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Determinants of Technical Inefficiency of Saccos in Kenya: A Net Operating Cash Flows Output Slack Analysis

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Abstract

Purpose: The purpose of this study was to evaluate the determinants of technical inefficiency of Saccos in Kenya. Methodology: The explanatory research design was utilized. The financial statements data was collected from a census of 46 audited deposit taking Saccos and methods used included estimation of technical inefficiency by employing a non-parametric DEA method while the second step concerned determination of inefficiency using parametric SFA. The log truncated panel data was used for a period of 8 years (2007-2014). Result: All the predictors jointly influence inefficiency and are significant except for prime regressors given NOCF slack as hypothesized in agency, efficiency and intermediation theories. NOCF slack regression reflects lack of managerial influence as indicated by Gamma (1.13E-23) while DEA result of all Saccos indicated 0.976 mean efficiency. Contribution to policy and practice: The NPTA, CA and FI predictors had significant influence on pure technical inefficiency, thus apt for decision making.

Keywords: Saccos in Kenya, Technical inefficiency, Net operating cash flows (NOCF) Output slack.

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Contents

1. Introduction

The efficiency of an organization is an overriding aspect in finance. A well-managed savings and credit co-operative society is expected to increase the members' interest. Since independence, the Kenya savings and credit co-operatives societies'(or Saccos) sub-sector has undergone a series of liberalizations and prudential regulation aimed at improving its relative act or efficiency (Wanyama, 2009).This study seeks to find out the determinants of inefficiency given the net operating cash flow slack (inefficiency) as a dependent variable over a period of two eras using both data envelopment analysis(a linear programming approach) and stochastic frontier analysis methods.

The co-operatives development regulation era in Kenya involved enactment of prudential regulation of Saccos through the Saccos Act, 2008 which legally commenced in September 2009 and gave birth to Sacco Societies Regulatory Authority or SASRA with effect from October 2009 (SSA, 2008; MOCDM, 2013). Basically the pre-regulation era covered period 2010 and before.

Kenya Saccos have high urge for shifting from savings and credit co-operatives to credit and savings co-operatives that is, they actually bend towards sourcing for external funds than relying on equity funding. Capital inadequacy and insolvency risks are key factors influencing performance of deposit taking Saccos (or FOSA) in Kenya (Kivuvo and Olweny, 2014). This behavior scores them well as candidates of capital rationing. The shifting appetite to credit and savings Saccos come at an expensive interest charges from the lenders as the borrowed funds or credit facilities are meant for onward affordable lending to Saccos' members. According to SASRA (2011) Saccos in Kenya total borrowings from banks in 2010 was estimated at Kshs.15 billion compared to Kshs. 5.6 billion in 2011. Thus the sector is key financial channel in fostering access to credit.

On the international front, the Regulatory Authorities and Standards Setting Committees have been able to come up with acceptable information on the financial institutions' efficient operations and risk management criteria (Cooper *et al*., 2007). World Council of Credit Unions is one similar body that offers related services. Caprio *et al.* (2003) in their study in 44 countries, postulate that insignificant influence is experienced by banks due to regulation and supervision.

2. Literature Review and Background of the Study

Brealey and Myers (1981) postulated that rationing of a firm's capital in more than one period call for application of linear programming or net present value methods as a capital budgeting decision making techniques instead of other methods such as marginal rate of return which depict prominence of linear programming in the field of finance theory. This study adopted DEA approach which is linear programming oriented based on a capital rationing argument, since the Saccos' external loan capital demand tend to fluctuate periodically (SASRA, 2011).

Efficiency is a subset of performance (Ozcan, 2008). An efficient organization identification assist in identifying the managers' rewards and the kind of good practices employed or which can be copied by inefficient firms in the industry. Adeptness also aid in identifying profitable areas of organizations to invest their assets (Healy, 1988). An efficient measurement system is able to identify optimal resources allocation besides setting of targets.

