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A TWO-STAGE STUDY OF EFFICIENCY OF SAVINGS AND CREDIT COOPERATIVES SOCIETIES IN KENYA

AN APPLICATION OF DATA ENVELOPMENT ANALYSIS AND TOBIT REGRESSION MODELLING

Phares Ochola
Kenya School of Monetary Studies, Kenya
Ocholap@ksms.or.ke

Abstract

The study uses a two stage approach to evaluate efficiency of SACCOs in Kenya from 2011-2013. Firstly we use Data Envelopment Analysis (DEA) to estimate relative DEA efficiency of SACCOs registered by SASRA Secondly Tobit regression model is used to analyse the determinants (inputs and outputs) of the resulting efficiency levels. Data is obtained from Sacco Societies Regulatory Authority (SASRA supervisory reports over the target period and only the 94 SACCOs with complete input and output data are included in the study. The study also complies with comply with the requirement of DEA that the sum of the inputs and output variables must be equal to one third of the DMUs. The two-stage analysis is undertaken for each year and conclusions drawn thus. The result estimated using censored normal regression model offers useful economic insights. The significance of SACCO members and loans and advances in 2011 and 2013 and members, loans and advances and turnover is an indication that the SACCOs with higher number of members, loans and advances ad turnover were more efficient. In terms of beta values, deposits and loan and advances are negatively associated to efficiency, indicating that an increase in deposits and loans and advances may be an obstacle to SACCO efficiency in Kenya. However while the effect of loans and advances is statistically significant that of deposits is not. The rest of the input and output variables though affecting efficiency positively are however also not statistically significant.

Keywords: Data Envelopment Analysis, Decision Making Units (DMUS), CCR And BCR Efficiency, SACCOS, TOBIT Regression Analysis

INTRODUCTION

The Sacco sub-sector, which is part of the cooperative sector in Kenya consist of the traditional Savings and Credit Cooperative Societies (Saccos), which are Non-Deposit Taking Saccos and the deposit taking Saccos (DTS) which besides the basic savings and credit products, also provide basic 'banking' services (demand deposits, payments services and channels such as quasi banking services commonly known as ATMs), Front Office Service Activities (FOSA) and are licensed and supervised under the Sacco Societies Act of, 2008. According to Kenya's Sacco Supervision Annual Report (2013), by the end of 2013, there were 6,000 registered non-deposit taking SACCOs with only 1,995 being activate. The report further indicates that, by end of 2013, there were 215 deposit taking Saccos accounting for 78% of the total assets and deposits of the entire Sacco sub-sector and commanding 82% of membership in the Sacco industry. This study focuses on the deposit taking SACCOs.

In the recent past, there has been considerable interest in the performance, more so given the increasing level of competition in the industry in the country. Concern have not only be on efficiency levels but also on their determinants. Globally, a number of studies have being carried out to analyze efficiency issues of various types of industries using the nonparametric data envelopment analysis (DEA) approach. For example while Shun, and Han (2012) studied the efficiency of public listed companies in Taiwan, Erkut and Hatice (2007) used DEA methodology to study the performance of manufacturing firms in Turkey.

On determinants of efficiency, Tobit regression analysis have been widely used. Le and Harvie (2010) examined the factors affecting efficiency and found that firm age, size, location, ownership, cooperation with a foreign partner, product innovation, competition, are significantly related to technical efficiency. Similarly Aggrey et al. (2010) used a similar approach and found a negative association between firm's size and efficiency. This was on top of finding positive relationship between foreign ownership and efficiency. In East Africa Niringiye, et. al (2010) studied the effect of firm size on technical efficiency. In the first step, technical efficiency measures were calculated using DEA approach. Secondly, using GLS technique, a technical efficiency equation was estimated to investigate whether technical efficiency is increasing in firm size.

It is against this background that this study was undertaken. The study tried to find the determinants of efficiency of SACCOs in Kenya using Tobit regression analysis. Firstly, the performance efficiency of each SACCO was evaluated using CCR and BCR model of the DEA. In addition, the determinants of efficiency were also investigated using censored regression analysis of the Tobit model, with the intentions to explain the variation in calculated efficiencies to a set of explanatory variables.

The purpose of this study is to extend the earlier empirical work on DEA efficiency analysis of financial sector more specifically the saving and credit cooperatives (SACCOs) in Kenya. The outcome of this study should provide a better undemanding not on the efficiency distribution but also on the factors that affect the sector's efficiency. The findings of this a study could also provide insights needed to formulate long-term policy and development management strategy for SACCOs in the country especially to stakeholders such as SASRA.

