Technical and Scale Efficiency of Tanzania Saving and Credit Cooperatives

Nyankomo Marwa and Meshach Aziakpono

ERSA working paper 510

March 2015
Technical and Scale Efficiency of Tanzanian Saving and Credit Cooperatives

Nyankomo Marwa∗ and Meshach Aziakpono†

March 13, 2015

Abstract

In measuring technical and scale efficiency of Tanzanian Saving and Credit Cooperatives we used a sample of 103 audited financial statements during 2011. Data envelopment analysis was employed to explore the efficiency scores. The results show that average scores are 42%, 52% and 76% for technical, pure technical and scale efficiencies respectively. Since most of the inefficiencies are either technical or scale in nature, the study recommends increasing the operating scale for smaller firms. Firms operating beyond the optimal scale may need to downsize. Also the managers from technically inefficient firms should reduce the waste of the productive resources by utilizing their inputs more efficiently.

JEL Classification: G21, D2, C5

Key Words: Efficiency, Saving and Credit Cooperatives, Data Envelopment Analysis, Tanzania

1 Introduction

The financial sector plays a critical role in economic growth and economic development (Beck and Levine, 2004; Levine, 1998). However, the impact of the financial sector to economic growth is realized if the sector is efficiently managed and well monitored. Corollary to that, if the financial sector is not effectively monitored and regulated it may lead to economic crisis. As argued by Sufian (2011) the health of financial sector is very critical for the health of the economy at large. Given the relationship between financial sector and economic growth, the knowledge about the efficiency of financial institutions and the underlying factors that influence efficiency is crucial. Such knowledge is necessary to provide insights for managers, regulators, policy makers and other stakeholders to formulate going forward policies to improve the efficiency of the financial sector.

∗PhD candidate in Development Finance, Stellenbosch University Business School, South Africa. Email: nyankomo.marwa@gmail.com
†Professor of Development Finance, Stellenbosch Business School, South Africa. Email: Meshach.Aziakpono@usb.ac.za
The purpose of this study is to extend the earlier empirical work on efficiency analysis of financial sector into saving and credit cooperatives (SACCOs). More specifically, the study investigates the technical and scale efficiency of SACCOs in Tanzania. Such analysis could foster a better understanding of the performance of the SACCOs and provide evidence-based inputs for informed policy dialogue and decision making in the microfinance sectors. The findings of such a study could also provide insights needed to formulate long-term policy and development management strategy for SACCOs in the country.

SACCOs is among the fastest growing microfinance niches but often less explored in empirical literature. Among others, the limited data availability and poor governance might have acted as red tape preventing the academic research in this area. Most of the empirical literature on microfinance performance modelling is based on Asia and Latin America with some focus on credit unions from North America and the UK (Jayamaha and Mula, 2011; Haq et al., 2009; Qayyum and Ahmad, 2006; Gregoriou and Sedzro, 2005; Nghiem, 2004; Fried et al., 1993). The mix market dataset has been a dominant source for most of the recent empirical work on microfinance performance (Louis and Baesens, 2013; Arrasen and Avouyi-dovi, 2013; Haq et al., 2009; Bassem, 2008). Unfortunately the mix market data does not include most small microfinance institutions such as saving and credit cooperatives. This has led to structural omission of such a segment of microfinance in empirical research due to data problems. The current study explores this frontier and makes the first attempt in exploring the data challenges and solving the existing knowledge gap on the performance of these institutions in Tanzanian context.

Despite the dearth of empirical work, the sector plays significant role in bridging the gap left by credit market failure in developing countries and Tanzania in particular. In fact, the financial sector in Tanzania is highly underdeveloped, with a private sector credit to GDP ratio of 20%, and about 90% of the population excluded from the main stream financial sector (WB, 2013; Finscope, 2009). As a result of such market failures, saving and credit cooperatives (SACCOs) and other microfinance institutions have emerged as an alternative solution. Saving and Credit Cooperatives particularly have experienced strong growth as an alternative financial service provider for the poor. According to the Ministry of Agriculture, Food Security and Cooperatives (2012) and Bank of Tanzania (2009), the number of SACCOs has increased from 803 in 2000 to 5,344 in 2009. Such an increase is about 565% over nine years. The number of members and direct beneficiaries has increased from 133,134 to 911,873 in the same period, which is about a sevenfold growth rate within 9 years. Members’ savings have increased from 8.4 billion to 158 billion Tanzanian shillings (TSHS), equivalent to about a 19-fold growth in the same period.

While the growth rate is impressive, the speed at which SACCOs are growing raises many questions about their performance. The fact that, most of these

\footnote{Mix Market (Microfinance Information Exchange) is an online data base portal for microfinance around the world. It is important to note that most of the small microfinance organizations, such as saving and credit cooperatives from poor countries, are not included in the data base. The data set can be accessed at http://www.mixmarket.org/}
institutions operate in a relatively small scale and high risk environment with low potential for cost and loan recovery (at least in theory) complicates the issue further. Hence, the observed growth record despite the odds makes a systematic investigation of their performance a timely undertaking.

