it is apt to use the Tobit model, which is a censored regression model, applicable in cases where the dependent variable is constrained in some way. The Tobit model may be defined as:

$$y_0^* = \beta' x_0 + \varepsilon_0$$
$$y_0^* = y_0^* \text{ if } y_0^* \text{ iff } 0 \text{ otherwise} \quad (12)$$
$$y_0 = 0, \varepsilon_0 \gg N\left(0, \sigma^2\right)$$

Where x_0 and β are the vectors of explanatory variables and its coefficients respectively, y_0 and y_0^* and are the vectors of the observed SFA efficiency score and the vector of the latent variable. Thus, the Tobit model used in this study for determinants of technical and cost efficiency may be specified as

$$EE = \delta 0 + \delta_1 NIM_{it} + \delta_2 ALB_{it} + \delta_3 SZ_{it} + \delta_4 LI_{it} + \delta_5 LD_{it} + \delta_6 BPS_{it} + \delta_7 IYTY_{it} + \delta_8 DPS_{it} + \delta_{19} BPS_{it} + \delta_{10} LAG_{it} + \delta_{11} ROA_{it} + \varepsilon_{it} \quad \textbf{(13)}$$

Where EE= Efficiency scores,

NIM= Net interest income, ROA=Return on assets,

ALB= Average loan balance,

SZ= Size,

LI= loan intensity,

LD= Loan deposit ratio,

BPS=borrowers per staff,

IYTY=Interest income total income ratio,

DPS= Deposits per staff,

LND= Natural log of deposits,

AG= Age.

3.6 Mode of Analysis

Descriptive statistics of data as well as cost and production frontiers were obtained using the computer software Excel 2007 and maximum likelihood estimates of the parameters were obtained using Frontier 4.1 developed by Coelli. The estimation of results and analysis proceeded in this format: to facilitate the computation of the annual and overall mean efficiency index for the sampled financial cooperative institutions, efficiency indices was computed per annually across the different sets of financial cooperative institutions. Based on the computed ratios, benchmarking of the CFIs was conducted. The average efficiency indices were finally regressed on the control variables selected to determine the factors that affect efficiency in the industry.

3.7 Data Sources

One hundred and eighty eight sampled units will be included in the study from the broad spectrum of financial cooperatives in Ghana over the period of 2009 to 2012. The four year period is chosen not only to set analysis and understanding to current trends in the field of cooperative finance; but it is assumed that most of the institutions were in full operation and have consistent data for the sample periods. The limitation study is the availability of data which affected the sample size. Data will be mainly sourced from Association Credit of Unions (CUA).

CHAPTER FOUR

EMPIRICAL ANALYSIS AND DISCUSSION OF RESULTS

4.0 Introduction

Given the premise of the study, this chapter will give a presentation of the results and then analyses the estimated results on the variants of efficiency. The general aim of this study is to analyse cost and technical efficiency of cooperative financial institutions in Ghana; and to do this, 66 units were selected. The full sample observation is 188 units. The results are generated by the use of the statistical packages Frontier 4.1. The presentation of the results is as follows: first, the results of the cost model will be presented which will then be followed by that of the production frontier model. The two estimated results will help give a fair idea of the operational performance of the CFIs which will be useful for benchmarking. The final part of the chapter will investigate the drivers of efficiency and discuss the results.

Table 3 contains a summary statistics of the variables used in the study. Huge variability is observed in the variables used in the study in the cost and production functions. All the financial figures are in new Ghana cedi. The descriptive statistics of the variables are provided in table 3 as can be seen from the means, minimums, maximum sand, and coefficients of variation.

Table 3: Summary of Descriptive statistics of variables used in the study

Variables	Mean	Minimum	Maximum	Coefficient of variation
Total operating cost	172,658.46	3451.92	2,052,816.00	1.42
Personnel expenses	38130.41	210.00	489,279.4	1.55
Cost of funds	54,626.600	179.94	711,603.90	1.79
Total income	219,904.33	3797.00	2557762	1.54
Number of borrowers	571.55	9.00	5872	1.46
Number of staff	7.00	1.00	56	1.12
Gross loan portfolio	852,744.67	6,450.00	16406415	2.26

Table 3 Continued

Investment	367,280.45	2,710.00	4175211	1.66
Deposit	13503.31	0.01	12642985	1.44
Materials expenses	345.65	0.0006	1235980.00	2.8774
Salary of staff	5325.000	132	73548.92	1.285
Interest paid on funds	0.044	0.0002	0.537774	1.273
Price of materials used	3.882472	4.78E-06	26540.25	1.5231

All financial figures are in new Ghana Cedi (GHS)

From the table 3 it can be shown that the cost on personnel and interest payment on member deposits constitutes a greater share of the operating cost of firms, although the average number of staff per CFI is small.

4.1 Estimation of Technical Efficiency Frontier Models

The production frontier models used in this study to estimate technical efficiency by approach are production approach and intermediation approach.

4.1.1 Technical Efficiency Model Production Approach

The results of the maximum likelihood estimates of the parameters of the Cobb–Douglas Stochastic frontier function for production indicates that all the parameters are positive and significant at 95% confidence interval. The sum of the elasticities of the input variables to output of 0.995 approximately shows constant returns to size. The likelihood ratio test result also shows that the null hypothesis is to be rejected for the alternative hypothesis of the existence of inefficiency in the observed behaviour of units sampled. LR test of the one-sided error of 5.109 compared with a critical value of 2.706 (Kodde and Palm, 1986) at 5% shows the strength of the technical efficiency frontier model to estimate the relationship between observed variables in the industry. Table 4 gives the report of the coefficient of the estimated model.

Table 4: Maximum Likelihood estimates Technical efficiency production

PRODUCTION APPROACH			
VARIABLE	Coefficient	standard error	t
CONST.	12.358***	0.430	28.728
ln of Staff	0.932***	0.076	12.341
ln of Materials	0.063	0.071	0.893
sigma-squared	1.427***	0.282	5.070
gamma	0.660***	0.135	4.904
LR test of the one-sided error	5.109		
log likelihood	-247.466		

Where *, **, and *** indicate 10%, 5%, and 1% significance respectively. Source: Field Survey 2014

Table 4 shows that all the variables except materials (CB) under production approach are statistically significant at 95% confidence interval but it has positive effect on technical efficiency. The value of gamma (0.660) indicates a significant variation in technical inefficiencies. The estimated value of gamma implies 66.0% of the total variation in the level of total output is due to the presence of inefficiency.

4.1.2 Technical Efficiency Model Intermediation Approach.

The results of the maximum likelihood estimates of the parameters of the Cobb–Douglas Stochastic technical frontier function for intermediation approach indicates that all the parameters are positive and significant at 95% confidence interval. The sum of the elasticities of the input variables to output of 1.055 approximately shows constant returns to size. The likelihood ratio test result also shows that the null hypothesis is to be rejected for the alternative hypothesis of the existence of inefficiency in the observed behaviour of units sampled. LR test of the one-sided error of 7.229 compared with a critical value of 2.706 (Kode and Palm, 1986) at 5% shows the strength of the technical efficiency frontier model to

estimate the relationship between observed variables in the industry. Table 5 gives the report of the coefficient of the estimated model.

Table 5: Maximum Likelihood estimates of Technical efficiency intermediation

INTERMEDIATION APPROACH			
VARIABLE	Coefficient	standard error	t-ratio
CONST.	5.408***	0.961	5.626
ln Staff	0.310***	0.105	2.953
ln Deposits	0.548***	0.076	7.229
ln materials	0.187***	0.075	2.480
sigma-squared	1.385***	0.219	6.325
gamma	0.508***	0.112	4.519
LR test of the one-sided error	7.229		
log likelihood	-259.448		

Where *, **, and *** indicate 10%, 5%, and 1% significance respectively. Source: Field Survey 2014

Table 5 shows that all the variables are statistically significant at 95% confidence interval. The value of gamma (0.508) indicates a significant variation in technical inefficiencies. The estimated value of gamma 0.508 implies 50.8% of the total variation in the level of total output is due to the presence of inefficiency.