Study Objectives

This study was designed to:

a) Assess DEA efficiency amongst Kenya's Savings and Credit Co-operative (SACCO) Societies in Kenya
b) To establish the determinants of efficiency of Savings and Credit Co-operative (SACCO) Societies in Kenya

REVIEW OF RELATED LITERATURE

Theoretical Literature

The core objective of Cooperative organizations, which are special types of economic entities, is to maximize the members' welfare/benefits. Typically, the members are the users of the services provided. For instance, in a credit cooperative, services are exclusively for the members who share some common bond. Generally, a typical cooperative does not pursue the standard neoclassical assumption of profit maximization in the theory of a firm but rather its objective is to pursue both economic and social objectives. In its simplest form, SACCOs are usually 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. The efficiency of cooperative societies is hence a critical component of the quality of services provided to the members.

Both theoretical and empirical literature on assessment of organizational efficiency is preponderated by the use of frontier models. These models consist of two categories: parametric and non-parametric models, however, despite their inherent diversity, they share common characteristics especially in their use of relative efficiency as a quantitative measure of performance. Studied by Sufian (2011) among others defines efficiency of a producer of output, (decision-making unit (DMU), as its ability to produce maximum possible output(s) with minimum possible inputs relative to its peers, subject to resource constraints and operating environments. While the dominant methodology of the parametric category is the

Stochastic Frontier Approach (SFA), data envelopment analysis remains the most used of the non-parametric models in both theoretical and empirical literature.

Over the years, the Data Envelopment Analysis (DEA) methodology developed by Charnes, Cooper and Rhodes (1978) has increasingly become the preferred approach for efficiency estimation in financial sector literature. DEA employs piecewise linear programming procedure in identifying the empirical production functions based on the actual data. The methodology compares similar producers of outputs by taking several outputs and inputs into account simultaneously. The producer of output in the context of DEA is commonly referred to as a Decision Making Unit (DMU).

Of the different versions of DEA models, the most frequently used in empirical studies: is that developed by Charnes, Cooper and Rhodes, commonly referred to as the CCR-model (Charnes et al., 1978) and that developed by Banker, Charnes and Cooper also known as the BCC-model (Banker et al., 1984). The fundamental difference between the CCR and the BCC models rests in the way the return to scale are treated. BCC models take into account variable returns to scale while the CCR assumes that each DMU operates with constant returns to scale. We use both models in the current study

Empirical Literature on Efficiency Estimation

Data Envelopment analysis has over the years found extensive use in assessment of efficiency diverse field such as microfinance including SACCO sectors, university departments, banking, heath sector and manufacturing to cite but a few. This study however focuses on the SACCO sector.

In the banking sector, Paradi and Schaffnit [2004] evaluated the performance of the commercial branches of a large Canadian bank. The study focused on assessing the performance of the Commercial branches of a large Canadian bank. It used two models, one model, looked directly at resource usage while the other incorporated financial results. The cost-minimization study produced results relating to efficiency of individual branches. Other studies that have applied DEA to the Banking sector globally include Asmild et al. [2004] which evaluated the performance of Canadian banking industry over time. Other studies on DEA application include that by Thagunna (2013) which examined Bank Performance of Nepali- India. The study found that efficiency level is relatively stable and has increased on overall. It further revealed that there was no significant relationship between efficiency level and ownership structure of banks neither that there was a significant differences in the efficiency levels of banks according to their asset size. Other studies among others were that by Eken1 and Kale2 (2011) which examined Turkish bank branch performance and Gishkori

and Ullah (2013) which analysed the technical efficiency of Islamic and Commercial Banks in Pakistan

Regarding efficiency of universities and/or universities departments, a number of studies are reported in literature. For example, Agasisti and Johnes (2009) examined efficiencies, using DEA methodology, of universities in Italy and the UK .The study, fund that that UK universities were more efficient, but the Italian ones were improving their technical efficiency while the English ones obtained stable Scores. Also, a study by Bonaccorsi et al.(2007) looked at efficacy of 79 universities in Italy, Spain, Portugal and Switzerland) focusing specifically on the relationship between the size of the University and its efficiency. A positive relationship between the size of a University and efficiency was found for all the disciplines investigated. A two –stage methodology was used by Wolszczak-Derlacz and Parteka (2011) on a set of 259 universities in seven European countries for the period 2001-2005. The study found a significantly large variation both within and between countries. When the derived efficiencies were regressed on inputs and outputs, the results showed that more efficient universities have a higher number of different departments, a larger proportion of females among the academic staff, a higher percentage of funds from external sources and are older. Abdulkareem and Oyeniran (2011) examined using Data Envelopment Analysis (DEA) Nigerian Universities and found that to enhance efficiency and realize sustainable development, the Universities must carefully select their inputs to realize the required level of outputs.