2 Background of Tanzanian Cooperative Movement

The cooperative movement in Tanzania dates back to 1925 when small holder farmers in Tanganyika (now the Tanzania) started informal (unregistered) cooperatives so that they could capture part of the trade profit of their crops. The first cooperative union in the country was the Kilimanjaro Native Cooperative Union (KNCU), which was registered with its eleven affiliated primary cooperatives on first of January 1933. Since then, the cooperative movement experienced vibrant growth across the country with visible presence in southern highland, Lake Zone and other parts of the country especially during post-independence era. By 1968 Tanzania had the largest cooperative movement in Africa and the third largest cooperative in the world in terms of percentage of the market share of agricultural exports (University Press, 1968, Maghimbi, 1992; Maghimbi, 2010, Mwakajumilo, 2011). It was observed that the cooperative movement in Tanganyika was expansive as the quotes below demonstrate:

... Cooperatives handle £27.5 million worth or 49 per cent of the country’s annual exports. Only in Israel and Denmark do cooperatives market a greater proportion of the nation’s overseas business (University Press, 1968:176).

During this era the cooperative movement was dominated by agricultural and marketing cooperatives with relatively weak participation of saving and credit cooperatives. Unfortunately during the mid-1970s the government instituted radical changes in government policy on cooperatives after the introduction of socialism to all macroeconomic and social programmes. During mid-1976 all primary cooperatives were abolished by the government and their crop marketing functions were taken over by communal villages. At the same time cooperative unions were also abolished and their functions were taken over by parastatal crop authorities, which had to buy crops directly from villages. “The services which were rendered by the abolished cooperatives, such as wholesale and retail trade, were taken over by state owned cooperatives in Tanzania mainland” (Maghimbi, 1992:224-225).

The said policy change led to almost total collapse of the cooperative movement in the country, however after serious failure of the policy, the country’s cooperative movements were re-introduced in 1982. But, when they were reinstated they failed to recover their old vibrancy. Interestingly, saving and credit cooperatives (SACCOs) which were dwarfed by the crop marketing cooperatives during the pre-abolition period have become more vibrant. SACCOs have grown rapidly since the late 1980s. As institutions, they have remained more stable than the crop marketing cooperatives. During 1980s and 1990s when
most crop marketing cooperatives collapsed, the Sacco Societies (SACCOs) continued to survive (Maghimbi, 2006).

Statistics from Savings and Credit Cooperative Union League of Tanzania (SCCULT), show that, SACCOs increased from 803 in 2000 to 4,524 SACCOs in 2007. Most recent statistics from bank of Tanzania show that during 2012, there were about 5400 SACCOs. It is further reported that, SACCOs are now the leading type of cooperative in terms of numbers of cooperatives and memberships (Mwakajumilo, 2011). In terms of regional ranking, Dar Es Salaam, Mwanza, Mbeya, Kilimanjaro, Kagera and Iringa are the leading regions in number of SACCOs (Mwakajumilo, 2011).

While the causes of the surge in SACCOs' growth is beyond the scope of this study, such growth might be explained by a combination of reasons including the organic growth and partly the positive incentive introduced by the recent wholesale lending policy initiatives by commercial bank and public institutions like pension funds. The widely mentioned major driver by practitioner on the field is the active public and private sectors involvement in making external funding available. There are at least four major players in this space. These players can be broadly categorized into public players which include government funding and pension funds initiatives. Private sector players, which include local banks and international entrepreneurs.

The government of Tanzania in the past decade has initiated at least three major programmes to promote saving cooperatives and improve financial access. These initiatives includes: Rural Financial Services Programme (RFSP), Presidential Trust Fund to foster entrepreneurial spirit and increase access to finance for the poor. Also the African Development Bank funded project known as Small Entrepreneurs Loan Facility (SELF) is actively extending loans to SACCOs. Another public initiative is the active involvement of public pension funds like National Social Security Fund (NSSF) and Parastatal Pension Fund (PPF) in extending whole sale loans to SACCOs. All these initiatives focuses on making finance available to the poor but with conditions that they can only be channeled through a group managed financial cooperatives. Thus there has been a positive incentive from the supply side which has catalyzed the positive response from the demand side.

The private sector also have played an active role in this pace, many local banks and international social entrepreneurs have microfinance window which offers whole sale lending to SACCOs. A good example is local banks like CRDB, National Microfinance Bank (NMB) and Women Bank of Tanzania which have a special window for wholesale lending for SACCOs. Other international entrepreneurs playing in this space includes Opportunity International, Oiko Credit, FINCA, BRAC, Desdjardins International Development, and Alliance for Green Revolution (AGRA). While there may be other factors driving the growth of SACCOs by large, the observed surge in growth can be explained by positive incentives from the supply side. Also the recent trend of market based economic policy and economic liberalization in the country may have played important role from the supply side. Since about 90% of the population is excluded from the classical banking system, it follows that the increased supply of wholesale
lending would create its own demand as would be predicted by Says law\(^2\).

The questions which calls for answers after observing the explosive growth of these institutions are: How is such growth fairing in terms of efficiency and financial performance? Are these institutions run in a sustainable manner? Is it a boom which is going to burst? Since the industry is relatively new, operating in a relatively riskier segment and resource constrained clients, the questions raised become imperative?

