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EFFICIENCY AND PRODUCTIVITY OF DEPOSIT TAKING COOPERATIVES IN A REGULATORY TRANSITION: EVIDENCE FROM KENYA

Moses Kipchirchir Biwott
School of Business, Jomo Kenyatta University of Agriculture & Technology, Kenya
mbiwott@yahoo.com

Evans Ombongi Nyakang'o
School of Business, Jomo Kenyatta University of Agriculture & Technology, Kenya
ombongien@yahoo.com

Abstract

This study sought out to examine the nature and the extent of efficiency and productivity growth among Deposit Taking Cooperatives Societies (DTS) in Kenya between 2010-2014; a regulatory transition period using non parametric Data envelopment technique (DEA) and Malmquist index techniques. The productivity changes were decomposed into technical efficiency and technological change for thirty three small and twenty eight large licensed cooperatives societies. The finding indicates a marginal growth in the sector mainly driven by improvement in efficiency rather than technological progress. Smaller DTS based on total assets when evaluated alone peer achieved better improvement in efficiency and technological progress that large DTS in their own peer group. However the was no significant difference in the efficiency and productivity between the two groups.

Keywords: Technical Efficiency, Scale efficiency; Deposit Taking cooperative Societies; Data Envelopment analysis (DEA), Malmquist Index

INTRODUCTION

The noble concept of cooperatives unions continues to dominate the economic development agenda in middle income and low income countries globally. Their continued growth has not only lifted the world's global poor out of poverty but has also taken up an integral part as a key player in most financial sectors in developing economies. Their continued influence on the financial sector growth and economic policies has a generated notable interest and the sector is becoming a center of regulatory framework. Kenya has been credit to have the most vibrant and a highly developed SACCO sector in Africa holding close to 67% in total assets and 62% of total deposits in the continent (SASRA, 2011). Despite Kenya ranking first in Africa, in terms of total assets held by SACCOs, it lags behind in terms of penetration with 19% compared to Senegal which has 21.9%. Ombado, (2010), posit that low penetration is often attributed to inefficiencies among other reasons. Due to low penetration of financial market players, a considerable proportion of adult population remains financially excluded.

A Financial Access survey carried out in 2013 to assess the extent of financial sector Deeping revealed that 25.4% of the adult population was totally excluded from financial services in Kenya. The utilization of SACCO services was found to have decreased since 2006, from 13.5% in 2009 to 9.1% in 2013 (FSD, 2013).However, these decline and continued influence of the stability of the financial sector give rise in 2008 to a debate on the sufficiency or otherwise of the existing policy, legal and regulatory frameworks governing the incorporation and regulation of the sector giving rise to the introduction and enactment if SASRA act 2008.

The Kenya's vision 2030 envisages creating a vibrant and globally competitive financial sector, driving high levels of savings and financing Kenya's investment needs. This is achievable only if the financial sector is more efficient (Nasieku, 2014). By enhancing efficiency, financial institutions are capable of offering more affordable banking services. Efficiency is important for promoting access to financial services as well as stability of the banking sector as integral component of the financial system (Kamau, (2011)).Delis and Papanikolaou (2009) posit that an efficient banking sector is better able to withstand negative shocks and contribute to the stability of the financial system. Efficiency of financial institution should constantly be assessed and maintained at the highest possible levels.

However, despite DTSs being significant players in the provision of financial services to the Kenyan households and small businesses segments, there is limited research on their efficiency. Much of the research done in Kenya has largely focused on efficiency of commercial banks ((Kamau, (2011), Nasieku, Kosimbei & Obwongi. (2013) & Mathuva, (2009)). A continued implementation of a regulatory framework without a deeper understanding of its inherent influence on performance and efficiency of the regulated institutions will not only subjecting a core sector in the economy to uncurtaining but also increasing inherent risks.