Last but not least, regarding the SACCO sector Tesfamariam1 et.al. (2013) examined the relative efficiency of 329 rural saving and credit cooperatives in Tigrai region of Ethiopia. The study found that there is significant variation in technical efficiency across geographical regions and size of the SACCOs. Similarly Magalia md Pastory (2013), in their study of the efficiency rural SACCOs in Tanzania found also that there was statistically significant variation in technical efficiency of SACCOS across and within the regions and there was a significant decrease in technical efficiency with increasing operation cost . Similar studies which have examined SACCO efficiency using DEA include Marwa and Aziakpono (2014) which examined SACCO efficiency and profitability in Tanzania.

While a significant number of DEA efficiency studies have been undertaken in the financial institutions generally for example by Taylor et al., (1997) of Mexican banks, Schaffnit, Rosen and Parade (1997) of large Canadian banks, Kao and Liu,(2004) of Taiwanese Commercial banks, Portela and Thanassoulis (2007) of Portuguese banks and Jayamaha and Mula (2011) of cooperative rural banks in Sri Lanka very few such studies have been undertaken in Sub-Saharan Africa's SACCOs and more so in Kenya.

Specification of Inputs and Outputs

Studies by Moffat (2008) and Qayyum and Ahmad (2006) among others identifies three approaches that have been widely used in specifying inputs and outputs in the context of Data Envelopment Analysis and these are (a) intermediation approach, (b) the production approach, and (c) the assets approach. Regarding the intermediation approach, the DMUs (financial institutions) are seen as intermediaries which are concerned mainly with the transfer of financial assets. In this context, labour, capital cost and interest payable on deposits will form the input set with loans and financial investments form output set. On the production approach, the DMUs are seen as producers of outputs (deposits and loans) using an array of inputs (employees and capital expenditures). Last but not least, under the assets approach, DMUs are seen as creators of outputs through the use of existing assets. The choice of inputs and output for use in efficiency assessment therefore depends on the approach that is adopted (Drake, 2003).

While there is no simple solution to the problem of input and output specification as argued by. Favero and Papi (1995), the nature of study and availability of data are critical factors in selection of the variables for DEA efficiency. SACCOs by their nature can be viewed as intermediary institutions since their core mandate relates to mobilizing the savings and offering loans. Another challenge on the efficiency estimation is the choice of the orientation, that is, input or output orientation. Input orientation has been recommended for cost minimization focused policies, while output orientation has been recommended for impact maximization policies (Cooper et al., 2011). On the other hand it is argued that the orientation choice must be chosen according to the quantities of inputs and outputs that the managers are able to control (Coelli et al., 2005). In our case, managers are more able to control the inputs (personnel, total assets and total costs) than the outputs (demand for loans, and returns on assets) which are subject to external market forces. Therefore, in this paper we adopted the input orientation and intermediation approach.

METHODOLOGY

In this study, a two-step efficiency analysis; DEA efficiency analysis to determine efficiency scores followed by Tobit regression analysis to evaluate the effect of the selected input and output variables on the derived efficiency levels. In this section we present both the Data Envelopment Analysis (DEA) and the Censored regressions (TOBIT) methodologies.

Data Envelopment Analysis (DEA) Methodology

The study used Data Envelopment Analysis (DEA) model to examine, at macro – level, County efficiency scores for the entities having Societies in operation and at micro-level

efficiency of each SACCO registered with SASRA and for a period of five years from 2010 – 2014. The sole data source was the SASRA Supervision reports over the target period. The data envelopment model was adopted due to its flexibility to accommodate multiples of inputs and outputs over selected periods of time. Inputs and outputs variable selection was influenced by the core business of the SACCOs and that its financial intermediation functions.

Data Envelopment Analysis (DEA) methodology, was first introduced by Charnes, Cooper and Rhodes (1978) (CCR) to measure the relative efficiency of say "s" Decision Making Units in this case SACCOs. It involves finding the efficiency score of, DMU_0 in comparison with a set of ''n'' DMUs in a given sample. Commonly known as CCR model after the names of the authors, DEA is a generalization of efficiency model proposed by Farrell (1957). The CCR model measures relative efficiency of a number of Decision Making Units (DMUs) using a set of multiple inputs to generate a set multiple outputs. DEA's key objective is to establish a level of relative efficiency $"\theta"$ such that $0 \le \theta \le 1$),for each DMU by comparing its quantities of inputs and outputs with other DMUs. By defining efficiency as the weighted sum of outputs over the weighted sum of inputs, the following equation is developed

$$\text{Max} \quad h_o(u,v) = \frac{\sum_{r=1}^{s} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{io}} \text{----------(i)}$$

Subject to:

$$\frac{\sum_{r=1}^{k} u_r y_{ro}}{\sum_{i=1}^{m} v_i x_{ioj}} \le 1 \quad \text{for each } j = 1,2.3.....j_o.....n \text{----------(ii)}$$

$$u_r, v_i \ge 0 \quad \text{for } r = 1,2,3,....s \text{ and } i = 1,2,3,4,.....m \text{----------(iii)}$$

Where:

$h_o(u,v)$ = Relative efficiency of the o^{th} the $SACCO_o$

x_{ij} = observed amount of input of the i^{th} type of the j^{th} SACCO (x_{ij} >0, i=1,2,3…….m and j=1,2,3,….n)

y_{rj} = observed amount of output of the r^{th} type of the j^{th} SACCO (y_{rj} >0, r=1,2,3…….s and j=1,2,3,….n)

u_r and v_i: the weights of the outputs and inputs respectively to be determined.