The inefficiency or efficiency measurement helps commercial and non-commercial entities in identification of best practice, identification of poor practice, in setting targets, in resource allocation and in monitoring efficiency changes periodically (Beasley, 1996). However, Barus *et al.* (2017) argues that financial performance of Saccos in Kenya is not significantly affected by management efficiency.

Studies have indicated that co-operative banks future in the long run is unknown as they will completely transform to banks, merge or just die, Zvi (1998). This chain of events is likely to impact negatively on the steady or focused efficiency growth of Saccos. A question that then arises is: do co-operatives transformations to banks or FOSA exist for long term benefit of members? Zvi (1998) states that credit co-operatives around the world do not exist to allocate credit to their members as only 30% - 70% is allocated as loans and the rest is either in cash and cash equivalent.

A study by Johnson and Nino-Zarazua (2008) has shown that in Kenya 12.8% of the population save with Saccos and 4.1% borrow from them. In addition, Saccos in Kenya are principally either based on common bonds of farming or employment (Johnson and Nino-Zarazua, 2008). It is also worth noting that in Africa South of the Sahara, Kenyan Saccos movement has the second largest number of Saccos following Ethiopia (Woccu, 2009). For instance, in March 2013, the number of Saccos in Tanzania were 5,559 (Magali, 2014) while in Kenya the total number of registered Saccos were estimated at about 7,500 in August 2013 (SASRA, 2013).

The efficiency of co-operatives during the era of economic liberalization (1980s up to 2004) was initially absolutely poor due to the government *modus operandi* (Wanyama, 2009). However since the start of the second era period; co-operative development in the country is still not well understood. This is because there are a few studies in the area of co-operatives since 1990 (Evans, 2002; Petrie, 2002; Emerson and Wiren, 2005). Further, these studies are basically based on absolute performance measures (such as increase in loans, increase in membership levels of delinquent loans, and growth in number of co-operatives) and interview responses from the stakeholders. The situation is slowly changing as other research are now coming up especially based on ratios, efficiency and multiple regression such as (Tesfamariam *et al*., 2013; Kivuvo and Olweny, 2014; Mirie, 2014; Marwa and Aziakpono, 2015).

During the pre-regulation era in 2009, the world experienced a financial crisis that affected the efficiency of financial institutions over the period and this was amenably reflected in the levels of macro-economic indicators including GDP. In 2009, for instance the global economy contracted by negative 0.6% (IMF, 2012) while in 2011 the country also experienced a down turn in the economy due to high fluctuation of the Kenya shilling against the hard foreign currencies (SASRA, 2011). In addition, the GDP percent change rate fluctuated to an average of 5.13% in 2012 before rising again to a mean of 5.62% in 2013 (IMF, 2014).

The down turn in an economy impairs the efficiency of commercial enterprises than it does to co-operatives. Co-operatives have shown their ability to provide services to their members even during the financial crisis. However, in developing countries of Africa the co-operatives' resilience to financial crisis is not strong and this coupled with the internal political impact or mismanagement within co-operatives means, the crisis gets worse (Wanyama *et al*., 2009). This then raises a corporate governance or integrity problem in co-operative movement

that was catered for, to some extent, in this study through the introduction of the number of women on the board predictor variable.

According to prior studies, there is a conflicting result on effect of gender diversity on the boards. Adams and Ferreira (2008) argue that on average the presence of both gender on the boards in companies having no takeover prevention mechanism do experience inefficiency. On the contrary, Higgs (2003) postulate that performance improvement result from gender diversity in the board room while Gompers *et al.* (2003) conclude that gender is a good performance contributor in organizations with non-strong shareholder rights.

The latest liberalization of co-operatives movement is in the area of devolution of co-operatives regulation from the national level to county levels as enshrined in the Constitution of Kenya 2010 (COK, 2010; MOCDM, 2013). These changes are aimed at enhancing efficiency. However, despite the existence of the prudential regulations, the deposit taking Saccos have continued to reveal mixed levels of management practices or inefficiency (SASRA, 2013). In addition, a study by Chavez (2006) indicates that the Kenya Sacco sub-sector reflects a seriously weak financial performance position that is pervasive.