4.1.3 Average Technical Efficiency over Time

Overall, the distribution of technical efficiency scores for production technology show that efficiency ranges from 17.5% to 75.0% across the sampled units between 2009 -2012 with an average of 53.40%. The cooperative finance units therefore exhibited significant differences in inefficiency from 25.0% to 82.5%. The average technical efficiency score indicate that on the whole, the average microfinance unit can increase output by 46.60% and with the same inputs. The mean annual efficiency scores from 2009-2012 for production approach are 48.02%, 53.0%, and 53.89% and 57.96% respectively. The consistent rise in the scores indicates an improvement in technology.

A frequency distribution of technical efficiency scores of the CFIs calculated over the 4year sample period is presented on the following frequency table. Analysis shows that the majority of the sampled units had efficiency ratio falling between the efficiency level of 0.41 and 0.64. This shows that greater number (64%) of financial cooperatives scored between 41% and 64% from 2009 to 2012.

Table 6: Frequency Distribution Technical Efficiency Production Approach

Efficiency levels (%)	Frequency	Percentage	Cumulative Frequency
17-28	4	0.06	4
29-40	7	0.11	11
41-52	21	0.32	32
53-64	21	0.32	53
65-76	13	0.20	66
Mean	53.43%		
Minimum	17.50%		
Maximum	75%		

Source: Field Survey 2014

Table 6 portrays generally average levels of cost efficiencies across the CFIs in the combination of inputs to produce expected output.

Similarly, the distribution of technical efficiency scores for intermediation technology show that efficiency ranges from 30.0% to 84.95% across the sampled units between 2009 -2012 with an average of 57.96%. The cooperative financial units therefore exhibited significant differences in inefficiency from 15.05% to 70.0%. The average technical efficiency score indicate that on the whole, the average financial co-operative unit can increase output by 42.04% and with the same inputs. The mean annual efficiency scores from 2009-2012 are 55.12%, 56.84%, 59.13, and 60.07% for intermediation approach respectively. The consistent rise in the scores indicates an improvement in technology.

A frequency distribution of technical efficiency scores of the CFIs calculated over the 4year sample period is presented on the following frequency table. Analysis shows that the majority of the sampled units had efficiency ratio falling between the efficiency level of 0.54 and 0.61 for intermediation approach.

Table 7: Frequency Distribution of Technical Efficiency Intermediation approach

Efficiency Levels (%)	Frequency	Percentage	Cumulative frequency
30-37	1	0.02	1
38-45	2	0.03	3
46-53	12	0.18	15
54-61	30	0.45	45
62-69	18	0.27	63
70-77	2	0.03	65
78-85	1	0.02	66
Mean	57.96%		
Minimum	30.83%		
Maximum	84.95%		

Where *, **, and *** indicate 10%, 5%, and 1% significance respectively. Source: Field Survey 2014

Table 7 portrays generally average levels of technical efficiencies across the CFIs in the combination of inputs to produce expected output but on the average, intermediation scores are greater than production scores.

4.2 Cost efficiency Models

This section discusses the empirical results of cost efficiency.

4.2.1 Cost Function production approach

The results of the maximum likelihood estimates of the parameters of the Cobb–Douglas Stochastic Cost frontier function for production indicate that all the parameters are positive and significant at 95% confidence interval. The sum of the elasticities of the input variables to cost of 2.993 shows increasing returns to size. The likelihood ratio test result also shows that the null hypothesis is to be rejected for the alternative hypothesis of the existence of inefficiency in the observed behaviour of units sampled. The mixed chi square distribution of 15.227 compared with a critical value of 2.706 (Kodde and Palm, 1986) at 5% shows the strength of the cost frontier model to estimate the relationship between observed variables in the industry. Table 8 gives the report of the coefficient of the estimated model.

Table 8: Maximum Likelihood estimates of Cost Function production approach

Variable	Coefficient	Standard error	t-ratio
CONST.	-0.056	0.076	-0.739
ln Deposits	0.980***	0.008	115.8
Ln number of borrowers	1.004***	0.010	100.615
ln Salary	0.020**	0.010	2.024
ln price of materials	0.989***	0.010	102.36
sigma-squared	0.013***	0.002	7.130
gamma	0.681***	0.067	10.156
LR test of the one-sided error	15.22769		
Log likelihood	197.093900		
number of iterations = 11 Source: Field Survey 2014	number of iterations = 14		

Where *, **, and *** indicate 10%, 5%, and 1% significance respectively.

Table 8 shows that all the variables are statistically significant at 95% confidence interval. The value of gamma indicates that a significant variation in cost is due to differences in cost inefficiencies. The estimated value of gamma 0.681 that implies 68.1% of the total variation in the level of total cost is due to the presence of inefficiency.

4.2.2 Cost Frontier Model intermediation approach

The results of the maximum likelihood estimates of the parameters of the Cobb–Douglas Stochastic Cost frontier function for intermediation indicates that all the parameters are positive and significant at 95% confidence interval. The sum of the elasticities of the input variables to 1.299 shows increasing returns to size. The likelihood ratio test result also shows that the null hypothesis is to be rejected for the alternative hypothesis of the existence of inefficiency in the observed behaviour of units sampled. The mixed chi square distribution of 2.813 compared with a critical value of 2.706 (Kode and Palm, 1986) at 5% shows the strength of the cost frontier model to estimate the relationship between observed variables in the industry. Table 9 gives the report of the coefficient of the estimated model.

Table 9: Maximum Likelihood estimates of Cost Function intermediation approach

Variable	coefficient	Standard error	t-ratio
CONST.	0.804***	0.279	2.878
ln Gross loan portfolio	0.055**	0.027	2.051
ln Borrowers	0.202***	0.034	5.99
ln Total income	0.710***	0.025	27.550
ln Investment	0.064***	0.022	2.875
ln Salary	0.093***	0.029	3.139
ln Price of funds	0.063***	0.023	2.686
ln price of materials	0.112***	0.0284	3.937
sigma-squared	0.124***	0.0271	4.573
gamma	0.727***	0.139	5.222
LR test of the one-sided error	2.813314		
Log likelihood	-10.3530		
number of iterations = 11	number of iterations = 14		

Source: Field Survey 2014

Where *, **, and *** indicate 10%, 5%, and 1% significance respectively

Table 9 shows that all the variables are statistically significant at 95% confidence interval. The value of gamma indicates that a significant variation in cost is due to differences in cost

inefficiencies. The estimated value of gamma 0.727 implies 72.7% of the total variation in the level of total cost is due to the presence of inefficiency.

4.2.3 Average Economic Efficiency over Time

Overall, the distribution of economic efficiency scores for production technology show that efficiency ranges from 78.19% to 95.06% across the sampled units between 2009 -2012 with an average of 92.44%. The cooperative financial units therefore exhibited significant differences in inefficiency from 4.94% to 21.81%. The estimated value of gamma 0.681 for production implies 68.1% of the total variation in the level of total cost is due to the presence of inefficiency. The mean annual efficiency scores for production approach from 2009-2012 are 92.28%, 93.06%, and 91.73% and 92.79% respectively.

A frequency distribution of the economic efficiency scores of the CFIs calculated over the 4year sample period is presented on the following frequency table. Analysis shows that the majority of the sampled units had efficiency ratio falling between the efficiency level of 0.90 and 0.95 for production approach. This shows that greater number of financial co-operatives performed better in production.

Table 10: Frequency Distribution of Cost Efficiency production approach

Efficiency Level (%)	Frequency	Percentage	Cumulative Frequency
78-83	5	8	5
84-89	4	6	9
90-95	57	86	66
Mean	92.44%		
Minimum	78.19%		
Maximum	(95.06%%		

Source: field Survey 2014

Table 10 portrays generally high levels of cost efficiencies across the CFIs in the combination of inputs to produce expected output.

On the other hand the cost frontier model for intermediation approach shows that efficiency ranges from 23.68% to 90.55% with an average of 70.67%. This means that the financial co-operatives exhibited significant differences in inefficiency from 9.45% to 76.32%. The estimated value of gamma 0.727 implies 68.1% and 72.7% of the total variation in the level of total cost is due to the presence of inefficiency. The mean annual efficiency scores from 2009-2012 are 71.14%, 71.06%, and 70.79% and 70.40% respectively.

A frequency distribution of the cost efficiency scores of the CFIs calculated over the 4year sample period is presented on the following frequency table. Analysis shows that the majority of the sampled units had efficiency ratio falling between the efficiency level of 0.72 and 0.77 for intermediation approach.