The solution to the above CCR problem, however, is infinite since if (u^*,v^*) is optimal, then for any positive scalar value λ then $(\lambda u^*, \lambda v^*)$ will also be optimal. To solve the problem therefore, we use the Charnes-Copper (1962) transformation to select a representative optimal solution (u,v) for which $\sum_{i=1}^{m} v_i x_{io} = 1$. Towards this end, a linear programming

problem equivalent to the linear fractional programming problem (i) – (iii) is derived as follows:

$$\text{Max} \quad h_o(u,v) = \sum_{r=1}^{s} u_r y_{ro} \text{---} (iv)$$

Subject to:

$$\sum_{r=1}^{s} u_r y_{ro} - \sum_{i=1}^{m} v_i x_{ij} \leq 0, (j=1,2,.......n) \text{---------------------------------------}.(v)$$

$$\sum_{i=1}^{m} v_i x_{io} = 1 \quad (i=1,2,3,\ldots\ldots\ldots\ldots m)\ldots\ldots\ldots\ldots\ldots\text{---}\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(vi)$$

$$u_r, v_i \geq 0 \text{ for } r = 1,2,3....s \text{ and } i = 1,2,3,\ldots, m \text{ - } (viii)$$

Models (iv) – (vii) is the so called input oriented CCR model in which maximization is pointed towards the choice of weights u and v which produces the greatest rate of output per unit of input.

From the above, input-oriented CCR model can be written as follows:

$$\underset{\lambda}{\text{Min}} \quad Z_o = \Theta_o \text{---} (viii)$$

Subject to:

$$\sum_{j=1}^{n} \lambda_j y_{rj} \geq y_{ro}, (r=1,2,.......s) \text{---} (ix)$$

$$\Theta x_{io} - \sum_{j=1}^{m} \lambda_i x_{ij} \geq 0, (j=1,2,.......m) \text{---} (x)$$

$$\lambda_j \geq 0, \ j = 1,2,3.....n \text{---}.(xi)$$

Solving the dual problem above yields an optimal solution Θ^* representing the technical efficiency score (CCR- efficiency) for a particular DMU_o and repeated for all n DMUs such that $0 \leq \Theta^* \leq 1$. All DMUs $\Theta^* < 1$ with said to inefficient

The alternate to the CRR model is the BCC model named after Barker, Charnes – Cooper (1884). It is sometimes referred to as the Variable Return to scale (VRS) BCC model as opposed to the Constant return to scale (CCR) model. BCC model is obtained by imposing an extra condition $\sum_{j=1}^{n} \lambda_j = 1$ on the dual CCR model above. When solved, the BCC efficiency scores while having same interpretation as the CCR efficiency are called pore technical efficiency scores

According Cooper et. al., (2000), using the scale property of the CCR and BCC models, another measure, the scale efficiency can be derived by dividing the CCR efficiency for each DMU by a corresponding BCC efficiency scores This is the definition used in this study.

Model Speciation and Data

Using the CCR and BCC models efficiency scores for two categories of production units as follows:

DMU Category	Number	Description
SACCOs	94	In this context, SACCOs are the DMUs processing inputs to produces various output levels

From 2010-2013 94 SACCO had complete information and are registered with the regulator, SASRA. In it terms DEA efficiency variables, the following table represents the selected inputs and outputs used in the study.

Item	Measurement
Inputs	
Membership	Number
Total Assets	Ksh.
Deposits	Ksh.
Output	
Turnover	Ksh.
Loans and Advances	Ksh.

Tobit Regression Analysis

DEA methodology yields efficiency scores that range between 0 and 1, making the dependent variable a limited dependent variable. According to previously conducted studies the use of Tobit model is more accurate in estimating the variation of performance measurement and thus provides a precise result which may serve as guidance for further improvement, whereas the estimation with an ordinary least square (OLS) may lead bias to variation estimated. The efficiency scores obtained from DEA in the first stage are the dependent variables in the second stage of the Tobit model. Tobit models refer to regression models in which the range of the dependent variable is constrained or limited (Amemiya, 1984).