2.1. Theoretical Review

This research was guided by the theory of agency and the financial institutions efficiency measurement theories; more precisely, the intermediation theory. Other discussed models relevant to this research are the financial institutions' prudential monitoring standards. However, the regulator of deposit taking Saccos in Kenya advocates for the adoption of Camels Prudential Reporting Standards (Kivuvo and Olweny, 2014). Further, this study utilized the BCC analysis based on inefficient results of DEA as dependent variables (Banker *et al.*, 1984) which were used to identify the variables that best measure the pure technical inefficiency of the Saccos by running a truncated-normal regression given a census of 46 deposit taking Saccos that had by then attained the FOSA operation requirements.

2.2. Statement of the Problem

The co-operatives sector in Kenya has gone through a historical development process known for inefficiency. The inefficiency was more prevalent during the liberalization period (Wanyama, 2009). As a result, the need for regulation and inefficiency understanding becomes necessary to ensure the stability of Saccos' sub-sector and guaranteed efficiency. This study is also an addition to ongoing inefficiency of Saccos' research in the Kenyan context.

A few past researchers in Kenya have studied Saccos without utilizing SFA and identifying benchmark Saccos , they based on performance: (Olando *et al.*, 2012; Karanja, 2013; Njagi *et al.*, 2013; Nyambere, 2013; Okibo and Karagu, 2014; Barus *et al.*, 2017). These studies ignored the aspect of efficiency measurement yet Saccos unlike other commercial enterprises exist for purposes of service delivery to members and therefore are not highly profit oriented. A more recent study by Mirie (2014) indicates Saccos' efficiency in Kenya being within a range of 0.56 and 1.0. However, it failed to consider other specific variables of efficiency measurement such as the economic indicators, gender diversity on Saccos' boards, and net profit to total assets ratio beside the extent of management influence on Saccos' inefficiency. Marwa and Aziakpono (2015) studied technical and scale efficiency of Saccos in Tanzania using DEA and concluded that on average majority of Saccos scored 0.48 pure technical inefficiency and at least 75% of Saccos exhibited an increasing returns to scale. A study by Kipesha (2012) arrived at an efficiency of between 0.145 and 0.69 for the Tanzanian micro finance bodies. Similar researches in banking industry in sub-Saharan Africa opine that technical efficiency falls between 0.6 and 0.9 (Moffat, 2008; Kamau, 2011).

According to Tesfamariam *et al.* (2013) efficiency of rural Saccos in Ethiopia indicated that efficiency is affected by both location and size of Saccos. They also opine that on average efficiency ranged between 0.213 and 0.259 for small Saccos, while larger Saccos recorded higher efficiency compared to smaller ones. The study like Magali (2014) in Kenya also suggested future study in the area of Saccos' technical efficiency using the SFA.

Magali (2014) concludes that there is no prior studies on Saccos in East Africa that have assessed the influence of regulation on Saccos performance while at the same time considering the impact of rural and urban areas' location of Saccos on performance. He further argues that scholars should extend to econometrics to expand Saccos modeling. A few studies such as Marwa and Aziakpono (2015) in Tanzania, and Tesfamariam *et al.* (2013) in Ethiopia, have researched on the efficiency of Saccos in the African continent.

Considering the above mentioned gap of prior studies, this study examined whether Saccos were more inefficient during regulation era than pre-regulation era. The stars Saccos were also identified. Essentially this study assessed the determinants of inefficiency of FOSA. Specifically the pure technical efficiency (a cost-efficiency measure) model was utilized (Coelli *et al.*, 1997).

The creation of SASRA as a regulator of Saccos has been necessitated by the challenges of a liberalized economy. The question that arises then is: to what extent has the Saccos' market become efficient? These facts then point to the need to measure and determine the Kenyan Saccos' pure technical inefficiency or efficiency. This study sets deliberate standards on how Saccos in Kenya can be monitored and peers emulated to ensure efficiency in their operations.