Table 11: Frequency Distribution of Cost Efficiency Intermediation Approach

Efficiency (%)	Frequency	Percentage	Cumulative frequency
24-29	1	2	1
30-35	2	3	3
36-41	1	2	4
42-47	2	3	6
48-53	2	3	8
54-59	2	3	10
60-65	7	11	17
66-71	10	15	27
72-77	16	24	43
78-83	15	23	58
84-89	5	8	63
90-95	3	5	66
Mean	70.67%		
Minimum	23.68%		
Maximum	90.55%		

Source: Field survey 2014

Table 11 portrays generally low levels of cost efficiencies across the CFIs in the combination of inputs to produce expected output. On the average, intermediation scores are lower than production scores.

4.3 Determinants of efficiency

We analyse here the correlations between efficiency scores and standard performance measures in order to evaluate their consistency. Thus, if the frontier efficiency scores are correlated with some standard financial ratio measures of performance, then policy makers could be more confident that the measured efficiencies are accurate indicators of performance and not simply artificial measures resulting from the specific assumptions on which the efficiency measures are based (Bauer et al., 1998). Summary of descriptive statistics of the determinants of efficiency are shown on table 12 below.

Table 12: Summary of Descriptive Statistics of Determinants of Efficiency

Variable	Mean	Minimum	Maximum	Coefficient of variation
Net interest margin	0.27	-0.03	17.74	5.91
Average loan balance	2,874.59	0.02	108,734.60	3.21
Size	5.84	4.27	7.09	0.09
Loan intensity	0.75	0.02	24.13	2.35
Loans deposit ratio	1.11	0.03	35.59	3.31
Borrowers per staff	103.02	1.29	1211.00	1.43
Interest income total income ratio	2.05	0.09	91.36	4.38
Deposit per staff	190,789.50	13,270.13	1,339,879.00	0.91
Growth in deposit	13.34	10.19	16.35	0.09
Age	17.52	2.00	43.00	0.60
Return on assets	0.03	-0.15	0.85	2.48

All financial figures are in new Ghana cedis (GHS)

4.3.1 Determinants of technical efficiency

This section is to use Tobit regression of technical and efficiency scores and its determinants for both production and intermediation approaches. The correlates of technical efficiency are shown on table 13 below.

Table 13: Tobit regression of determinants of Technical efficiency by Approach

	PRODUCTION APPROACH				INTERMEDIATION APPROACH			
Variable	Coefficient	Std.Err	t	P>t	Coefficient	Std. Err.	t	P>t
NIM	-0.00035	0.0110	-0.03	0.975	0.0058	0.0105	0.55	0.580
ALB	-1.02E07	5.63E0	-0.18	0.856	-2.4E07	5.4E-07	-0.46	0.649
SZ	-0.1135***	0.0326	-3.46	0.001	0.1496***	0.0315	4.74	0.000
LI	-0.0143***	-46933	3.05	0.003	0.0183***	0.0045	4.04 0	0.000
LD	0.000706	31699	0.22	0.824	0.0033	0.0031	1.07 0	0.286
BPS	0.00021***	7.76E0	2.71	0.007	8.4E-06	7.5E-05	0.11	0.911
IYTY	0.000783	0.0018	0.39	0.694	0.0020	0.0019	1.09	0.278
DPS	4.7E-07***	4.35E8	10.82	0.0 00	5.7E-08	4.1E-08	1.38	0.170
LND	0.09283***	0.0141	6.44	0.000	-0.0499***	0.0138	-3.6	0.000
AGE	0.000534	0.0008	0.92	0.361	0.0009**	0.0005	1.72	0.088
ROA	-0.2549***	0.0783	-3.26	0.001	0.1394**	0.0749	1.86	0.064
_CONS	-0.1459**	0.0710	-2.06	0.041	0.3160***	0.0681	4.64	0.000
LR	272.750				112.86			
Prob > chi2	0.000				0.000			
Log likelihood	226.3168				235.472			

Where *, **, and *** indicate 10%, 5%, and 1% significance respectively. Source: Field Survey 2014

From table 13 net interest margin (NIM) has the expected sign under production approach as against intermediation approach. Net interest margin (NIM) is negatively related with technical efficiency. With regards to NIM, Demirguc-Kunt and Huizinga (1999) suggest that wider margins imply lower competition which reflects a degree of lower technical efficiency. The expected sign between NIM and CFI efficiency is negative. These results confirm previous findings for Brazil and Venezuela (Herrero, Santillan, Gallego, Cuadro and Egea, 2002, p. 13) and agree with the view that wider margins suggest lower competition. However, the intermediation approach suggests that net interest margin is positively related to technical efficiency but insignificant.

Average loan balance (ALB) an indicator of outreach has the expected sign in both approaches but are insignificant. This shows that financial co-operatives provide small loans to the poor. The smaller the average balances of the loan, the deeper the reach of the microcredit (Olivares-Polanco (2005), Cull et al., (2007), Roy et al. (2009)).

The size (SZ) of a financial co-operative does not have the expected sign in production approach positive under intermediation approach and is statistically significant. These mixed results suggest that under production approach small size financial co-operatives are technically efficient than large size financial co-operatives whiles large financial co-operatives are technically efficient in intermediation than small size financial co-operatives due economies of scale argument. That is, large co-operatives pursue goals of intermediation than production. Also technical efficiency is not necessarily linked with size but the quality of management and staff is critical.

Loan intensity (LI) is statistically and negatively related to technical efficiency in production approach but is positively related under intermediation. It reflects the lending intensity of financial co-operative and a positive relationship with technical efficiency is expected since loans are the main source of profits; however, the quality of the loans may deteriorate under some circumstances in which case a higher degree of loan intensity may be detrimental to technical efficiency. Isik and Hassan (2003) argue that the positive relationship between loan activity and CFI efficiency may be attributed to the ability of the relatively efficient CFI to manage operations more productively.

The variable loan deposit ratio (LD) measures the rate at which a co-operative converts its deposit into loans. It is positively related to technical efficiency in both approaches but more

significant in intermediation approach than production approach. The higher this ratio, the more efficient the process of financial intermediation provided by the CFI.

Productivity indicators borrowers per staff (BPS) and deposits per staff (DPS) have the expected sign but statistically significant in production approach than intermediation approach. This means that the ratios are higher in production. Growth in deposit (LND) is positively correlated with technical efficiency in production approach and negatively related to technical efficiency in intermediation. This shows that financial co-operatives high deposits rate are technically efficient in production whiles those with low growth rates are technically efficient in intermediation.

Age (AG) has positive coefficient in both approaches but significant under intermediation at 10%. This means that there is some evidence in intermediation models that an increase in age leads to an increase in technical efficiency. The positive coefficient suggests that technical efficiency improves as the financial co-operative institutions grow. This also goes to confirm the importance of training and experience in the industry, as the evidence shows the existence of a learning curve effects in the sector.

Lastly, the variable return on assets (ROA) has the expected sign only under intermediation. Measures of profitability are related to a good use of resources. We expect a positive relationship between those ratios and efficiencies. The results confirm previous finding for by Isik and Hassan (2002), as well as findings by Berger and Humphrey (1997). However the significant negative sign under production suggest that profitability reduces technical efficiency but it also signifies that there is a waste in the use of resources in production which reduces technical efficiencies. Finally, a negative and significant coefficient suggests larger CFIs are relatively cost inefficient possibly due to higher structural overloads

4.3.2 Determinants of cost efficiency by approach

The correlates of cost efficiency are shown on table 14 below.