In statistics literature, Tobit model is an extension of profit analysis developed by Tobin (1958) which is also called censored normal regression model (Goldberger, 1964). In this stage therefore, we investigate the effect of concerned variables on DEA efficiency of SACCOs using Tobit regression model. The model consist of five independent variables of which two (members and total assets) are DEA input while three (Turnover, Loans and

Advances and Deposits) are output variables. All those variables are measured at 5% level of significance. The identified efficiency determinants help inefficient SACCOs to pay attention on those, so as to become efficient. Tobit regression model is applied on the derived Scale efficiency and the results are tabulated as indicated in table below. The following Tobit regression mode equation is used

$$E_{it} = \beta_0 + \beta_1 Turnover_{it} + \beta_2 Loan\ \&\ \text{Advances}_{it} + \beta_3\ \text{Members}_{it} + \beta_4\ \text{Deposits}_{it} + \beta_5\ \text{Total-Assets}_{it} + \xi_{it}$$

Where E_{it} = Efficiency of the i^{th} DMU(SACCO) in year t, $Turnover_{it}$ = Annual Turnover for the i^{th} SACCO in year t, $Annual\ Loan\ \&\ Advances_{it}$ = Loan & Advances for the i^{th} SACCO in year t, $Members_{it}$ = Members for the i^{th} SACCO in year t, $Annual\ deposit_{it}$ = Annual deposit for the i^{th} SACCO in year t and $Total\ Asset_{it}$ = Total Asset for the i^{th} SACCO in year t. Where I = 1,2,3,4……94 and t=1,2,3

The sign of coefficients β_i (J=1,2,3,4,5) is expected to be positive (+) or negative (-). A positive sign implies a positive effect on the mean of E_{it} being observed or has a positive likelihood of E_{it} being observed

Test for the significance of the input and output my coefficients:

$H_o : \beta_j = 0$

$H_1 : \beta_j \neq 0$ for j = 1,2,3,4,5

The Data Set

The study used secondary data from SASRA Supervisory Reports from 2011-2013. The SACCOs included in the study were from the entire County but with complete data on the selected variables. In total the information from 188 SACCOs were collected but only 94 had complete information and were used in the analysis. The key variables extracted from financial statements are: Annual turnover, Loans and Advances, Members, Deposits and Total Assets. The first two were used as inputs and the last two variables were used as outputs in the analysis.

According to Charnes and Coopers (1990) the rule of thumb suggests that the minimum sample size required for data envelopment analysis is three times the sum of total number of inputs (X) and total number of outputs (Y), that is, N = (Y+X) *3. Further empirical studies using simulation data demonstrated that as sample size increases, the DEA frontier converges to a true relative efficient frontier for a specific industry under study. The improvement follows a negative exponential trend with the optimal sample size between 50-160 observations (Zhang and Bartels, 1998). Based on this literature our sample size is considered reasonable for data envelopment modeling.

EMPIRICAL RESULTS

Descriptive Statistics

In the table 1, we present the descriptive statistics (mean, standard deviation and skeweness) for annual turnover, loans and Advances, members, deposits Total assets and efficiency from 2011-2013.

Table 1: Descriptive statistics

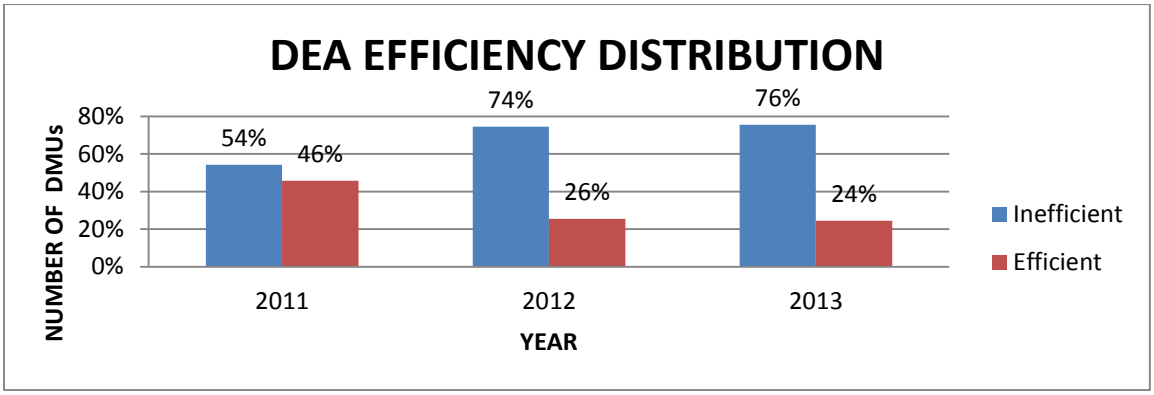
		2011			2012			2013		
Variables		(1.11)	(2.11)	(3.11)	(1.12)	(2.12)	(3.12)	(1.13)	(2.13)	(3.13)
Output	Turnover	208.30	418.23	4.29	163.30	313.53	4.08	250.85	493.93	4.16
	Loans Adv	1265.54	2826.63	4.25	1139.69	2529.48	4.52	1450.07	3185.37	3.98
	Members	12981.0	23017.3	3.82	10342.4	15898.7	2.97	14964.4	24891.5	3.09
Inputs	Deposits	1173.11	2507.66	4.01	1043.43	2242.91	4.27	1369.35	2803.37	3.93
	Total-Assets	1603.67	3349.68	4.06	1432.65	2989.26	4.12	1901.10	3769.99	3.85
Efficiency		0.95	0.08	-2.66	0.86	0.18	-2.14	0.67	0.36	-0.66