3 Literature Review

3.1 Distinguishing Features of Financial Cooperatives

It is important to review the concept of financial cooperatives and show how it is different from conventional banking sector in setting the stage for further literature review on efficiency modeling. Cooperative organizations are special type of economic entities whose objective is to maximize the members’ welfare/benefits. In a typical cooperative organization, members are also users of the service(s). In some financial cooperatives, 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 cooperative (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 cooperative is to pursue both economic and social objectives.

In its simplest form, a financial cooperative is both a producer cooperative and a consumer cooperative. It is a producer cooperative 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 the main objective 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.

In Tanzanian context SACCOs are very diverse in terms of membership, size and affiliation. But they all operate under the cooperative principles, managed by democratically selected managers and board of directors. The limitation of being guided by democratic principle and owned and run by members is that, for small SACCOs or less diverse SACCOs they may not have enough pool of competence and skills to select from internally. However, as SACCOs grows bigger and become even more diverse there is an increasing tendency to hire external managers and accountants based on the experience and competence.

\(^2\)Says law states that supply creates its own demand.
3.2 Theoretical Literature on Efficiency Estimation

Both theoretical and empirical literature evaluating organizational performance is dominated by the use of frontier models. There are diverse frontier models, including parametric and non-parametric models. Despite their diversity, they share common characteristics in modelling relative efficiency as a quantitative measure of performance. In its simplest version, the efficiency of the decision-making unit (DMU) is defined as its ability to produce maximum possible output(s) with minimum possible inputs relative to its peers, subject to resource constraints and operating environments (Sufian, 2011; Coelli et al., 1996; Banker et al., 1984). When evaluating the relative efficiency of different firms, the best practice frontier function is estimated using the most productive units which share a common technology.

The dominant model under the parametric approach is the Stochastic Frontier Approach (SFA). In the non-parametric approach, Data Envelopment Analysis (DEA) is widely used in theoretical and the empirical literature. The SFA approach assumes the specific production function which is then used to map the relationship between the inputs and outputs to estimate economic efficiency which is further decomposed into pure technical efficiency and allocative efficiency (Fried et al., 1993). The advantage of this approach is its ability to control for the stochastic error component in its econometric estimation, but it suffers from being data intensive. Another downside of this approach is the possibility of mis-specifying the production function and the unresolved issues of the actual probability distribution of the random component which may lead to biased results (Drake, 2001).

Alternatively, the Data Envelopment Analysis (DEA) method developed by Charnes, Cooper and Rhodes (1978) has become an increasingly popular approach for efficiency estimation in banking literature. The method uses a piecewise linear programming procedure in identifying the empirical production functions based on the actual data. DEA compares all the similar units in a given population by taking several dimensions of the output and inputs into account simultaneously. Every unit is considered as a decision making unit (DMU) which transforms inputs into outputs.

The DEA model developed by Charnes, Cooper and Rhodes abbreviated as CCR-model (Charnes et al., 1978) and the model developed by Banker, Charnes and Cooper or the BCC-model (Banker et al., 1984) are used in this study. The two models are similar except that BCC model takes into account additional constrain to accommodate variable returns to scale. Because of the flexibility of DEA and data limitations the current study will employ DEA in efficiency estimation.

3.3 Empirical Literature on Efficiency Estimation

DEA have been extensively used in modelling efficiency in diverse fields such as: banking sector, microfinance, health sectors, and agriculture. According to Lee (2013) there are over 446 empirical works which have used the DEA approach,
mainly published in operation research, management science, production analysis, applied economics etc. Of interest to this paper is the empirical work on efficiency estimation in the banking and microfinance literature. There is extensive empirical research on the efficiency of financial institutions; however most of the literature is clustered around the banking sector with limited work on microfinance. When assessing the geographical distribution of the existing literature, most of the work is skewed towards North America and Europe with some notable work in Asia and Latin America but little in the African region. Among others, the existing empirical literature on banking performance in North America, Asia and Latin America can be accessed in Fukuyama (1993), Berger (1993), Berger and Humphrey (1997), Berger and Mester (1997), Drake and Hall (2003), Berger (2007), Delis and Papanikolaou (2009) Tahir et al. (2009), Saez-Fernandez and Picazo-Tadeo (2011), Sufian (2011) and Charles et al. (2011).

In sub-Saharan Africa the empirical work on banking performance focuses on Kenya, Tanzania, Botswana, Uganda, and South Africa and some traces in other countries. The most comprehensive study which provides a comparative analysis of sub-Saharan African commercial banks is the study by Kiyota (2011). However this study focused more on profit and cost efficiency using the stochastic frontier approach. Kamau (2011), Aikaeli (2008), Oberholzer and Westhuizen (2009) and Moffat (2008) investigated the efficiency of commercial banks in Kenya, Botswana, Tanzania and South Africa respectively.

Most of the empirical literature on microfinance performance modelling is based on Asia and Latin America with some focus on credit unions from North America and the UK (Jayamaha and Mula, 2011; Haq et al., 2009; Qayyam and Ahmad, 2006; Gregoriou and Sedzro, 2005; Nghiem, 2004; Fried et al., 1993). The mix market data set has been a dominant source for most of the recent empirical work on microfinance performance (Louis and Baesens, 2013; Arrasen and Avouyi-dovi, 2013; Haq et al., 2009; Bassem, 2008). Unfortunately the mix market data does not include most of small microfinance institutions such as saving and credit cooperatives. Such structural omission of SACCOs in mix market might be a possible explanation of the limited empirical research in this domain due to data problems. The current study tries to explore this frontier and make the first attempt in exploring the data challenges and solving the existing knowledge gap on the performance of these institutions.