Table 14: Tobit Regression of Determinants of Cost Efficiency by Approach

	PRODUCTION APPROACH				INTERMEDIATION APPROACH			
Variable	Coefficient	Std. Err.	t	P>t	Coefficient	Std. Err.	t	P>t
NIM	-0.00024	0.0083	-0.03	0.977	0.03269	0.02880	1.13	0.258
ALB	3.49E-07	4.2E-07	0.82	0.415	-3.9E06***	1.4E-06	-2.83	0.005
SZ	0.0760***	0.0249	3.05	0.003	-0.06442	0.082	-0.79	0.433
LI	0.007735**	0.0035	2.17	0.031	0.014047	0.011	1.2	0.231
LD	-0.0071***	0.0024	-2.98	0.003	0.01007	7.0E-03	1.27	0.205
BPS	-2.97E-06	5.89E0	-0.05	0.96	-0.00015	1.0E-04	-0.8	0.426
IYTY	-7.4E-05	0.0015	-0.05	0.961	-0.00715	0.00504	-1.42	0.158
DPS	-4.53E-08	3.31E0	-1.37	0.172	-2.5E-07***	1.0E-07	-2.37	0.019
ln D	-0.0284***	0.0109	-2.6	0.01	0.042132	0.03598	1.17	0.243
AG	-0.00047	0.0004	-1.05	0.294	-0.00097	0.00145	-0.67	0.506
ROA	0.1268**	0.0595	2.13	0.035	0.5916***	0.1962	3.02	0.003
_cons	0.8744***	9.0538	16.24	0.00	0.58002***	2.17700	3.2	0.001
LR	26.5				30.14			
Prob>chi2	0.0055				0.0015			
Log likelihood	278.2589				57.89501			

Where *, **, and *** indicate 10%, 5%, and 1% significance respectively Source: Field Survey 2014

From table 14 net interest margin (NIM) has the expected sign under production approach as against intermediation approach. However, the intermediation approach suggests that net interest margin is positively related to cost efficiency but insignificant. The positive coefficient is not in line with previous findings for Brazil and Venezuela (Herrero, Santillan, Gallego, Cuadro and Egea, 2002, p. 13) and agrees with the view that wider margins suggest lower competition that results in lower economic efficiencies (Dermiguc-Kunt and Levine, 1999). However, NIM has a significantly positive relationship with cost efficiency in intermediation. This finding suggests that managers allocate resources more efficiently to cut cost, but to the detriment of technical efficiency.

Average loan balance (ALB) an indicator of outreach has the expected sign in intermediation but both are significant approaches. The negative coefficient shows that financial co-operatives provide small loans to the poor which tends to lower cost efficiency. However, the significant positive coefficient means that the co-operatives grant huge loans to borrowers (rich and middle) in order to improve efficiency which is in contradiction with their goal of reducing poverty.

The size (SZ) of a financial co-operative has the expected sign in production approach but negative under intermediation approach which is statistically insignificant. The results suggest that under production approach large size financial co-operatives are cost efficient than small financial co-operatives due economies of scale argument. That is, large co-operatives pursue goals of cost efficiency in production approach to the detriment of intermediation. Also cost efficiency is linked with size and the quality of management and staff.

Loan intensity (LI) is statistically and positively related to cost efficiency in production approach. It reflects the lending intensity of financial co-operative and a positive relationship with cost efficiency is expected since loans are the main source of profits. Isik and Hassan (2003) argue that the positive relationship between loan activity and CFI efficiency may be attributed to the ability of the relatively efficient CFI to manage operations more productively to lower the ratio.

The variable loan deposit ratio (LD) measures the rate at which a co-operative converts its deposit into loans it is positively related to cost efficiency in intermediation but negatively related to cost efficiency in production approach. This is not in with Vu and Turnell (2011) who found a positive and statistically significant relationship between LD and cost efficiency,

which indicates that the banks with a higher ability to transform deposits into loans would be more cost efficient.

Productivity indicators borrowers per staff (BPS) and deposits per staff (DPS) do not have the expected sign but DPS is statistically significant in intermediation approach. This means that the productivity is low in intermediation. It also indicates that there is trade-off between technical and cost efficiency.

Growth in deposit (ln D) is positively correlated with cost efficiency in intermediation and is statistically and negatively related to cost efficiency in production approach. This shows that financial co-operatives with low deposits rates are cost efficient in production whiles those with high growth rates are cost inefficient. There is no evidence that high growth in deposits leads to cost efficiency intermediation.

Age (AG) has negative coefficient in both approaches but insignificant under in both approaches. This means that there is no evidence in the models that an increase in age leads to an increase in cost efficiency. The negative coefficient suggests that cost efficiency does not necessarily improve as financial co-operative institutions grow. This also goes to confirm that new CFIs can also achieve higher level of efficiency with strong fundamentals, rational policy and management.

Lastly, the variable return on assets (ROA) has the expected sign. Measures of profitability are related to a good use of resources. We expect a positive relationship between those ratios and efficiencies. The results confirm previous finding for by Isik and Hassan (2002), as well

as findings by Berger and Humphrey (1997). The significant positive signs suggest that profitability increases cost efficiency signifies the efficient use of resources.

4.4 Conclusions

In estimating cost and technical efficiency using Cobb- Douglas specification the following findings were made. For one, the increasing mean efficiency scores over the years for technical efficiency lend credence to improvements in the strategies of financial cooperatives in Ghana. This supports the findings of Annim, et al (2010) and Hag, et al (2010) who also find an improvement in the management decisions of CFIs. It is also evident that the maturity of firms affects efficiency. According to Vega (2008), CFI efficiency is strongly related to age through a positive learning curve.

Also the average technical efficiency scores in intermediation approach were higher than average technical efficiency scores in the production approach. But in the cost efficiency frontier the average scores in production approach were higher than the average efficiency scores in intermediation approach. Generally, the average cost efficiency scores were higher than the technical efficiency scores.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter summarizes the findings of the study on the analysis of cost and technical efficiency of cooperative financial institutions. Section 5.1 describes an overview of the study. Section 5.2 discusses the empirical result and relevant implications for the study. Recommendations and policy implication from the research results is discussed in section 5.3. Section 5.4 discusses the limitations of the study and some recommendations for future research

5.1 Summary of Main Findings

The co-operative financial sector has experienced significant changes over the years. The main focus of this study is to analyse cost and technical efficiency of cooperative financial institutions in Ghana using stochastic frontier analysis. These institutions are required to register as legal entities but are not licensed by the Bank of Ghana. In the selection of input and outputs, production and intermediation functions were used.

The main motivation for this study is due to the widely accepted notion that financial cooperatives a are successful instruments in tackling poverty and upgrade of these institutions become necessary to be able to facilitate financial services to the poor on a much larger scale and therefore need to make profits to stay sustainable in the long term. Secondly, how CFIs can natured to become part of the formal financial system of a country by addressing inefficiencies and so can access capital markets to fund their lending portfolios, allowing them to dramatically increase the number of poor people they can reach. In examining the

level of efficiency, the SFA was used because of the argument that it controls for both noise and inefficiency in the available data. This provides information on how internal and external factors influence efficiency.

We analyzed the Cobb-Douglas Stochastic Frontier Production and cost Functions with distributional assumptions for technical and cost efficiency models and the presence of one sided error component is justified by the LR test individually, which is highly significant for these models. The estimated gamma indicates that the inefficiency element Uit is stochastic in the production and intermediation approaches used in selecting inputs and outputs for co-operative financial institutions in Ghana.

We find that average technical efficiency scores were lower than cost efficiency scores. This suggests that co-operative financial institutions reduced cost to the detriment of technical efficiency. The co-operative in Ghana are generally operating below their optimal scale capacity as none of the sampled units was identified as technically and cost efficient. There is strong evidence of inefficiency in the sector but improvement in technical and cost efficiency as economies of scale is experienced.

The key determinants of technical efficiency in production approach size of the CFI, loan intensity, productivity measures borrowers per staff and deposits per staff, growth in deposits, and return on assets. With the exception of the size and loan intensity, and return on assets, the others have positive impact on the efficiency of the co-operatives. On the other hand, size of the CFI, loan intensity, and productivity measures borrowers per staff and deposits per staff, growth in deposits, age and return on assets. The results show that the productivity measures do not significantly affect technical efficiency in the intermediation; growth in

deposits though significant has negative effect on technical efficiency. the loan intensity determinant being negative suggest that the quality of loans may have deteriorated under some circumstances in which case a higher degree of loan intensity may be detrimental to technical efficiency. The consideration is that the positive relationship between loan activity and CFI efficiency may be attributed to the ability of the relatively efficient CFI to manage operations more productively.

The mixed results on the effect of size on technical efficiency suggest that under production approach small size financial co-operatives are technically efficient than large size financial co-operatives whiles large financial co-operatives are technically efficient in intermediation than small size financial co-operatives due economies of scale argument. That is, large co-operatives pursue goals of intermediation than production. Also technical efficiency is not necessarily linked with size but the quality of management and staff is critical.

The major determinants of cost efficiency in the production approach model are found to be net interest margin, size, loan deposit ratio, growth in deposit and returns on assets. Loan deposit ratio and growth in deposits did have the expected signs. This suggests that the proportion of loans to total deposits of members was low. This shows that financial co-operatives with low deposits rates are cost efficient in production whiles those with high growth rates are cost inefficient. In the intermediation average loan balance, deposits per staff, and return on assets have significant effect on cost efficiency. This means that the productivity is low in intermediation. It also indicates that there is trade-off between technical and cost efficiency.