METHODOLOGY

This study used a DEA-based Malmquist index to assess the changes in the efficiency of Deposit Taking SACCOs in Kenya over a four year transition period when a new regulatory framework was under implementation. The choice of Malmquist index as an assessment tool rests on its ability to decompose efficiency changes into four components; technical efficiency change, technological change, pure technical efficiency change and scale efficiency change. Efficiency measured using DEA are static in nature and its use in the current study would be rendered ineffective in estimating efficiency where technology is subject to change, causing shifts in best practice. To overcome this limitation, the study used Malmquist Total Factor Productivity Change Index.

The definition of inputs and outputs for a financial sector entity rests on their intermediary role in the Economy. The intermediation process comes into play through the transformation of deposits from surplus spending units) into loans and advances to deficit spending units, a modified approach consistent with that adopted by Kamau, (2011). Data Envelopment Analysis (DEA), a multi-factor productivity analysis model works by measuring the relative efficiencies of decision making units (DMUs) with similar operating inputs and expected outputs. DEA is built on the principles of linear programming theory that examines how a particular DMU performs relative to other similar DMUs. A frontier based on actual data is developed and the firm/s on the frontier is deemed efficient, while any firms on a position off the efficiency frontier are deemed inefficient

This study examines sixty one licensed Deposit Taking SACCOs over a five year period between 2010 and 2014 the end of which they were required to have achieved full compliance to new regulatory requirements. All the DTS who had their financial statements published with the regulator (SASRA) over the period were selected. Sixty one (61) DTS fell into this group with thirty three (33) DTS by the close of 2010 financial year holding total assets less that Kshs 1 Billion and while Twenty eight (28) had total assets greater than 1 billion shilling. With the implementation transition period starting from 2010 to the end of 2014, Data from this transition period were used for the study. Given that financial intermediation is defined by how well the intermediary links the net surplus units to the net deficit units in a financial system, total deposits and total loans were used as inputs and output of the DEA model in estimating the DMUs efficiency.

This paper adopted a non-parametric approach in estimating the efficiency and productivity of the DTS intermediation process during the regulatory transition period in Kenya. Data Envelopment Analysis (DEA), developed by Charnels, Cooper and Rhodes was used for estimating technical efficiency estimation constant returns. A Modified model by Banker, Charnes and Cooper was also to accommodate variable returns to scale yielding pure technical efficiencies (Casu & Molyneux (2000)). The choice of Non parametric DEA was due to the non-availability of the factor prices and its non-reliance on specified functional form for the frontier and its ability to accommodate multiple inputs and outputs for each firm or decision making unit in the estimation of their efficiency. As relative analysis tool, the resulting efficiency scores are benchmarked across DMUs in the same industry ranking each DTS against an efficient frontier

Following the model adopted by Casu & Molyneux (2000), and assuming the number of DTS is *s* and each DTS uses *m* inputs and produces *n* outputs and taking *m*in puts which are marked with $X^k{}_i$(i = 1... m), and n outputs marked with $Y^k{}_j$ (j = 1... n). Taking efficiency the ratio of total outputs divided by total inputs, the estimated efficiency of DTS under constant Return to Scale (CRS) was computed as indicated in equation (i):

$$\text{Efficiency of } DTS_k = \frac{\sum_{j=1}^{n} u_j Y_j^k}{\sum_{i=1}^{m} v_i X_i^k} \quad \text{………………………………………………..…….…….(i)}$$

X_i^k, $Y_j^k \geq 0$, i = 1,…,m, j = 1,….n, k = 1,…,s

u_j, $V_i \geq 0$, i =1,…,m, j = 1,….n

Where V_i, U_j *are* virtual multipliers (weights) for the i th input and the j th output.