Legend: (1.11)= Mean 2011, (2.11) = Standard Deviation for 2011, (3.11) = Skewness for 2011, 1.12)= Mean 2012, (2.12) = Standard Deviation for 2012, (3.12 = Skewness for 2012 and 1.13)= Mean 2013, (2.13) = Standard Deviation for 2013 and , (3.13) = Skewness for 2013

SACCO DEA Efficiency

The performance of 94 SACCOs is examined in terms of their ability to provide outputs with minimum input consumption. The DEA efficiency scores can be seen as indicating how much each SACCO could reduce its input usage without reducing output. For example, if a particular firm has an efficiency score of 0.78, this implies that this particular SACCO needs to reduce its inputs by 22%, to achieve 100% efficiency. The DEA-Solver software of Cooper et al. (2000) was used to run both the CCR and BCR models. Figure 1 shows a descriptive distribution of efficiency results. Out of the 94 SACCOs, 46%, 26% and 24% of the SACCOs were efficient meaning that at least 54% of the firms needed to reduce their inputs to achieved 100% efficiency

Figure 1: SACCO DEA efficiency Score (2011-2013)



It is clear from the above result that there is a significant decrease in efficient SACCOs over the target period. Further Table 2 presents the summary of SACCOs' efficiency scores. A firm is said to be efficient if it produces maximum outputs at the minimum possible inputs compared to its peers. The technical efficiency (TE) scores were further decomposed into pure technical efficiency (PTE) and scale efficiency (SE). The decomposition provides more insights into the sources of inefficiencies. Pure technical efficiency measures how SACCO utilizes the resources to produce output under exogenous environments. Scale efficiency measures if the SACCOS are operating at their optimal scale. The returns to scale helps determine whether the SACCOs have been operating at the most productive scale size (constant returns to scale), increasing returns to scale (IRS) or decreasing returns to scale (DRS). The performance ranking is reported based on the composite efficiency score (Technical efficiency). The table shows Estimates for Technical Efficiency (TE), Pure Technical Efficiency (PTE), Scale Efficiency and Returns to Scale

To make sense of the individual scores from Table 2 the results were aggregated into overall average scores for technical, pure technical and scale efficiency as reported in Table 3. The results of efficiency estimates reveal that in 2011, 2012, and 2013 12 (23)(14), 10 (19)(11) and 15 (35)(17) SACCOs were technically fully efficient (had a score of 100% under technical efficiency) under the CRS, VRS and Scale respectively. The average technical efficiency score is about 81%(86.4%(94.4), 65%(76%)(86.6) and 51.4%(72.3%)(67.1%) under CRS and VRS and Scale models in 2011, 2012, 2013 respectively.

Table 2: Summary of Efficiency Estimate with total number of DMU per category in brackets Item

Attribute				**2011**	**2012**	**2013**
Number of DMU				94	94	94
Number of Efficiency DMU under			CRSTE	12	10	15
VRSTE	23	29	35			
Scale	14	11	17			
Mean			CRSTE	0.810	0.650	0.514
VRSTE	0.854	0.760	0.723			
Scale	0.949	0.866	0.671			
Returns to Scale			CRS	14.8% (14)	12.% (12)	18% (17)
DRS	44.5% (42)	15.9% (15)	13.8% (13)			
IRS	40.7% (38)	72.1 (67)	68.2% (63)			

Note: The actual number of firms is shown in the brackets

The results show that there is a drop in the three efficiency measures with the highest drop being in the average technical efficiency scores which decreased from 81% during 2011 to 51.4% in 2013. The decline was mainly attributed to both decreasing pure and scale technical efficiency scores over the target period.

Further, we also tested whether there is a significant difference between efficiency scores over the target period. Paired sample t-test was used when both the input and output variables are considered as treatments (Table 3).