5.3 Recommendations

The empirical findings from this study shed light on the potential direction of future reforms in Ghana and also, on the issue of how CFIs might go about increasing the efficiency of their operations. The policy implications from this study are:

- Management must continue explore opportunities of economies of scale since increasing returns is experienced in cost efficiency whiles constant returns is enjoyed in technical efficiency.
- The share of interest income in total income is not significant. This suggests that financial cooperatives should investigate into other investment opportunities that yield high returns.
- Borrowers per staff were not significant in cost efficiency. Therefore financial cooperatives should adopt strategies that improve productivity of staff since productivity increasing productivity will only take effect if there are well-motivated and well-equipped staffs that are set to offer valued financial services to clients. CFIs must invest resources and adequate time into the training of staff.
- The primary societies focus more on reducing poverty of members rather than investments that yield low returns. At the firm level, management must also heighten the scope of social commitment to both staff and clients whilst improving on marketing strategies.
- The management of primary societies should take care about the improvement of the technical as well as cost efficiency and the potential improvements that come from the analysis of results of this research in order to improve the efficiency of inefficient societies. Suitable balance between technical and cost efficiency must be pursued by primary societies ensure sustainability.

5.4 Limitations of the Study and Future Research

Our study has some limitations and these suggest potential directions for future work.

The first shortcoming of the present study is that we only investigate the cost and technical efficiency CFIs. Cost efficiency gives a measure of how close a bank's costs are to those of the best banking practice after controlling for comparative output levels.

As indicated by Berger and Mester (1997), a CFI that is relatively cost efficient at its current output levels may not be cost efficient at optimal output levels, since this typically involves a different scale and mix of outputs. However, profit efficiency which is based on the economic goal of profit maximization, could capture inefficiencies on the output side as well as those on the input side. Thus, further research into investigating the profit efficiency would be a valuable addition to the literature.

In addition, this study is also subject to limitations related to the number of observations included in the data sample, because of the relatively small number and relatively short history of CFIs. Fortunately, a more exhaustive data set gradually becoming available. Therefore, future research can use this emerging and larger sample to provide a more comprehensive study of efficiency of financial cooperatives in Ghana.

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APPENDIX A: Maximum Likelihood estimates Technical efficiency production approach

$$LnQ= \beta 0 +\beta_1 ST+ \beta 2 lnCPB$$

	coefficient	standard-error	t-ratio
beta 0	0.12358077E+02	0.43017375E+00	0.28728107E+02
beta 1	0.93191115E+00	0.75515077E-01	0.12340730E+02
beta 2	0.63321422E-01	0.70890659E-01	0.89322660E+00
sigma-squared	0.14274749E+01	0.28154339E+00	0.50701772E+01
gamma	0.66031362E+00	0.13464334E+00	0.49041683E+01

mu is restricted to be zero eta is restricted to be zero

log likelihood function = -0.24746631E+03

LR test of the one-sided error = 0.51088911E+01

with number of restrictions = 1

[note that this statistic has a mixed chi-square distribution]

number of iterations = 8 (maximum number of iterations set at : 100)

number of cross-sections = 188 number of time periods = 1 total number of observations = 188

APPENDIX B: Maximum Likelihood estimates Technical efficiency Intermediation approach

$$LnQ= \beta 0 +\beta_1 ST+ \beta_2 lnD+ \beta_3 lnCPB$$

	coefficient	standard-error	t-ratio
beta 0	0.54083192E+01	0.96130984E+00	0.56259896E+01
beta 1	0.31035281E+00	0.10508546E+00	0.29533371E+01
beta 2	0.5478747E+00	0.7578794E-01	0.72290490E+01
beta 3	0.18715905E+00	0.75473092E-01	0.24798116E+01
sigma-squared	0.13851269E+01	0.21897955E+00	0.63253709E+01
gamma	0.50768259E+00	0.11233315E+00	0.45194371E+01

mu is restricted to be zero eta is restricted to be zero

log likelihood function = -0.25944826E+03

LR test of the one-sided error = 0.72287314E+01

with number of restrictions = 1

[note that this statistic has a mixed chi-square distribution]

number of iterations = 8

(maximum number of iterations set at : 100) number of cross-sections = 188

number of time periods = 1 total number of observations = 188

APPENDIX C: Maximum Likelihood estimates of Cost Function production approach

$$LnTC= \beta_0 +\beta_1 lnD+ \beta_2 lnNL+ln\beta_3 SA+ln\beta_4 PCB$$

	coefficient	standard-error	t-ratio
beta 0	-0.59879517E-01	0.75146503E-01	-0.79683705E+00
beta 1	0.98005573E+00	0.83455696E-02	0.11743425E+03
beta 2	0.10044349E+01	0.99491505E-02	0.10095685E+03
beta 3	0.19366072E-01	0.95468503E-02	0.20285300E+01
beta 4	0.98902179E+00	0.96043647E-02	0.10297628E+03
sigma-squared	0.12966454E-01	0.18082301E-02	0.71707984E+01
gamma	0.68202693E+00	0.66488583E-01	0.10257805E+02

mu is restricted to be zero eta is restricted to be zero

log likelihood function = 0.19709329E+03

LR test of the one-sided error = 0.15457089E+02

with number of restrictions = 1

[note that this statistic has a mixed chi-square distribution]

number of iterations = 11 (maximum number of iterations set at : 100)

number of cross-sections = 188 number of time periods = 1

total number of observations = 188

APPENDIX D: Maximum Likelihood estimates of Cost Function intermediation approach

$LnTC= \beta_0 +\beta_1 lnGLP+ \beta_2 BRW+ \beta_3 lnTY+ \beta_4 INV+ ln\beta_5 SA+ln\beta_6 R + \beta_7 PCB$

	coefficient	standard-error	t-ratio
beta 0	0.80492448E+00	0.27960564E+00	0.28787848E+01
beta 1	0.55877084E-01	0.27245803E-01	0.20508511E+01
beta 2	0.20203295E+00	0.34077310E-01	0.59286650E+01
beta 3	0.71062853E+00	0.25793345E-01	0.27550849E+02
beta 4	0.64524146E-01	0.22443236E-01	0.28749931E+01
beta 5	0.93508859E-01	0.29786211E-01	0.31393338E+01
beta 6	0.63815829E-01	0.23757994E-01	0.26860781E+01
beta 7	0.11210695E+00	0.28474378E-01	0.39371167E+01
sigma-squared	0.12407957E+00	0.27131911E-01	0.45731968E+01
gamma	0.72776147E+00	0.13935634E+00	0.52223060E+01

mu is restricted to be zero

eta is restricted to be zero

log likelihood function = -0.10353011E+02

LR test of the one-sided error = 0.28133140E+01

with number of restrictions = 1

[note that this statistic has a mixed chi-square distribution]

number of iterations = 14 (maximum number of iterations set at : 100)

number of cross-sections = 188 number of time periods = 1

total number of observations = 188

APPENDIX E: Tobit regression of determinants of technical efficiency production approach

obit tecpro nim alb siz li ld bps iyty dps lnd age roa, ll ul						
Number of obs =188						
LR chi2(11) =272.75						
Prob > chi2 = 000						
Log likelihood = 226.3168 Pseudo R2 =-1.5163						
Tecpro	Coeff.	Std. Err.	t	P>t	[95% Conf. Interval]	
Nim	-0.00035	0.011054	-0.03	0.975	-0.02217	0.021462
Alb	-1.02E07	5.63E-07	-0.18	0.856	-1.21E06	1.01E-06
Siz	-0.11355	0.032866	-3.46	0.001	-0.17841	-0.04869
li -	.0143342	-0.46933	3.05	0.003	-.023596	-0.00507
Ld	.000706	.31699	0.22	0.824	-0.00555	0.006962
Bps	0.000211	7.76E-05	2.71	0.007	5.75E-05	0.000364
Iyty	0.000783	0.001985	0.39	0.694	-0.00313	0.004701
Dps	4.71E-07	4.35E-08	10.82	0	3.85E-07	5.57E-07
Lnd	0.092838	0.014414	6.44	0	0.064393	0.121283
Age	0.000534	0.000583	0.92	0.361	-0.00062	0.001684
Roa	-0.25496	0.078132	-3.26	0.001	-0.40915	-0.10077
_cons	-0.14594	0.071012	-2.06	0.041	-0.28608	-0.0058
/sigma .070113 .0036514 .0629071 .0773189						
Obs. summary: 1 left-censored observation at tecpro<=.026557						
186 uncensored observations						
1 right-censored observation at tecpro>=.84298003						