The BCC model, assumes variable returns to scale (VRS) estimating Overall Technical Efficiency (OTE) took the form presented in equation (ii);

$$\text{Minimize} \qquad \theta - \varepsilon\left[\sum_{i=1}^{m} S_i^- + \sum_{k=1}^{n} S_j^+\right] \quad \text{…………………………………. (ii)}$$

Subject to:

$$\sum_{i=1}^{s} \lambda_r X_i^r - \theta X_i^k + S_i^- = 0 \qquad i = 1, \dots, m$$

$$\sum_{i=1}^{s} \lambda_r Y_j^r - S_i^+ = Y_j^r \qquad j = 1, \dots, n$$

$\lambda_r \geq 0 \quad r = 1,..., s$

$S_i^- \geq 0 \quad i = 1,..., m$

$S_j^+ \geq 0 \quad j = 1,..., n$

Where

θ = Efficiency of DTS

Si^- = A slack variable for input excess value

Sj^+ = Surplus variable for output shortfall value

ε = A non-Archimedean number denoting a very small constant

λ_r = Proportion of referencing *DTS* $_r$ when assessing the efficiency of *DTS*

To assess the productivity changes during the study period, Malmquist Total Factor Productivity (TFP) index was used decomposing the inherent changes in productivity into technical change and technological efficiency change necessary for distinguishing between improvements emanating from the DTS internal efficiency improvement towards the efficient frontier and those resulting from the changes in the efficient frontier over time. For this study an output - oriented Malmquistindex provided a means on which efficiency changes and technological change were examined. Malmquist index takes the following form:

$$M = E \cdot P$$

where

$$E = \frac{D_I^{t+1}(y^{t+1}, x^{t+1})}{D_I^t(y^t, x^t)}$$

$$P = \left[\frac{D_I^t(y^{t+1}, x^{t+1})}{D_I^{t+1}(y^{t+1}, x^{t+1})} \times \frac{D_I^t(y^t, x^t)}{D_I^{t+t}(y^t, x^t)}\right]^{1/2}$$

…………………………………………………. (iv)

Where M (the Malmquist total factor productivity index) is the product of technical progress P measuring the shifts in the frontier measured at two subsequent period (t + 1,t) and E a measure of change in efficiency over an identical period.(D)Represents the input distance function, while x and y represents inputs and outputs of the DMUs respectively. Where constant returns-to-scale is considered, the following input-orientated linear programs were used:

$$\begin{aligned} \left[D_I^t(y_t, x_t)\right]^{-1} &= \min_{\theta,\lambda} \theta \\ s.t. - y_{it} + Y_t\lambda &\geq 0 \\ \theta x_{it} - X_t\lambda &\geq 0 \\ \lambda &\geq 0 \end{aligned}$$

……………………………………………………………. (v)

$$\left[D_i^{t+1}(y_{t+1},x_{t+1}\right]^{-1} = \min_{\theta,\lambda}\theta$$
$$s.t.-y_{it,+1}+Y_{t+1}\lambda \geq 0$$
$$\theta x_{i,t+1} - X_{t+1}\lambda \geq 0$$
$$\lambda \geq 0 \quad \text{(vi)}$$

$$\left[D_i^{t+1}(y_t,x_t\right]^{-1} = \min_{\theta,\lambda}\theta$$
$$s.t.-y_{it}+Y_{t+1}\lambda \geq 0$$
$$\theta x_{it} - X_{t+1}\lambda \geq 0$$
$$\lambda \geq 0 \quad \text{(vii)}$$

$$\left[D_i^{t}(y_{t+1},x_{t+1}\right]^{-1} = \min_{\theta,\lambda}\theta$$
$$s.t.-y_{it,+1}+Y_t\lambda \geq 0$$
$$\theta x_{i,t+1} - X_t\lambda \geq 0$$
$$\lambda \geq 0 \quad \text{(viii)}$$

To decompose the constant returns-to-scale technical efficiency change into scale efficiency and pure technical efficiency components, a convexity constraint *N*1'λ=1 was introduced to the linear programs (v) to (vii). Under a constant returns-to-scale without convexity constraint the measure of overall technical efficiency (*E*) was established while variable returns-to-scale with convexity constraint yielded 'pure' technical efficiency (*PT*). Dividing overall technical efficiency (*E*) by pure technical efficiency allowed for the determination of scale efficiency (*S*). A combination of the above models with Fare *et al*. (1994) approach; four efficiency/productivity indices for each DTS including a measure of technical progress over time were established. Technical efficiency change (*E*) (ii) Scale Efficiency change (*S*); (iii) Pure Technical Efficiency change (*PT*) (iv) Technological change (*P*); and (v) Total Factor Productivity (*M*) change were estimated. Determining the major sources of productivity gains/losses can be seen through a comparison of E and *P* values. Where *E* >*P* the inherent productivity gains are largely attributed to improvements in efficiency and where *E* <*P* the productivity gains are considered a result of technological progress (Färe, et al., 1994).