The overall finding from the empirical literature is that the average relative technical efficiency of the banking sector ranged between 60%-94% for OECDs (Favero and Papi, 1995, Delis and Papanikolaou, 2009). For the sub-Saharan African banking sector, the average efficiency ranges from 60%-90% (Kamau, 2011; Moffat, 2008; Aikaeli, 2008; Oberholzer and Westhuizen, 2009). In the domain of microfinance the technical average efficiency estimates range between 14.5% and 69.0% (Kipesha, 2013; Jayamaha and Mula, 2011; Haq et al., 2009). The observed inter and intra region heterogeneity of efficiency scores is expected due to the differences in firms’ specific factors and operating environments. Apart from the environmental factors, the choice of variables included as inputs and outputs have been documented to influence the empirical results on efficiency. More discussions on the different approaches which have been used.
by the previous studies and the justification of the selection of the variable in banking literature are presented in the next section.

3.4 Specification of Inputs and Outputs

The specification of inputs and outputs in efficiency modeling is an important decision to be considered. In banking literature there are three major approaches which are useful in guiding the specification of inputs and outputs (Nghiem, 2004; Qayyum and Ahmad, 2006; Moffat, 2008). These approaches are: production approach, intermediation approach and assets based approach. The financial institutions are considered as the producers of deposits and loans under production approach. The number of employees and capital expenditures are important inputs in this approach. The second approach considers financial institutions as intermediaries, and as such they have the responsibility of transferring financial assets from the savers (surplus unit) to the investors (deficit unit). In this case the inputs can be defined as labour, capital cost and interest payable on deposits, while the loans and financial investments are considered as outputs in this approach. Finally under the assets approach it is assumed that the basic function of any financial institution is the creation of credit (loans), whereas the value of assets of financial institutions acts as output.

Depending on the approach adopted, the choice of the inputs and outputs may be different (Moffat, 2008; Drake, 2003), and the empirical results may be sensitive to the choice of inputs and outputs. Favero and Papi (1995) posit that there is no simple solution for the problem of input and output specification since reasonable arguments can be made in all the approaches. Hence the nature of the study and data availability plays a significant role in the final choice of the input and output variables. Since the intermediation approach closely matches the main objective of SACCOs, i.e. mobilizing savings and offering loans, this study adopts the intermediation approach in selecting the inputs and outputs. The choice of the intermediation approach for this study is also partly influenced by the data issues. In the intermediation approach the SACCOs are treated as financial intermediaries between the savers and borrowers. They seek to maximize the outputs (total loans and other incomes) given the input levels: deposit, labour and capital (Sufian, 2011).

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.
4 Methodology

4.1 Estimation Technique

Data Envelopment Analysis is used for estimation under constant returns to scale and variable returns to scale assumption. Basically DEA derives the data envelopment surface by joining those points in the input–output space such that it is no longer possible to produce more output with the same input or the same output with less input. In case of constant returns to scale the frontier will be linear, and for variables returns to scale the frontier will be convex hull (Favero and Papi, 1995). Once the data envelopment surface is established it is then used as a benchmark to measure the relative efficiency or inefficiency of all other firms outside the envelopment surface.

According to Yue (1992) a firm is said to be in a decreasing return to scale space if a proportionate decrease in both inputs and outputs will place the firm inside the production frontier, whereas if a proportionate increase or decrease will move the firm either along or above the production frontier, then a firm is said to be in constant returns to scale space. In the case of decreasing returns to scale, a proportionate decrease in a firm’s output and inputs will place it inside the frontier and a proportionate increase is not possible because it moves the firm outside the frontier. Therefore, depending on the actual behavior experienced, a firm may be categorized in any of the three scale categories: increasing returns to scale, decreasing returns to scale, or constant returns to scale.

Technical efficiency is estimated by measuring the ratio of the distance between reference point’s distance to constant returns to scale frontier and inefficient firm’s distance from the same frontier. The distance measured can be either in the input space or output space depending on input orientation. It is possible to decompose technical efficiency into scale efficiency and “pure” technical efficiency (Lee and Ji, 2013). Pure technical efficiency (PTE) is measured as the ratio of the distance between inefficient points to variable returns to scale (VRS) efficient frontier.