APPENDIX F: Tobit regression of determinants of technical efficiency production approach

Tobit tecint nim alb siz li ld bps iyty dps lnd age roa, ll ul						
Number of obs = 188						
LR chi2(11) = 112.86						
Prob > chi2 = 0.0000						
Log likelihood = 235.47246 Pseudo R2 = 0.3152						
tecin	Coeff	Std. Err.	t	P>t	[95% Conf.	Interval]
nim	0.005879	0.010597	0.55	0.58	-0.01503	0.026792
alb	-2.4E-07	5.40E-07	-0.46	0.649	-1.31E-06	8.19E-07
siz	0.149657	0.03155	4.74	0	0.087396	0.211919
li	0.018333	0.00454	4.0 0	0	0.009373	0.027293
ld	0.003343	0.003121	1.07 0	0.286	-0.00282	0.009502
bps	8.41E-06	7.53E-05	0.11	0.911	-0.00014	0.000157
iyty	0.002071	0.001903	1.09	0.278	-0.00169	0.005827
dps	5.76E-08	4.18E-08	1.38	0.17	-2.49E-08	1.40E-07
lnd	-0.0499	0.01385	-3.6	0	-0.07723	-0.02257
age	0.000959	0.000559	1.72	0.088	-0.00014	0.002063
roa	0.139428	0.074905	1.86	0.064	-0.00839	0.287249
_cons	0.316028	0.068165	4.64	0	0.181506	0.450549
/sigma .0672137 .0034915 .0603234 .0741039						
Obs. summary: 1 left-censored observation at tecint<=.014058						
186 uncensored observations			1 right-censored tecint>=.850995			

APPENDIX G: Tobit regression of determinants of cost efficiency production approach

Tobit cpro nim alb siz li ld bps iyty dps lnd age roa, ll ul						
Tobit regression		Number of obs. =188				
LR chi2(11) =26.5		Prob > chi2 =0.0055				
Log likelihood =278.2589		Pseudo	R2=-0.05			
Cpro	Coeff.	Std. Err.	t	P>t	[95%Conf.	Interval]
Nim	-0.00024	0.008393	-0.03	0.977	-0.0168	0.016323
Alb	3.49E-07	4.27E-07	0.82	0.415	-4.94E-07	1.19E-06
Siz	0.076082	0.024974	3.05	0.003	0.026796	0.125367
Li	0.007735	0.003561	2.17	0.031	0.000706	0.014763
Ld	-0.00718	0.002409	-2.98	0.003	-0.01193	-0.00242
Bps	-2.97E-06	5.89E-05	-0.05	0.96	-0.00012	0.000113
Iyty	-7.4E-05	0.001507	-0.05	0.961	-0.00305	0.0029
Dps	-4.53E-08	3.31E-08	-1.37	0.172	-1.11E-07	1.99E-08
Lnd	-0.02845	0.010954	-2.6	0.01	-0.05006	-0.00683
Age	-0.00047	0.000443	-1.05	0.294	-0.00134	0.000408
Roa	0.126889	0.059585	2.13	0.035	0.0093	0.244478
_cons	0.8744	9.0538413	16.2	4 0.000	0.768155	0.980663
/sigma .0531849 .0027676 .0477231 .0586466						
Obs. summary: 1 left-censored observation at cpro<=.56520998						
186 uncensored observations		1 right-censored observation at cpro>=.992419				

APPENDIX H:Tobit regression of determinants of cost efficiency intermediation approach

Tobit cnt nim alb siz li ld bps iyty dps lnd age roa, ll ul						
Tobit regression			Number of obs =	188		
LR chi2(11) =	30.14					
Prob > chi2 =	0.0015					
Log likelihood = 57.895008			Pseudo R2 =	-0.3519		
cnt	Coeff.	Std. Err.	t	P>t	[95% Conf.	Interval]
nim	0.03269	0.028808	1.13	0.258	-0.02416	0.089542
alb	-3.97E-06	1.40E-06	-2.83	0.005	-6.7E-06	-1.2E-06
siz	-0.06442	0.082047	-0.79	0.433	-0.22634	0.097492
li	0.014047	0.011694	1.2	0.231	-0.00903	0.037124
ld	0.01007	0.007912	1.27	0.205	-0.00554	0.025684
bps	-0.00015	0.000193	-0.8	0.426	-0.00054	0.000227
iyty	-0.00715	0.005048	-1.42	0.158	-0.01711	0.002811
dps	-2.57E-07	1.09E-07	-2.37	0.019	-4.7E-07	-4.3E-08
lnd	0.042132	0.035983	1.17	0.243	-0.02888	0.113143
age	-0.00097	0.001455	-0.67	0.506	-0.00384	0.001902
roa	0.591667	0.196235	3.02	0.003	0.204405	0.978928
_cons	0.58002	2.1770052	3.2	0.001	.2307098	.9293341
/sigma .1746982 .0090903				.1567589	.1926374	
summary: 1 left-censored observation at cnt<=.074001						
186 uncensored observations						
1 right-censored observation at cnt>=.93206698						

APPENDIX I: Annual Technical Efficiency Scores Production Approach

FINANCIAL CO-OPERATIVE	2009	2010	2011	2012	MEAN
Accountant General department	0.6523	0.6835			0.6679
Ghana Statistical Service			0.6549	0.6784	0.6667
Ghana Atomic Energy	0.6796	0.7801	0.8130	0.7671	0.7599
Ghana Standard Board	0.6724	0.7071			0.6898
Martyrs of Uganda	0.3762	0.4829	0.4343	0.4592	0.4381
Global Evangelical	0.3749	0.7328			0.5538
AME Zion(ACCRA)	0.3614	0.7135			0.5374
KAMCCU			0.4936	0.5727	0.5332
Darkuman Central		0.5413	0.6455	0.6836	0.6235
Agogo Hospital Workers	0.6464	0.6520	0.6284	0.6748	0.6504
Atebubub teachers			0.5210	0.5485	0.5347
Amansen		0.4232	0.4189	0.4134	0.4185
AME(BSM) Church(Kumasi)	0.2839	0.2688	0.3174	0.4828	0.3382
Asawase District	0.4510	0.5136	0.4452	0.3949	0.4512
Anglican Diocese	0.4650		0.5213	0.6359	0.5407
Wealth Creation	0.3534		0.3033		0.3283
Danwell	0.4636	0.4926	0.4509	0.6057	0.5032
Kwadaso District	0.4735	0.5219	0.5194		0.5049
Kumasi Polytechnic			0.5006	0.4915	0.4960
Abura-Asebu-Kwamankese	0.6636	0.7033	0.7341	0.7689	0.7175
Ajumako E.E. Teachers	0.5465	0.6386	0.7090	0.7240	0.6545
Dunkwa Area Teachers	0.5916	0.6053			0.5985
Dunkwa Traders	0.5257	0.5413	0.7125	0.7333	0.6282
K.E.E.A. Workers	0.5495	0.5907	0.7227	0.7280	0.6477
Oguaa Teachers			0.5679	0.6484	0.6082
Swedru Methodist	0.4373	0.5319	0.6369	0.6815	0.5719
Anum Apapam Community	0.7091	0.7081	0.7260	0.6951	0.7096
Effiduase St. Theresa			0.3179	0.2663	0.2921
Bunso CRIG Workers	0.3216	0.5124			0.4170
Nsawam Area Apostolic	0.5068	0.5294			0.5181
Crocodile Matchet Employees	0.5123	0.5329			0.5226
North Tema			0.5349	0.6383	0.5866
Ghana Co-operative Pharmacists		0.6180	0.5934	0.6327	0.6147
Aluworks Staff	0.7405	0.7489	0.7504	0.7173	0.7393
Tema Chapter Teachers Network	0.4145	0.5534	0.5879	0.6019	0.5394
T.O.R. Management		0.6712	0.7296	0.7082	0.7030
Bethel Methodist			0.4139	0.4568	0.4353
Tema business	0.4535	0.4576			0.4556