2.3. The General Objective

The general objective of this study is to establish the determinants of technical inefficiency of deposit taking Saccos in Kenya, given a net operating cash flow slack (an output inefficiency) as a dependent variable.

2.4. The Specific Objectives

The specific objectives of this study are as follows:

1. Measure the extent of managerial inefficiency over the pre-regulation and regulation eras.
2. Establish the effect of macro-economic variables on the Saccos' net operating cash flows output inefficiency.

3. Determine the effect of Saccos' specific predictor variables on Saccos' net operating cash flows output inefficiency.
4. Determine the inefficiency mean scores over the two regulation and pre-regulation eras.

2.5. Research Hypotheses

The study also tests the hypotheses that:

1. H_{01}: The Saccos operation is not influenced by managerial influence (inefficiency) as measured by Gamma (ϒ) over the two eras.
2. H_{02}: There is no strong relationship between the Saccos' macro-economic variables and net operating cash flows output inefficiency dependent variable.
3. H_{03}: There is no strong relationship between the Saccos' specific independent variables and net operating cash flows output inefficiency dependent variable.
4. H_{04}: Pre-regulation and regulation eras have the same population of inefficiency mean scores.

2.6. The Concept of Technical Inefficiency

The conceptual framework model in Figure 1 reflects the dependent variables derived from the output inefficiencies (specifically, the NOCF slack), and independent variables relationship. The frontier preliminary analysis involved determination of correlation between each of the Saccos' variance regressors and prime regressors, and if a high correlation is discovered, such specific independent variable (prime regressor) is removed from the second or final stage regression process. However, no variable was removed and this estimation was also internalized within the Stata14.1. Further, prime regressors are also assumed to be measurement errors free (Cooper *et al.*, 2007).

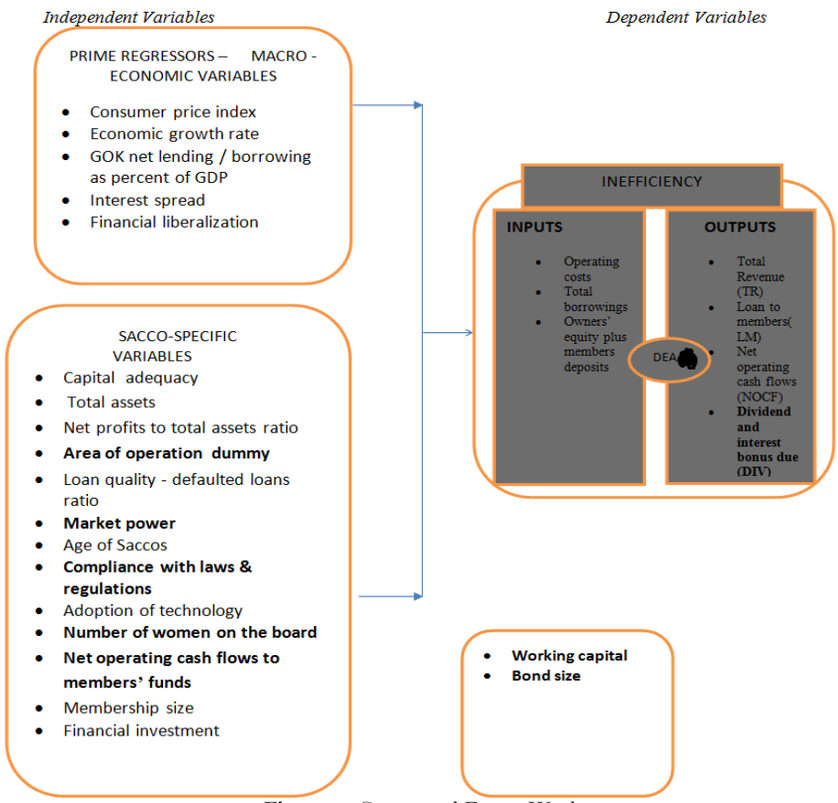

Figure-1. Conceptual Frame Work

Source: Research (2015)