EMPIRICAL RESULTS

The core interest of examine the efficiency of DTS during the existence of new regulatory framework in Kenya between 2010 and 2014, was to bring to the fore three key issues. First was to examine the productivity changes that have taken place if any, secondly was to decompose the productivity changes into efficiency change (Catch up effect) and technological change (Frontier shift effects). Finally, to test whether the changes in the four efficiency/productivity indices can be attributed to the DTS sizes.

We started by looking at changes in efficiency, technology and productivity of the DTS between 2010 and 2014. The descriptive statistics of the four indices over the four periodic changes are presented in Table 1.

Table 1: Productivity and Efficiency Changes of DTS between 2010 -2014

DTS Grouping	**Year**	Effch	Tech ch	Ptech	Se ch	Tfpch
	2011	0.962	1.081	1.002	0.96	1.04
	2012	0.855	1.21	0.891	0.96	1.035
ALL DTS (n = 61)	2013	1.286	0.724	1.183	1.087	0.93
	2014	1.003	1.056	1	1.003	1.059
	Group mean	**1.015**	**1**	**1.014**	**1.001**	**1.015**
	2011	1.007	1.020	0.999	1.008	1.028
LARGE DTS	2012	1.033	0.987	1.03	1.003	1.02
(n = 28)	2013	0.918	0.968	0.912	1.007	0.889
	2014	1.084	1.043	1.108	0.978	1.13
	Group mean	**1.009**	**1.004**	**1.01**	**0.999**	**1.013**
	2011	0.947	1.093	0.979	0.968	1.036
SMALL DTS	2012	0.847	1.247	0.867	0.977	1.057
(n = 33)	2013	1.395	0.719	1.297	1.075	1.003
	2014	0.933	1.074	0.942	0.99	1.002
	Group mean	**1.011**	**1.013**	**1.009**	**1.002**	**1.024**

From an industry wide perspective bring together DTS both large and small, the mean total productivity change over the regulatory period improved marginally by 1.5% (sd = 4.91%) that can be attributed to technical efficiency (M = 1.5%, sd = 3.85%) where technological change remained unchanged (M = 0.00, sd = 3.30%). The first two years of the regulatory period saw a regress in technical efficiency with improvement showing up in the last two periods, a sign that restructuring in an effort to achieve compliance may have impacted negatively on the efficiency despite a positive change in technology in the first two years. It was also notable that scale efficiency change were regressed during the first two years but improved marginally in the second half of the implementation period. DTS with the most improvement in Technical efficiency.

A comparative analysis of the large and small DTS from an industry wide perspective where a common efficiency frontier was used indicates little variations as seen in Table 2.

Table 2: Malmquist Index Summary of All DSTs from an industry perspective

Year	Effch	Techch	Ptech	Sech	Tfpch
2011	0.962	1.081	1.002	0.96	1.04
2012	0.855	1.21	0.891	0.96	1.035
2013	1.286	0.724	1.183	1.087	0.93
2014	1.003	1.056	1.000	1.003	1.059
Mean	1.015	1.000	1.014	1.001	1.015
SD	0.038	0.033	0.032	0.021	0.049
Max	1.165	1.131	1.118	1.091	1.17
min	0.947	0.95	0.94	0.94	0.947

More than a third (68.8%) of the DTSs showed improvement in technical efficiency, 37.7% presented an evidence of improved technology while 77.1% and 50.8% had improved pure technical and scale efficiencies. When a comparison is carried out between the changes in efficiency and productivity for both large and small DTSs, a few unique features emerge that are worth noting. Among the large DTSs, 64.3% had an improved average technical efficiency compared to 57.57% of the small DTS. To the contrary, only 21.4% experienced improved technological change as compared to 48.48% of the Small DTS. A similar proportion was seen in the mean scale efficiency where positive change was seen among 25% of the large DTSs as compared to 51.52% of the Small DTSs.