Table 3: Paired sample t-test output

Estimated pure efficiency	Std. Error Mean	t-value	df	P-value
2011 & 2012	.018350	5.200	93	.000
2011 & 2013	.035336	7.958	93	.000
2012 & 2013	.036921	5.032	93	.000

It is noted that all the efficiency measures over the three years were found to be significantly lower than one. This implies that on average the SACCO sub-sector is operating below the desired efficiency level. A test for the difference between efficiency scores over the period produced a p-value of 0.000 for each year at 5% level of significance which can be interpreted to indicate that the various treatment (input and output) levels have a significant effect on the SACCOs performance

Tobit Regression Results

Proposed by Tobin (), Tobit regression model (TRM) sometimes called censored regression model (CRM) is a non-linear statistical model that describes the relationship between non-negative independent variables X and the dependent variable Y. The methodology is designed to estimate linear relationships between variables if the value of the dependent variable is non-negative (Y_i >0). This model has been extensively used in estimating the effect of determinant variables on efficiency. It is mainly used with DEA model as the second stage of analyzing efficiency in various fields including finance, education, health among others. From Tobit model results t-value of ±1.96 and p-value at 1%, 5% or 10% significance levels are normally used. However, p value at 5% significance level is highly accepted and recommended. We use censored regression model to analyze the effect of each input and output element on efficiency in order to complement the limitation caused by DEA model.

Tobit regression analysis is appropriate to estimate regression equation where the range of dependent variable is limited and because in this study the range of efficiency estimated is limited to 0 and 1. Therefore, this study models Tobit regression equation that has efficiency points as dependent variables and the elements that are considered to influence on the efficiency points as independent variables

In order to grasp multicollinearity of independent variables included in Tobit regression equation, we conducted an analysis of correlation between efficiency points calculated through the DEA model and all the input and output elements and the result is as the following Table.

Table 4: 2011 DEA Efficiency and Input/output Correlation Results

2011 Correlation results						
Variables	**E**	**T**	**LA**	**M**	**D**	**TA**
EFFICIENCY (E)	1.000000					
TURNOVER (T)	-0.007010	1.000000				
LOAN& ADVANCES (LA)	0.001397	0.972439	1.000000			
MEMBERS (M)	-0.073559	0.450688	0.414286	1.000000		
DEPOSITS (D)	-0.006576	0.976038	0.993224	0.415240	1.000000	
TOTAL ASSET (TA)	-0.008109	0.973520	0.996624	0.437859	0.995934	1.00000
2012 Correlation results						
Variables	E	T	LA	M	D	TA
EFFICIENCY (E)	1.000000					
TURNOVER (T)	0.026143	1.000000				
LOAN& ADVANCES (LA)	-0.028878	0.979905	1.000000			
MEMBERS (M)	0.066620	0.571248	0.614074	1.000000		
DEPOSITS (D)	-0.030329	0.975466	0.993963	0.608523	1.000000	
TOTAL ASSET (TA)	-0.031143	0.973065	0.994964	0.639125	0.993728	1.00000

2013 Correlation results						
Variables	E	T	LA	M	D	TA
EFFICIENCY (E)	1.000000					
TURNOVER (T)	0.114146	1.000000				
LOAN& ADVANCES (LA)	0.103128	0.983990	1.000000			
MEMBERS (M)	0.180680	0.416024	0.388619	1.000000		
DEPOSITS (D)	0.110146	0.981181	0.992120	0.391411	1.000000	
TOTAL ASSET (TA)	0.105149	0.982731	0.994706	0.409372	0.996844	1.00000

From the results the input variables with the largest correlation coefficient with efficiency is total assets in 2011 and 2012 and deposits in 2013. Of the input variables, the one with the largest coefficient estimate is members for each year while that with the least value is loans and advances in 2011 and 2013. It is noteworthy that whether largest or lowest all the correlations coefficients are significantly low ranging from 0.001 to 0.18. Therefore, a Tobit regression models was derived using efficiency estimates as dependent variable by the DEA model and all the input and output variables for each year. The model was estimated using EVIEWS 8.0. . Thus the Tobit model specification used is this study may be as follows:

$$y_{it} = \beta_0 + \beta_1 Turnover_{it} + \beta_2 Loan\,\&\,\text{Advances}_{it} + \beta_3\,\text{Members}_{it} + \beta_4\,\text{Deposits}_{it} + \beta_5\,\text{Total - Assets}_{it} + \xi_{it}$$

For each t = 2011, 2012 and 2013. Table 4 shows the regression results for each of the three years together with other relevant statistical measures.