3. Research Methodology

3.1. Design

This explanatory study used a balanced panel data. The explanatory study research design was employed in soliciting for secondary information from the audited annual reports and websites of the regulators on determinants of Saccos' inefficiency in Kenya. This study utilized a second stage data envelopment analysis by subjecting the resultant data to SFA. An econometric approach in estimation of Saccos' inefficiency determinants was utilized since SFA stipulates the functional form of cost or production frontier (Cummins and Zi, 1998). The panel data has benefit of assisting in studying the behavior of each Sacco on cross-sectional and time-series or year basis (Ongore and Kusa, 2013). In addition, this study utilized a census technique whereby 46 licensed Saccos under the regulator's control within the two periods of study running from 2007 to 2010, and 2011 to 2014(a span of 8 years) were picked.

3.2. Model Specification

The estimation of inefficiency was carried out utilizing the Cobb-Douglas cost frontier cross- sectional panel data of Saccos over two periods. Truncated-normal distribution was assumed Coelli *et al.* (2005) and Cooper *et al.* (2011). Stata 14.1 was used to decompose errors (Jondrow *et al.*, 1982; Pascoe *et al.*, 2003). The SFA was based on Cobb-Douglas logarithmic model $\text{In}y^{*} = \beta_0+\sum_1^k \beta_r \text{In}Z_{kjt}+V_{rjt}+U_{rjt}$, where: β_r is the frontier deterministic component, V_{rjt} is stochastic part and U_{rjt} presents the shortfall observed individual fails to hit the optimum

(frontier), j (j=1,…,n) is the cross-sectional identifier, t(t=1,…,t) is time identifier , y^* is the first stage optimal slack(normalized) in output r of DMU_j, βo is the intercept of output slack equation, 'In' is natural logarithm, and Z has k(k=1,…,k) observable environmental factors (Battese and Coelli, 1995).

3.3. DEA Result

The study examined the inefficiency and efficiency census of 46 Saccos using a non-parametric variable return to scale (VRS) - BCC or technical efficiency model. The model utilized was output oriented whereby the output included: total revenue, loans to members, net operating cash flows, and divided plus interest on members deposits while inputs were: operating costs, total borrowings and owners' equity plus members deposits. The panel data model utilized using Stata DEA software was derived from 368 observations while technical efficiency was measured on scale of 0 up to a maximum of 1. DEA result indicated that a total of 24 out of 46 Saccos were strongly efficient and exhibited zero slacks across all output variables and this was attributed to net operating cash flows reported for the corresponding years.

3.4. Output Description

Table 1 presents the mean output as expressed in TR(total revenue slack), LM(loan to members slack), NOCF(net operating cash flows slack), and DIV(dividend slack) in Kshs.Million for years 2007 to 2014. As reflected in the table 3.1 the mean TR, LM, NOCF, DIV for the Saccos sub-sector (FOSA) was 427, 2234, 1038, and 148 respectively. The overall mean score as a percentage of the Saccos' sub-sector sum was 0.18% across all outputs.

Table-1. Eight Years Mean Outputs of Saccos in Kenya

Eight Years Mean Outputs of Saccos in Kenya				
	TR	LM	NOCF	DIV
Mean score	427	2234	1038	148
Standard Deviation	1114	6720	1380	596
Mean as a % of Industry Sum	0.18	0.18	0.18	0.18
Observations	368	368	368	368

Source: Research (2015)

3.5. Descriptive Statistics

The descriptive statistics in Table 2 presents specific variables that determine the inefficiency of Saccos in Kenya. As reflected in the Table 2, the mean capital adequacy of Saccos in Kenya was 21%. The percentage is above 10% set by SASRA (SSR, 2010). This indicates that Saccos in Kenya running FOSA hold more capital than required. This was an indication that Saccos running FOSA in Kenya were risk averse and in return earn less profit. On the contrary the ratio of net profit to total assets is high at 22%, an indication of mixed result pointing to the direction of inefficiency (Brown, 2006). The market power of 2% is far below 70% standard market share that indicates a few firms being in control of an industry (Ogebe *et al.*, 2013). Further, the average women on the board stood at 20 % with standard deviation of 12%.This is a low number and has little influence on Saccos' inefficiency (Higgs, 2003).