In a multiple outputs and inputs settings with large number of firms, DEA can be formulated either as constrained maximization or minimization objective function under the general framework of linear programming. Since the maximization (multipliers) formulation is cumbersome to solve numerically; the alternative minimization (dual) formulation is often used because of it is mathematically tractable (Coelli et al 2005). Following Coelli et al (2005) this study uses minimization formulation with following mathematical representation:

\[
\text{Min}_{\theta, \lambda} \theta \quad \text{subject to} \quad \begin{cases} 
-q_i + Q\lambda \geq 0 \\
\theta x_i - X\lambda \leq 0 \\
\lambda \geq 0
\end{cases} \quad j = 1, 2, 3, \ldots, I,
\]

Where \( \theta \) is efficiency score of \( i^{th} \) firm; \( q \) is column vector of outputs, \( Q \) is \( M \times I \) output matrix; \( x \) is column vector of inputs and \( X \) is \( N \times I \) input matrix for all DMUs and \( \lambda \) is \( I^*1 \) vector of weighting coefficients.
The value of $\theta$ computed is the efficiency score for the corresponding DMU. It ranges between 0 and 1 with the value of 1 indicating a point on the efficiency frontier and hence a technically efficient DMU. All efficient firms will be connected by a continuous locus to form efficient frontier. The efficient score for every DMU will be measured by how far it deviates from the frontier.

After estimating efficiency scores, one sample t test was used to test if average technical efficiency, scale efficiency and pure technical efficiency scores were statistically significantly different from one. Since the efficiency scores may be exhibiting positive skewness, the Wilcoxon rank sum test (a non-parametric alternative of the one sample t test) is used to check the robustness of the results. The estimation process was implemented in STATA version 11. In estimating efficiency scores we used a DEA user written command developed by Lee and Ji (2013).

The data sets were further decomposed into four quartiles based on the loan size to probe the variation of efficiency scores across different firm sizes. Technical Efficiency, Pure Technical Efficiency and Scale Efficiency scores were evaluated in each quartile. The median spline plot was used to plot the median scores of technical efficiency over different loan sizes. The box plot was used to study the distribution of different efficiency scores in each quartile.

4.2 Data Source

The study used secondary data from annual audited financial statements for 2011. The data collection was done during February – April 2013, by then this was the latest audited financial statement data available. The SACCOs included in the study were from four regions\(^3\): Dar Es Salaam, Mwanza, Kilimanjaro and Arusha. In total the information from 139 SACCOs were collected but only 103 had complete information and was used in the analysis. The key variables extracted from financial statements are: Total Cost in TZS, Total Fixed Asset in TZS (a proxy for capital), Total Deposit in TZS, Total Revenue and Total Loan Portfolio in TZS. The first three were used as inputs and the last two variables were used as an output in the analysis. Table 1 provides a detailed breakdown per region.

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,

\(^3\)The four regions were selected based on the highest concentration of SACCOs with audited financial statement. By law all SACCOs should be audited by Cooperative Auditing and Supervisory Corporation (COASCO). However in practice less than 10% of 5300 SACCOs are audited countrywide. COASCO is severely constrained in terms of manpower and financial resources. Due to these challenges, the regions were ranked according to total number of audited SACCOs. All SACCOs with audited financial statement were included in all the top four regions. We considered SACCOs with audited financial statement because of the data consistency and feasibility of the study. We could feasibly collect data from four regions due to time, logistical challenges due to geographical dispersion of the regions and financial constraints. In total the four regions constitute of 32% (1717) of the total SACCOs in the country. The remaining 70% spread across more than 18 regions.
N = (s+m) *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 being between 50-160 observations (Zhang and Bartels, 1998). Based on this literature our sample size is considered reasonable for data envelopment modeling.

5 Empirical Results and Discussion

Descriptive statistics (mean, minimum, maximum, standard deviation) are presented in Table 1 for total loans, total expenditure, total deposit, total revenue and total assets. In the lower part of the table the ratio of average total deposit, average total revenue and average total expenditure to average total loans is presented in the last column. Such a proportion is useful for checking the percentage of external funding and the percentage of total cost to loan portfolio. Based on the summary statistics, the average total loan portfolio outstanding during 2011 was TZS 869 million. The average total deposit and total expenditure are 555 million and 61.2 million respectively. The percentage of the average deposit to average loans is 64%, implying that on average about 36% of the total outstanding loans is being financed by external funding sources. It is also important to note that on average SACCOs’ total expenditure is around 7% of their loan portfolio.

The efficiency scores were estimated (technical efficiency, pure technical efficiency, scale efficiency and returns to scale classifications) for each firm. The ideal situation is to have all three efficiency scores as close as possible to one. In the case of returns to scale the desirable situation is to have as many firms as possible under constant returns to scale space.

A firm is said to be technically efficient if it produces maximum outputs at the minimum possible inputs compared to its peers. The technical efficiency (TE) scores are 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 a SACCO utilizes the resources to produce output under exogenous environments. Scale efficiency measures whether 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).

To make sense of the individual scores the results were aggregated into average scores for technical, pure technical and scale efficiency as reported in Table 2. The results of efficiency estimates reveal that 9 firms were technically fully efficient (had a score of 100% under technical efficiency), 24 firms had a score of 100% under pure technical efficiency, and 9 firms had a score of 100% under scale efficiency. The average technical efficiency score is about 42%. This implies that on average the sample SACCOs only needed 42% of the inputs currently
in use to produce the same amount of output. The estimated average efficiency score is relatively low compared to what is observed in the banking industry in Tanzania (about 80%) as reported in Aikaeli (2008). However average efficiency scores reported here is higher than Tanzanian microfinance efficiency score of 14.5% as reported by Kipesha (2013) using mix market dataset.