Bimbilla Community	0.4130	0.1975			0.3052
Kpandai Community	0.2829	0.2614	0.2646		0.2696
Bawku Community	0.4089		0.4547	0.5512	0.4716
Bawku Hospital	0.5025	0.5427			0.5226
Bawku Teachers	0.6327	0.6118	0.8430	0.6361	0.6809
Garu/Tempane Teachers	0.1564	0.1986			0.1775
Navarongo Teachers	0.4922	0.5663			0.5293
Hamile Parish	0.3135	0.3247			0.3191
Tumu Community			0.5341	0.5134	0.5237
Kuorbe Langtaa		0.4880	0.3972	0.4148	0.4333
Freeman Methodist			0.6587	0.6219	0.6403
GPRTU			0.5247	0.4483	0.4865
ARCCU		0.2118	0.2201		0.2159
Abotareye	0.2743	0.3487	0.3870	0.3341	0.3360
Nkoranza Area Teachers	0.5110	0.5763	0.6425	0.6832	0.6032
Nsoatre Community			0.0266	0.5120	0.2693
Abosomankotere	0.6446	0.3366	0.6746	0.7253	0.5953
Techiman Area Teachers	0.4497	0.4945	0.4847	0.5847	0.5034
Tamsoa			0.3794	0.4098	0.3946
Ebenezer Co-Operative	0.5025	0.5832	0.6364	0.5920	0.5785
Nkoranza Victory Presby			0.4904	0.5204	0.5054
Badu Community	0.4392	0.4460	0.4506	0.4514	0.4468
Sunyani Municipal Teachers	0.5406	0.6582	0.5544	0.6505	0.6009
Asiri Farmers		0.6083	0.5715	0.5325	0.5707
Dormaa Area Teachers			0.6213	0.6567	0.6390
Trinity Presby	0.3795	0.4696	0.6402	0.4083	0.4744
Berekum Area Teachers			0.6536	0.6691	0.6614
Standard			0.5116	0.4987	0.5051

APPENDIX J: Annual Technical Efficiency Scores Intermediation Approach

FINANCIAL CO-OPERATIVE	2009	2010	2011	2012	**MEAN**
Accountant General department	0.6217	0.6360			0.6288
Ghana Statistical Service			0.6482	0.5944	0.6213
Ghana Atomic Energy	0.5301	0.5355	0.7081	0.6674	0.6103
Ghana Standard Board	0.5638	0.5947			0.5793
Martyrs of Uganda	0.5471	0.5272	0.6080	0.5427	0.5562
Global Evangelical	0.5920	0.6702			0.6311
AME Zion(ACCRA)	0.6150	0.3899			0.5024
KAMCCU			0.8480	0.8510	0.8495
Darkuman Central		0.5610	0.8279	0.6785	0.6891
Agogo Hospital Workers	0.5771	0.6003	0.6373	0.6586	0.6183
Atebubub teachers			0.6222	0.6354	0.6288
Amansen		0.5218	0.5285	0.6368	0.5623
AME(BSM) Church(Kumasi)	0.4822	0.5248	0.5591	0.5936	0.5399
Asawase District	0.5418	0.4766	0.5426	0.4972	0.5146
Anglican Diocese	0.5876		0.6167	0.6374	0.6139
Wealth Creation	0.4887		0.5548		0.5217
Danwell	0.5466	0.5211	0.6132	0.8299	0.6277
Kwadaso District	0.5568	0.6507	0.5804		0.5960
Kumasi Polytechnic			0.5739	0.6330	0.6035
Abura-Asebu-Kwamankese	0.6291	0.5577	0.6465	0.6613	0.6236
Ajumako E.E. Teachers	0.5862	0.5830	0.5972	0.5922	0.5896
Dunkwa Area Teachers	0.4435	0.6332			0.5383
Dunkwa Traders	0.5390	0.5631	0.6325	0.5566	0.5728
K.E.E.A. Workers	0.5522	0.4633	0.5581	0.5781	0.5379
Oguaa Teachers			0.4953	0.5722	0.5337
Swedru Methodist	0.5062	0.5169	0.5621	0.5618	0.5367
Anum Apapam Community	0.5813	0.6013	0.5678	0.5848	0.5838
Effiduase St. Theresa			0.5594	0.4612	0.5103
Bunso CRIG Workers	0.4733	0.3703			0.4218
Nsawam Area Apostolic	0.6801	0.6591			0.6696
Crocodile Matchet Employees	0.5774	0.6045			0.5909
North Tema			0.6474	0.6409	0.6441
Ghana Co-operative Pharmacists		0.5320	0.5359	0.5752	0.5477
Aluworks Staff	0.4883	0.5138	0.5466	0.5548	0.5259
Tema Chapter Teachers Network	0.5795	0.5611	0.5635	0.6176	0.5804
T.O.R. Management		0.6123	0.6098	0.6389	0.6203
Bethel Methodist			0.5290	0.5443	0.5367
Tema business	0.4977	0.5322			0.5150

Bimbilla Community	0.4953	0.4999			0.4976
Kpandai Community	0.4560	0.5443	0.5375		0.5126
Bawku Community	0.5472		0.5772	0.6585	0.5943
Bawku Hospital	0.5765	0.6541			0.6153
Bawku Teachers	0.6113	0.6727	0.4597	0.6524	0.5990
Garu/Tempane Teachers	0.6632	0.7027			0.6829
Navarongo Teachers	0.5113	0.6355			0.5734
Hamile Parish	0.5013	0.5824			0.5418
Tumu Community			0.5940	0.5630	0.5785
Kuorbe Langtaa		0.6499	0.6588	0.5656	0.6248
Freeman Methodist			0.6129	0.6108	0.6118
GPRTU			0.6692	0.6430	0.6561
ARCCU		0.7815	0.7247		0.7531
Abotareye	0.5119	0.5247	0.4966	0.5520	0.5213
Nkoranza Area Teachers	0.5782	0.5970	0.6303	0.6824	0.6220
Nsoatre Community			0.5710	0.5940	0.5825
Abosomankotere	0.6695	0.5806	0.5943	0.6902	0.6337
Techiman Area Teachers	0.5261	0.5966	0.5643	0.6436	0.5826
Tamsoa			0.4884	0.4530	0.4707
Ebenezer Co-Operative	0.6113	0.5852	0.5003	0.8148	0.6279
Nkoranza Victory Presby			0.6025	0.0141	0.3083
Badu Community	0.4689	0.3272	0.5176	0.5366	0.4626
Sunyani Municipal Teachers	0.5954	0.5863	0.5389	0.5788	0.5748
Asiri Farmers		0.5748	0.5637	0.6396	0.5927
Dormaa Area Teachers			0.7011	0.6958	0.6985
Trinity Presby	0.4460	0.5357	0.6044	0.5581	0.5361
Berekum Area Teachers			0.6234	0.6033	0.6133
Standard			0.3941	0.4905	0.4423