Table 4: Regression Model Results

	2011				2012				2013			
Input/Output	Beta Coefficient	Std. Error	z-Statistic	P-Value	Beta Coefficient	Std. Error	z-Statistic	P-Value	Beta Coefficient	Std. Error	z-Statistic	P-Value
MEMBERS	8.54E-06*			0.0493	2.30E-05*			0.0000	7.97E-06*			0.0056
DEPOSITS	-0.00015			0.6986	0.000136			0.6638	-8.15E-06			0.9778
TOTASSET	0.00071	0.00093	1.160958	0.0881	0.000203	0.001030	4.780603	0.4607	0.000372	0.000740	1.375111	0.1586
TURNOVER	0.00108	0.00036	-2.146319	0.2457	0.004924*	0.000323	2.980498	0.0000	0.001018	0.000199	-2.719845	0.1691
LOANADV	-0.0007*	4.34E-06	1.966312	0.0318	-0.000962*	5.57E-06	4.121850	0.0029	-0.000542*	2.88E-06	2.769320	0.0065

*Significant variable at 5% level of significance

It is significant to note that the dependent variable in the model is DEA efficiency scores. Positive coefficients imply a rise in efficiency, whereas negative coefficients mean fall in efficiency. From the results, the explanatory variables with positive beta values , in this cases for turnover and members and total assets imply a rise in efficiency, whereas negative beta coefficients for example for loans and advances and total assets mean fall in efficiency. We further used Wald test of significance to test the null hypotheses that the betas are equal

to zero. The result was a F-test and a Chi-test = 0.000. This explains that the variables contribute to the fit of the model. The results further show that in 2012, Turnover, Loans and Advances and members were statistically significant while 2013, only Loans and Advances and Members were at 5% level of significance Like in 2011, we further used Wald test of significance to test the null hypotheses that the betas are equal to zero and found that in both years, both the F-test and a Chi-test = 0.000 implying that the input and output variables significantly contribute to the fit of the model. Results of insignificant coefficients across the years indicates that they may affect efficiency either positively (+ Betas) or negatively (- betas) however the effects are not statistically significant.

According to Tobit model empirical results in table 4 above, indicate that in 2011 and 2013 loans and advances while in 2012 an additional variable, turnover were statistically significant for efficiency at 5% level of significance. The rest of the variables remained statistically non-significant Whereas loans and Advances indicates a negative relationship with SACCO efficiency, SACCO members exhibited a positive relationship. A negative relation indicated by loans and advances implies that this variable has more inputs available to generate it as an output. Thus any increase in its outputs will lead to its decline as an output.

CONCLUSION

This study used two-stage DEA and Tobit regression methodology to investigate the efficiency and assess the determinants of performance of Kenya's SACCOs. In the first step, CCR, BCR and pure efficiency measurements were calculated using DEA approach on 94 firms taken in 2011 - 2013. Having obtained the various efficiency measures, the censored normal regression model of Tobit was used to explain the variation in calculated efficiencies to a set of explanatory variables. These variables were firm's output variables (turnover, loans and advances, members) and input variables (deposits and total assets).

The result estimated using censored normal regression model offers useful economic insights. The significance of SACCOs members and loans and advances in 2011 and 2013 and members, loans and advances and turnover is an indication that the SACCOs with higher values of members, loans and advances ad turnover were more efficient. In terms of beta values, deposits and loan and advances are negatively associated to efficiency, indicating that an increase in deposits and loans and advances may be an obstacle to a SACCO to be efficient in Kenya. However while the effect of loans and advances is statistically significant that of deposits is not. The rest of the input and output variables though affecting efficiency positively are however also not statistically significant

LIMITATIONS AND FURTHER STUDY

The basis of this study was purely secondary data published by SASRA in its annual supervisory reports. The data include SACCOs' financial statements so of which may not have been audited and thus having the potential to introduce inaccuracies which may then impact negatively on the results. Also the study did not disaggregate the SACCO by standard classification a situation which may lead to inconclusive interpretations.

Further studies shall be conducted on following areas: a. Evaluating the performance of the 47 counties in Kenyan using aggregated SACCO DEA efficiency scores; b. Assessing the efficiency of SACCOs using the two stage approach but over the years and not for each year.

RECOMMENDATIONS

The findings have implication to both the SACCOs, the regulatory authority SASRA and Academicians. From the results, the following recommendations could aid be made towards addressing issues of inefficiencies:

a) SACCO managers and members should be keen on those inputs variables that contribute to apparent inefficiencies. For example small SACCOs should to increase their size and managerial capacity to enhance efficiency. This can be realized by instituting improvement in the institution's managerial capacity technical support to increase their size of operation. This study also recommends that scholars to assess issues which limit the SACCOS' performance such as current influence of regulations in financial performance of SACCOS, and efficiency of SACCOS in all sectors of operations. The study further recommend that studies should be designed to assess compare the performance of rural and urban SACCOS, among others

b) Secondly, the regulator (SASRA) needs to focus on activities that assure quality especially in the use of inputs to produce outputs. This a part from the potential use of result to objectively rank the SACCOs on performance;

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