The total productivity index improved in 54.1% of the DTS with mean technical efficiency change over the transition period for small DTS improving by 1.51% (sd = 3.6%) compared to that of large DTS that saw a mean improvement of 1.61% (sd = 4.13%). There were no significant changes in Technology for both groups with pure technical efficiency improving by a marginal 1.48% (sd = 1.97%) for small DTS, an almost identical improvement of 1.35% (sd = 2.81%) for large DTS. The total factor productivity change was marginally better for small DTS with a mean improvement of 2.42% (sd =5.25%) compared with a mean improvement of 0.646% (sd = 4.36%) for large DTS with the net improvement linked to a marginal increase in technical efficiency accompanied by regressed technological change. Emerging from this finding is a clear indication that no significant technological progress was evident during the regulatory transition period with marginal improvements by the DTS towards the efficient frontier.

Table 3: Overall changes in Efficiency and Productivity from an industry perspective

Category of DTS		Eff change	TECH change	PTE change	SE change	TFP change
Small DTS Means	Mean	1.0151	1.009	1.0148	1.0005	1.0242
	SD	0.0365	0.0397	0.0362	0.0197	0.0526
	Max	1.122	1.131	1.118	1.056	1.152
	min	0.947	0.95	0.94	0.94	0.95
Large DTS Means	mean	1.016	0.99	1.014	1.0026	1.0065
	SD	0.041	0.019	0.028	0.0236	0.0436
	Max	1.165	1.059	1.09	1.091	1.17
	min	0.961	0.959	0.96	0.971	0.947

It was important to recognize evaluating both large and small DTS on the common frontiers could easy disadvantage the small DTS on a technical thus exposing a limited view of their underlying productivity change. The assumption that is taken for this choice of analysis is that the Small and the large DTSs compares with their peers of a frontier defined by their unique features inherent in their size, taking total asset as a determining proxy for size.

For large DTS with initial assets of over Kshs 1 Billion shilling in 2010, at the commencement of the regulatory framework, 67.7% had an increase in their mean technical efficiency change with only 39.3% revealing improved technology leading to 71.4% of the large DTSs achieving a growth in their mean total factor productivity index over the four year to year review period. Despite a good proportion of the DTS being on the positive side of the change, this yielded a meager 1.1 % increase in the mean technical efficiency change,1.3% improvement in technology and 2.4% improvement in the mean total factor productivity during the transition period. It is notable therefore that the improvement in the overall productivity arises from efficiency improvement rather than technological progress for the Large DTS.

Table 4: Small Firm Means Efficiency & Productivity change from a Peer Perspective

Year	Effch	Tech ch	Ptech	Se ch	Tfpch
2011	0.947	1.093	0.979	0.968	1.036
2012	0.847	1.247	0.867	0.977	1.057
2013	1.395	0.719	1.297	1.075	1.003
2014	0.933	1.074	0.942	0.99	1.002
Mean	1.011	1.013	1.009	1.002	1.024
SD	0.0367	0.0396	0.0385	0.0227	0.0527
Max	1.111	1.139	1.113	1.069	1.151
Min	0.941	0.95	0.921	0.94	0.95

A review of the small DTS peer reveals an even worse performance despite being the target group for that was intended to benefit from the regulated environment. Half (51.5%) of the small DTS had a positive growth in the mean technical efficiency, 57.57% had improved technology and 60.6% of the DTS had a positive mean total factor productivity change over the four years. The overall improvement in the mean technical efficiency change was a paltry 0.9% and a 0.04 % improvement in technology translating into 1.3% improvement in the mean total factor productivity of the peer group. Unlike the large DTS, the marginal improvement in total productivity is for small DTS is attributed to both improved technical efficiencies and technological progress.