Our results are quite close to the findings from cooperative rural banks reported in the study of Jayamaha and Mula (2011) from Sri Lanka. In their study, Jayamaha and Mula found that the average technical efficiency scores dropped from 66% during 2003 to 53.2% in 2005. The decline was mainly attributed to decreasing pure technical efficiency because the scale efficiency recorded positive growth during the same period. When compared with the results reported by Haq et al (2009) using mix market data for developing countries using intermediation approach (47%) the performance of SACCOS seems to be relatively lower. On other side our results are better than the recent SACCOS results reported by Tesfamariam et al (2013) in which they found average technical efficiency of Ethiopian rural SACCOS to be 21.3%.

When efficiency scores were tested to see if they were significantly different from one as reported in Table 3, all the three efficiency measures were found to be significantly lower than one. This implies that on average the industry is operating below the desired efficiency level as demonstrated by the negative and significant test statistics based on both one sample t test and one sample Wilcoxon signed rank test approach. In an effort to understand the sources of the inefficiency, technical efficiency scores were decomposed into pure technical efficiency and scale efficiency. When comparing the magnitude of t statistics, on average the scale efficiency seems to be relatively good compared to pure technical efficiency. This is in line with the results reported in table number two with average score of 42%, 52% and 76% for technical, pure technical and scale efficiencies respectively. This implies that most of the inefficiency is contributed by inefficient allocation of the factors of production. However, there is also a room for improvement in terms of scale efficiency.

Figure 1 illustrates the distribution of SACCOS across constant returns to scale (CRS-optimal scale), increasing return to scale (IRS-too small) and decreasing returns to scale (DRS-too large). In fact about 79 firms out of 103 (76.7%) are operating in sub-optimal scale. Only eight firms were operating in the optimal scale while 16 firms were operating beyond the optimal scale. From a policy and managerial perspective this means that those firms operating below the optimal scale may need to scale up and those operating beyond their optimal scale may need to improve their performance by scaling down.

Figure 2 demonstrates the behavior of technical efficiency across firm size using loan size as a measure of DMUs. The results show that technical efficiency follows an inverted U shape with two optimal solutions. The first sub optimal solution is the first half of the inverted U curve which represents the SACCOS whose loan size is below 1 billion (65%). The Second sub optimal represents the SACCOS whose loan size is above 1 billion. The implication of these results is that on average medium-sized firms and larger firms are more likely to be efficient. The smaller firms and very large firms are likely to be inefficient.
However the relationship between efficiency and size seems to be non-linear in nature. The possible explanation of the observed inverted U shape is that the small firms may be incurring higher fixed costs in offering the services and may not afford to attract the best talents in running their operations effectively. On the other hand relatively large firms are more likely to operate in diseconomies of scale. As pointed out by Coase(1937), large firms are more likely to suffer from resource misallocation, planning cost and cost of lack of motivation by the employee. Based on results reported in Figure 2, the optimal firm size seems to range between TZS 2.5 billion to TZS 6 billion. The range is wide which implies that, contrary to neoclassical economic theory, there is no single optimal point but there is a band of points which stretches between the ranges specified above.

Our findings are in line with the McConnell and Stigler’s illustration of the cost minimization curve of the firms in reality (Canback et al., 2006). According to Canback et al. (2006), such a cost curve with a wide range of optimal output reconciles with several real world observations. The implication from such an inverted U efficiency curve with a stretched “saddle point” is the possibility of a wide range of output levels which can be produced within that range for which the unit cost per output is somewhat constant. This implies that small, medium and large SACCOs can co-exist at the same time without compromising efficiency and competitiveness. However, when the firm is too small or too large, it may become counterproductive. Such flexibility is particularly important in SACCOs because they can easily converge to their maximum growth capacity due to their upper ceiling resulting from their inherent localized operations and ownership structure.

When the technical efficiency score is decomposed into pure technical efficiency and scale efficiency it becomes apparent that the major source of inefficiency emanates from pure technical inefficiency as compared to scale efficiency. While there is room for improvement for scale efficiency, the need for improvement in pure technical efficiency is even more critical. To understand how the three efficiency scores are distributed across the firm size, the box plot approach was used for each quartile as demonstrated in Figure 3.

A close look at Figure 3 reveals that the technical efficiencies score mimics a weak U shape. The U shape can be inferred by loosely connecting the median point of the corresponding box plot of the technical efficiency of each quartile. The observed U shape implies that the smaller firms and larger firms are relatively more efficient than the medium firms using loan quartiles as classification of firm size. The fourth quartile has the highest technical efficiency scores as demonstrated by the median scores in the box plot. The results for pure technical efficiency show the same pattern but with a more pronounced U shape with the fourth quartile almost fully efficient. This demonstrates that smaller firms and large firms are leading by efficiently utilizing the inputs under their disposal to produce the same amount of outputs. In contrast, the scale efficiency shows an inverted U shape. This can be observed by loosely connecting the median point of each corresponding box plot. The third quartile has the highest scale efficiency score followed by the fourth quartile. Based on the observed behavior for scale efficiency it appears that the optimal scale size for SACCOs is within
the third quartile. Comparing the results from Figures 2 and 3, it appears that
the inverted U shape results demonstrated by the technical efficiency scores are
mainly influenced by the scale efficiency.