APPENDIX K: Annual Cost Efficiency Scores Production Approach

FINANCIAL CO-OPERATIVE	2009	2010	2011	2012	MEAN
Accountant General department	0.9492	0.9496			0.9494
Ghana Statistical Service			0.9398	0.9364	0.9381
Ghana Atomic Energy	0.9432	0.9398	0.9438	0.9444	0.9428
Ghana Standard Board	0.9390	0.9398			0.9394
Martyrs of Uganda	0.9290	0.9297	0.9416	0.9327	0.9333
Global Evangelical	0.6742	0.9555			0.8148
AME Zion(ACCRA)	0.9472	0.7190			0.8331
KAMCCU			0.6019	0.9619	0.7819
Darkuman Central		0.8340	0.8804	0.8926	0.8690
Agogo Hospital Workers	0.7290	0.8799	0.9924	0.8700	0.8678
Atebubub teachers			0.7234	0.8905	0.8070
Amansen		0.9386	0.9378	0.9403	0.9389
AME(BSM) Church(Kumasi)	0.9474	0.9432	0.9414	0.9447	0.9442
Asawase District	0.9375	0.9388	0.9328	0.9312	0.9351
Anglican Diocese	0.9414		0.9372	0.9392	0.9393
Wealth Creation	0.9314		0.9162		0.9238
Danwell	0.9376	0.9348	0.9381	0.9396	0.9375
Kwadaso District	0.9313	0.9340	0.9332		0.9328
Kumasi Polytechnic			0.9419	0.9408	0.9414
Abura-Asebu-Kwamankese	0.9420	0.9374	0.9396	0.9429	0.9405
Ajumako E.E. Teachers	0.9433	0.9428	0.9467	0.9463	0.9448
Dunkwa Area Teachers	0.9398	0.9412			0.9405
Dunkwa Traders	0.9446	0.9399	0.9400	0.9355	0.9400
K.E.E.A. Workers	0.9371	0.9140	0.9444	0.9389	0.9336
Oguaa Teachers			0.9366	0.9436	0.9401
Swedru Methodist	0.9389	0.9389	0.9415	0.6452	0.8661
Anum Apapam Community	0.7427	0.9434	0.5652	0.9420	0.7983
Effiduase St. Theresa			0.9389	0.9309	0.9349
Bunso CRIG Workers	0.9353	0.9483			0.9418
Nsawam Area Apostolic	0.9322	0.9369			0.9345
Crocodile Matchet Employees	0.9435	0.9440			0.9437
North Tema			0.9438	0.9441	0.9439
Ghana Co-operative Pharmacists		0.9329	0.9320	0.9334	0.9328
Aluworks Staff	0.9428	0.9467	0.9449	0.9417	0.9440
Tema Chapter Teachers Network	0.9382	0.9424	0.9429	0.9463	0.9425
T.O.R. Management		0.9238	0.9255	0.9235	0.9243
Bethel Methodist			0.9422	0.9427	0.9425
Tema business	0.9397	0.9391			0.9394

Bimbilla Community	0.9439	0.9369			0.9404
Kpandai Community	0.9250	0.9414	0.9446		0.9370
Bawku Community	0.9375		0.9329	0.9336	0.9347
Bawku Hospital	0.9380	0.9394			0.9387
Bawku Teachers	0.9474	0.9454	0.9345	0.9365	0.9410
Garu/Tempane Teachers	0.9480	0.9478			0.9479
Navarongo Teachers	0.9361	0.9367			0.9364
Hamile Parish	0.9314	0.9293			0.9304
Tumu Community			0.9346	0.9255	0.9301
Kuorbe Langtaa		0.9479	0.9395	0.9416	0.9430
Freeman Methodist			0.9417	0.9333	0.9375
GPRTU			0.9408	0.9383	0.9395
ARCCU		0.9503	0.9510		0.9506
Abotareye	0.9255	0.9266	0.9272	0.9268	0.9265
Nkoranza Area Teachers	0.9417	0.9439	0.9430	0.9405	0.9423
Nsoatre Community			0.9370	0.9366	0.9368
Abosomankotere	0.9309	0.9280	0.9286	0.9315	0.9297
Techiman Area Teachers	0.9391	0.9427	0.9383	0.9378	0.9395
Tamsoa			0.9362	0.9349	0.9356
Ebenezer Co-Operative	0.9401	0.9387	0.9250	0.9346	0.9346
Nkoranza Victory Presby			0.9351	0.9368	0.9359
Badu Community	0.9419	0.9351	0.9394	0.9219	0.9346
Sunyani Municipal Teachers	0.9425	0.9447	0.9343	0.9364	0.9395
Asiri Farmers		0.9330	0.9367	0.9342	0.9346
Dormaa Area Teachers			0.9323	0.9391	0.9357
Trinity Presby	0.9294	0.9303	0.9356	0.9268	0.9305
Berekum Area Teachers			0.9331	0.9353	0.9342
Standard			0.8106	0.9350	0.8728

APPENDIX L : Annual Cost Efficiency Scores Intermediation Approach

FINANCIAL CO-OPERATIVE	2009	2010	2011	2012	MEAN
Accountant General department	0.8871	0.9051			0.8961
Ghana Statistical Service		0.4880	0.0740	0.4412	0.3344
Ghana Atomic Energy	0.9110	0.8361	0.6136	0.4970	0.7144
Ghana Standard Board	0.8171	0.9014			0.8592
Martyrs of Uganda	0.6157	0.8576	0.5813	0.8879	0.7356
Global Evangelical	0.3002	0.8397			0.5699
AME Zion(ACCRA)	0.9056	0.9057			0.9057
KAMCCU		0.8543	0.9286	0.6105	0.7978
Darkuman Central		0.8422	0.1307	0.8132	0.5954
Agogo Hospital Workers	0.8349		0.8661	0.8082	0.8364
Atebubub teachers		0.7571	0.7924	0.8186	0.7894
Amansen		0.8313	0.7868	0.8452	0.8211
AME(BSM) Church(Kumasi)	0.5759	0.7872	0.8695	0.8584	0.7728
Asawase District	0.8462		0.7291	0.7373	0.7709
Anglican Diocese	0.8464		0.7352	0.8031	0.7949
Wealth Creation	0.8558	0.6718	0.7831		0.7702
Danwell	0.7521	0.8051	0.7270	0.9321	0.8041
Kwadaso District	0.5534		0.7793		0.6663
Kumasi Polytechnic		0.8086	0.8814	0.7658	0.8186
Abura-Asebu-Kwamankese	0.8369	0.7349	0.8557	0.8375	0.8163
Ajumako E.E. Teachers	0.8052	0.8557	0.7917	0.7176	0.7926
Dunkwa Area Teachers	0.7976	0.6742			0.7359
Dunkwa Traders	0.7350	0.4198	0.7743	0.5659	0.6237
K.E.E.A. Workers	0.7081		0.6434	0.4780	0.6098
Oguaa Teachers		0.6958	0.3563	0.6448	0.5657
Swedru Methodist	0.6964	0.7605	0.7264	0.6196	0.7007
Anum Apapam Community	0.7961		0.1569	0.3594	0.4375
Effiduase St. Theresa		0.1838	0.7191	0.4118	0.4382
Bunso CRIG Workers	0.3551	0.8893			0.6222
Nsawam Area Apostolic	0.7227	0.7443			0.7335
Crocodile Matchet Employees	0.7605	0.7605			0.7605
North Tema		0.5668	0.7683	0.7177	0.6843
Ghana Co-operative Pharmacists		0.6839	0.5092	0.6733	0.6221
Aluworks Staff	0.5666	0.2482	0.6485	0.6299	0.5233
Tema Chapter Teachers Network	0.2456	0.5100	0.4998	0.7850	0.5101
T.O.R. Management			0.1053	0.3683	0.2368
Bethel Methodist		0.7567	0.9111	0.8841	0.8506
Tema business	0.7806	0.6608			0.7207

Bimbilla Community	0.7563	0.6863			0.7213
Kpandai Community	0.6408		0.6103		0.6255
Bawku Community	0.8813	0.5714	0.8344	0.7809	0.7670
Bawku Hospital	0.8894	0.9238			0.9066
Bawku Teachers	0.8816	0.9291	0.8304	0.8611	0.8755
Garu/Tempane Teachers	0.4877	0.8583			0.6730
Navarongo Teachers	0.7031	0.9015			0.8023
Hamile Parish	0.7662				0.7662
Tumu Community		0.8548	0.9093	0.2452	0.6698
Kuorbe Langtaa			0.8503	0.6976	0.7740
Freeman Methodist			0.8137	0.7926	0.8031
GPRTU		0.9004	0.8021	0.7849	0.8291
ARCCU		0.4846	0.1863		0.3355
Abotareye	0.4178	0.8870	0.4860	0.6142	0.6012
Nkoranza Area Teachers	0.8969		0.8674	0.8804	0.8816
Nsoatre Community		0.8264	0.8440	0.8078	0.8261
Abosomankotere	0.8709	0.7862	0.7630	0.8632	0.8208
Techiman Area Teachers	0.6777		0.7796	0.7790	0.7454
Tamsoa		0.8186	0.8173	0.4527	0.6962
Ebenezer Co-Operative	0.8134		0.6496	0.8011	0.7547
Nkoranza Victory Presby		0.7211	0.8445	0.8480	0.8045
Badu Community	0.8157	0.6645	0.7869	0.7477	0.7537
Sunyani Municipal Teachers	0.7529	0.7721	0.5751	0.6470	0.6868
Asiri Farmers			0.8160	0.7649	0.7904
Dormaa Area Teachers		0.7785	0.6531	0.7357	0.7225
Trinity Presby	0.8667		0.7265	0.4294	0.6742
Berekum Area Teachers			0.6628	0.6793	0.6711
Standard			0.6312	0.0911	0.3612