The Table 2 also reflect mean defaulted loans ratio being 3% which is below 4% according to census research on Saccos in Meru County Kenya (Olando *et al.*, 2012). This is an indication that the regulator role has played an impact in reducing the default risks to lower percentage and may point to the direction that in this sub-sector, loan guarantors carry next to 97% burden in case of any default thus lowering LP effect on inefficiency. According to Brown and O'Connor (1999) higher default rate lowers the relative efficiency of a money market. The average age of Saccos was shown as 27 years with a standard deviation of 9 years, a reflection of a young industry. Magali (2014) posit that age and size are correlated in the same direction and that a rise in age of a small firm has a positive relation with efficiency.

Table-2. Descriptive Statistics of Predictor Variables

Descriptive Statistics of Predictor Variables										
Variables	**CA**	**Bond**	**NPTA**	**MP**	**W**	**MS**	**LP**	**Age-Yrs.**	**GOKLB**	**Age-Yrs.**
Mean	0.21	5.33	0.22	0.02	0.20	21245	0.03	27.07	2.72	27.07
Standard Deviation	0.15	10.78	0.02	0.04	0.12	36063	0.09	9.30	1.37	9.30
Observations	368	368	368	368	368	368	368	368	368	368

Source: Research (2015)

3.6. Operationalization of the Study Variables

The study measurements used to operationalize the study specific variables are as indicated in Table 3.

Table-3. Study Variables

Study Variable	Measurement
Capital adequacy(CA)	Core capital to total assets
Total assets(TA)	Natural log of total assets
NPTA	Net profit to total assets
Area of operation (AO)	Dummies 1-City ; 0 -Urban
Loan quality(LP)	Loans provision
Market power(MP)	Sacco deposit to total FOSA deposits
Age	Number of years in operation
CLR	Compliance with regulations(average scores)
Atech	Computerization expenditures
W	Fraction of women on the board
NCFM	Net operating cash flows to members funds
MS	Number of members
WC	Current assets less current liabilities
Bond	Size of contributing common bond employers
FI	Financial investments total amount

Source: Research (2015)

3.7. Model Testing and Random Effects Estimation

The study test carried out to ensure that the data fits the linear regression assumptions include:

3.7.1. Normality Test

The study tested for normality using Shapiro-Francia W test as the observations were less than 5000 and greater than 10 under log normality condition (Stata, 2015). The result obtained is as shown in Table 4 which indicates that only two variables reflected p-values greater than 0.05 thus a possibility of heteroscedasticity. The data used also underwent natural logarithm transformation.

Table-4. Testing Study Variables for Normality

	Shapiro-Francia	W test for normal data		
Variable	W'	V'	z	Prob. > z
Age	0.89443	29.112	7.251	0.00001
Ca	0.99163	2.307	1.798	0.03608
Ta	0.98818	3.259	2.541	0.00553
Npta	0.84112	43.814	8.13	0.00001
Ao	1	0	-58.997	1
Lp	0.74358	70.711	9.16	0.00001
Mp	0.93325	18.406	6.265	0.00001
Clr	0.70719	80.744	9.445	0.00001
Atech	0.68281	87.468	9.617	0.00001
W	0.98012	5.482	3.66	0.00013
Ncfma	0.34704	180.06	11.171	0.00001
Ms	0.99448	1.522	0.904	0.1831
Cpi	0.95686	11.896	5.326	0.00001
Gdp	0.61534	106.072	10.032	0.00001
Goklb	0.62312	103.927	9.988	0.00001
Insp	0.90277	26.813	7.074	0.00001
Flib	0.53518	128.178	10.439	0.00001
Wc	0.13271	239.162	11.781	0.00001
Bond	0.92325	21.164	6.565	0.00001
Fi	0.80534	53.678	8.567	0.00001