The breakdown of firm size by quartile reveals a very interesting pattern
which may have important managerial and public policy implication. The ob-
ervation that pure technical efficient scores are higher in smaller firms (quar-
ter1) and larger firms (quarter4) are critical. The implication of this observation
is that as firms grow in size they start struggling with the internal managerial
challenges and this makes them become inefficient in allocating their inputs to
produce maximum possible outputs. In the context of SACCOs the results may
support the practice whereby as SACCOs grow bigger they tend to shift from
using member-based managerial skills to hiring external managers. However,
they can afford to hire the managers of a certain skill and education level which
can be outgrown by the managerial challenges of the organization as it grows
further. The process remains iterative and depends on their financial muscle to
compensate, attract and retain appropriate candidates for the position.

Furthermore, while people with low levels of education and financial liter-
acy can manage to lead small size SACCOs well, a slight increase in size may
outgrow their managerial competence. A corollary of the argument is that, as
the firm grows beyond a certain threshold, in our case as they move from quar-
tile 3 to quartile 4, their financial muscles increases, the size of their members
increase and diversity increases. The interaction of these factors is likely to
generate a new emergent complex pattern which may lead to a strong over-
sight, more willingness to hire external managers to manage the organization
and an increased ability to afford such services. This may possibly explain the
observed higher scores of pure technical efficiency in the fourth quartile. Also
as firms grow bigger, they tend to improve their scale efficiency by cutting down
per unit cost, as would be predicted by neoclassical economic theory. However,
such scale advantage occurs only up to a point beyond which it starts to become
self-destructive.

Based on our results, the optimal scale is reached in quarter three as demon-
strated by Figure 3. Further analysis demonstrates that the optimal scale advan-
tage can be reached as low as TZS 1.5 billion loan size and it starts decreasing
the further the firm is from this point. On the other side, the optimal pure
technical efficiency is achieved around TZS 2.3 billion and there is little gain
beyond this point (the figure 4 not included, available on request).

The observed declining efficiency in large SACCOs despite the highest scores
of pure technical efficiency is rather surprising. The possible explanation may
be that, as SACCOs grow larger, they are likely to become more specialized and
start attracting the lower end of the middle income clients and micro, small and
medium enterprises (MSMEs). By operating in such a space, they are exposed
to stiff competitive environment with the sophisticated commercial banks. If
this happens they are likely to lose through at least two channels. The first
channel is that commercial banks are highly sophisticated and enjoy economies
of scale which are relatively superior to those of large SACCOs. The second
channel is that since the large SACCOS are attracting clients on the bottom
of middle income clients and MSMEs, they are more likely to succumb to the riskier segment in this income category. If this happens, it means that large SACCOs are likely to increase their loans portfolio but with more risky clients.

6 Conclusion and Recommendation

The current study investigated the technical efficiency of 103 saving and credit cooperatives from Tanzania. The data used were collected from audited financial statements in 2011. The intermediation approach and input orientation was employed within a Data Envelopment Analysis Framework to estimate efficiency scores in terms of technical efficiency, scale efficiency and pure technical efficiency. The empirical findings show that the average technical efficiency is about 42%, and average pure technical efficiency was 52%, and scale efficiency was 76%. Most firms are struggling with how to efficiently utilize their resources to maximize the outputs. Smaller firms and larger firms seem to suffer from lack of economies of scale and diseconomies of scale respectively, while medium SACCOs experienced a significant increase in scale efficiency but a significant decrease in technical efficiency. Medium firms struggle with how to effectively manage and make effective decisions in resource allocation. Large SACCOs experienced high levels of technical efficiency but seemed to struggle with the scale problem. Large SACCOs may be exposed to a more competitive market space where they are forced to compete with large commercial banks. Only 8% of the SACCOs were operating in the optimal scale and about 15% and 77% of the SACCOs were operating at decreasing and increasing return to scale respectively. This implies that about 18% of the SACCOs were too large to operate efficiently and about 77% of the SACCOs were too small to operate efficiently. Since only SACCOs with audited financial statements were included in our study, there is a possibility of self-selection bias. Therefore our results may not be generalized to SACCOs without audited financial statements.

The policy implication from our finding is grouped into regulatory and management dimensions. The regulators (Bank of Tanzania, Ministry of Agriculture and Cooperatives, Cooperative Banks, Cooperatives Audit and Supervisory Corporation) need to work closely with SACCOs to create a supporting environment for small SACCOs to increase their size and managerial capacity. This may include the design of an in-service certificate course in SACCO management and accounting to improve managerial capacity and competence, constant monitoring and supervision, technical support and wholesale lending to increase their size of operation.

In terms of SACCO management, they need to be more careful in the way they manage their inputs in producing the outputs. With a better usage of available resources there is room to improve technical efficiency by 58%. Small SACCOs operating in the increasing return to scale space may wish to merge with other smaller ones or with larger and efficient ones. With the introduction of mobile banking such as M-Mpesa it should be easy to operate satellite offices virtually. Such technological innovation may be adopted by merged SACCOs to
reduce overhead cost but still maintain accessibility. Large SACCOs may need to spin out (demerger) since they have grown too big for efficient operation. Another option is for large SACCOs to merge with a commercial bank and operate as a microfinance satellite branch of a commercial bank.