Table 5: The Malmquist Index Summary of Large Firm Means From a Peer Perspective

Year	**Effch**	**Techch**	**Ptech**	**Sech**	**Tfpch**
2011	1.007	1.022	0.999	1.008	1.028
2012	1.033	0.987	1.03	1.003	1.02
2013	0.918	0.968	0.912	1.007	0.889
2014	1.084	1.043	1.108	0.978	1.13
Mean Change	1.009	1.004	1.01	0.999	1.013
SD	0.0248	0.017	0.0206	0.0123	0.029
Max change	1.066	1.074	1.065	1.025	1.074
Min Change	0.968	0.989	0.968	0.961	0.962

The last goal of this paper was to examine whether changes that have taken place in the technical efficiency and technological progress on an industry wide perspective could have been influenced by the initial size of the DTS at the onset of the regulatory framework. A Kruskall-Wallis test (one way analysis of variance)testing for equality of means revealed a non-significant difference between small and large DTS on all the five indicators. Changes in technical efficiency, pure technical efficiency and total factor productivity did not have any statistical significant difference between the two categories of DTSs at 5% and 10% levels of significance. Despite technological progress and scale efficiency change indicating non significance difference at 5%, they were found to be significantly different (*KW*= $\chi^2(60)$ =3.381, p< .01, $\chi^2(60)$ =3.077, p< .01) between the two DTS categories at 10%. Signifying that there was marginal adoption of better technology and better input allocation among the small DTSs compared to the large DTS over the regulatory period.

Table 6: Kruskal Wallis Test results for Efficiency and productivity Change

	TE change (E)	T change (p)	PTE change (PT)	SE change	TFP change (M)
Chi-Square	.012	3.381	.321	3.077	1.479
df	1	1	1	1	1
Asymp. Sig.	.914	.066	.571	.079	.224

Note: Grouping Variable: DTS size (1: Small (Assets <Kshs 1 Billion), 2: Large (Assets >Kshs 1 Billion)

CONCLUSIONS

The main objective of this paper was to bring to the fore the likely efficiency and productivity changes within a regulatory transition framework among Deposit taking Corporative societies in Kenya. Tracking the productivity and efficiency changes using DEA and Malmquist productivity index of sixty one DTSs between 2010 -2014 revealed three key evidences.

First, the introduction of prudential regulation for the cooperative sector did not significantly translated to better efficiency for both large and Small DTS over the transition periods. This could points to notable implications for the sector's regulation: the stringent regulatory framework did not translate into better transformation of the inputs: deposits and assets into loans and advances and membership for the DTS. This could be attributed to the impediment arising from tightened official supervisory power with a possibility of increasing agency problems, distortion of market equilibrium and minimize operational efficiencies, a similar reason seen in the works of Chortareas, Claudia and Alexia (2012).

Secondly, the source of productivity changes among the DTS was evidently associated with improved shift towards the efficient frontier more that the shift in the efficient frontier itself. From an industry perspective, smaller DTS did better in improving their technical efficiency and technology frontier than their larger counterparts despite having better resources. Similarly, from a peer perspective, small DTS out did the large DTS in both their improvements towards the efficient frontier as well as progression in the technological frontier leading to a more than double the improvement in total factor productivity among the small DTS compared to large DTS.

Thirdly, as far as to whether there is a significant difference in the efficiency and productivity changes between the small and large DTS, only change in technology and scale efficiency were significantly different at .01 significance level. This signifies a regulatory framework that was centered on promoting growth among small DTS and less emphasis on larger industry players, a sign of protectionist regulatory system.

While this study may have limited itself to the efficiency of the DTS during the transitional period when the DTS were implementing the regulatory requirement in uncertain environment, It will be of great interest if further analysis may be carried out to ascertain the trend of efficiency post the transition period. This will be critical in assessing true impact that the introduced regulations on the medium and long tern productivity and efficiency of the DTS, a significant input for future financial sector regulatory policy decisions.

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