Future studies may wish to upscale the study to widen both the geographical coverage and non-audited SACCOs. This will help to validate the study using more data. Also if data allows it may be important to analyze the performance over time to understand the dynamics within the industry.

Acknowledgement
We acknowledge the funding support from REPOA and African Economic Research Consortium.

References


Table 1: Averages loans per region (upper sub-table) for all 138 SACCOs and summary statistics (lower sub-table) for 103 completes cases

<table>
<thead>
<tr>
<th>Region</th>
<th>Audited SACCOs</th>
<th>Complete Cases</th>
<th>Mean (000000)</th>
<th>Std. Dev. (000000)</th>
<th>Min (000000)</th>
<th>Max (000000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arusha</td>
<td>25</td>
<td>22</td>
<td>518</td>
<td>729</td>
<td>3.5</td>
<td>2540</td>
</tr>
<tr>
<td>Dar Es Salaam</td>
<td>85</td>
<td>57</td>
<td>1120</td>
<td>1430</td>
<td>0.94</td>
<td>7460</td>
</tr>
<tr>
<td>Kilimanjaro</td>
<td>11</td>
<td>10</td>
<td>491</td>
<td>567</td>
<td>11.7</td>
<td>1700</td>
</tr>
<tr>
<td>Mwanza</td>
<td>17</td>
<td>14</td>
<td>656</td>
<td>779</td>
<td>18.8</td>
<td>2010</td>
</tr>
<tr>
<td>Total</td>
<td>138</td>
<td>103</td>
<td>869</td>
<td>1190</td>
<td>0.94</td>
<td>7460</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (000000)</th>
<th>Std. Dev. (000000)</th>
<th>Min (000000)</th>
<th>Max (0000000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Loans</td>
<td>869</td>
<td>1190</td>
<td>0.94</td>
<td>7460</td>
</tr>
<tr>
<td>Others Assets</td>
<td>126</td>
<td>243</td>
<td>1.5</td>
<td>1590</td>
</tr>
<tr>
<td>Total Deposit</td>
<td>555</td>
<td>1020</td>
<td>2.05</td>
<td>7160</td>
</tr>
<tr>
<td>Total Revenue</td>
<td>116</td>
<td>154</td>
<td>0.26</td>
<td>813</td>
</tr>
<tr>
<td>Total Expenditure</td>
<td>61.2</td>
<td>94.9</td>
<td>0.46</td>
<td>586</td>
</tr>
</tbody>
</table>

Source: Computed by authors

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of DMU</td>
<td>103</td>
</tr>
<tr>
<td>Number of Efficiency DMU under</td>
<td></td>
</tr>
<tr>
<td>TE</td>
<td>9</td>
</tr>
<tr>
<td>PTE</td>
<td>24</td>
</tr>
<tr>
<td>Scale</td>
<td>9</td>
</tr>
<tr>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>TE</td>
<td>0.42</td>
</tr>
<tr>
<td>PTE</td>
<td>0.52</td>
</tr>
<tr>
<td>Scale</td>
<td>0.76</td>
</tr>
<tr>
<td>Returns to Scale</td>
<td></td>
</tr>
<tr>
<td>CRS</td>
<td>7.8 % (8)</td>
</tr>
<tr>
<td>DRS</td>
<td>15.5 % (16)</td>
</tr>
<tr>
<td>IRS</td>
<td>76.7% (79)</td>
</tr>
</tbody>
</table>

Note: The actual number of firms is shown in the brackets. TE is technical efficiency, PTE is pure technical efficiency, Scale is scale efficiency score, CRS is constant returns to scale, DRS is decreasing returns to scale; IRS is increasing returns to scale

Table 3: Parameter Estimates for Testing Efficiency Scores are different from 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>T test (one sample)</th>
<th>Wilcoxon Signed Rank Text</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test Statistics</td>
<td>Pvalue</td>
</tr>
<tr>
<td>TE</td>
<td>-21</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>PTE</td>
<td>-13</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>SCALE</td>
<td>-9</td>
<td>&lt; 0.0001</td>
</tr>
</tbody>
</table>

Note: The left hand panel of the table represents one sample t test results for different efficiency scores and the right hand panel of table represents one sample Wilcoxon Signed Rank Test of efficiency scores
Figure 1: Distributions of SACCOs across different categories of returns to scale

Note: crs is constant returns to scale, drs is decreasing returns to scale and irs is increasing return to scale

Figure 2: Median Spline of Technical Efficiency Scores by Firm Size
Figure 3: Box Plot for Technical Efficiency (TE), Pure Technical Efficiency (PTE) and Scale Efficiency (SCALE) Scores across different categories of loan size

Note: The isolated dots in figure 3 above represents outlying observations; the horizontal line indicates the median. If our efficiency scores were normal, the line (the median) would be in the middle of the box (the 25th and 75th percentiles, Q1 and Q3) and the ends of the whiskers (the upper and lower adjacent values, which are the most extreme values which within Q3+1.5*(Q3-Q1) and Q1-1.5*(Q3-Q1) respectively) would be equidistant from the box. But box plots for our efficiency scores shows positive skew (technical efficiency) and negative skew (scale and pure technical efficiency) i.e. the median is pulled to the low end and upper end of the box respectively.