Source: Research (2015)

3.7.2. Multicollinearity Test

The possibility of strong relationship between predictor variables was checked using the correlation coefficient-Spearman rho as shown in the Table AP.1 in the Appendix. The result indicates a few scores of higher than or equal to 0.8, thus reflecting lack of serious multicollinearity among variables. Thus coefficients computed were considered reliable. A second non observational method was utilized in testing for multicollinearity that is, variation inflation factor and the result for each dependent variable is as indicated in Table 5. This result indicates NOCF slack regressed against all independent variables confirm lack of serious multicollinearity possibility. Studies have also indicated that a VIF above 20 is the one that should be categorized as challenging (Greene, 2012). Goklb and clr being above 20 are the only two challenging, thus ignored. Also a mean VIF of around 4 is not problematic (Stata, 2015).

Table-5. Dependent Variable-NOCF Slack and all Covariates VIF Results

Covariates	Variation Inflation Factor(VIF)
goklb	42.58
clr	25.17
ta	9.97
mp	10.59
gdp	5.79
cpi	6.07
age	5.08
flib	5.38
ao	2.49
w	2.04
insp	3.85
ms	2.64
ca	3.88
fi	4.09
ncfma	1.46
lp	1.79
bond	1.54
npta	1.69
atech	1.63
wc	1.42
Mean VIF	6.96

Source: Research (2015)

3.7.3. Random Effects Estimation

The Hausman-Taylor estimator method was used to confirm that none of the covariates of the panel-level models are correlated with unobserved panel-level random effects (U_{rjt}), although some of the covariates may be associated with the unobserved individual-level random effect. The result of the estimation summary is as indicated in Table 6. The result indicates that the unobserved random effect $\delta\mu = 2.5589$ greater than $\delta_{error} = .63966$, suggesting that large portion total error variance is as a result of $U_{rjt,}$ idiosyncratic error. Therefore, the fixed effects model and random effects model in the panel data are different(H_1)and random effects model is preferred (that is, reject H_0). Meaning the ordinary least squares (OLS) would give inconsistent result (Stata, 2015).

Table-6. Hausmann Taylor Estimation –Slack NOCF and Covariates

Summary of Items	Result
Number of observations	88
Number of groups	36
Random effect	U_{rjt}~iid
Wald chi sq.(20)	38.34
Prob.> chi sq	0.0081
Sigma U_{rjt}	2.5589
Sigma error(V_{rjt})	0.63966
R_{ho}	0.9419(fraction of value due to U_{rjt})

Source: Research (2015).

4. Spearman Correlation and other Key Findings

The results of the correlation in AP.I indicate that the working capital or insolvency measure had weak negative correlation of -0.2739 with NOCF slack while women on the board at + 0.562. This correlation is not in compliance to a prior study which postulate that higher number of women on the board decreases inefficiency depending on the type of industry (Ferreira and Adams, 2009). Capital adequacy is also negatively correlated (-0.4108) to dependent variables of NOCF slack in line with the expectation of the agency, financial intermediation and efficiency theories (Famma, 1980; Magali and Pastory, 2013). The correlation also indicates that there is a negative relationship between log of total assets (size measure) and the NOCF output slack (or inefficiency) at -0.4108. This finding ties well with prior study which found out an existence of positive relationship between the size of Saccos and efficiency (Magali, 2014).

4.1. OLS Regression Correlation and Stochastic Frontier Analysis Results

The correlation between environmental factors (prime regressors) and specific predictor variables was tested for purpose of eliminating highly correlated prime regressor(s). The results indicated are mixed with only one significant variable of compliance with regulation having R^2 adjusted of 0.868 as shown in Table 7. This lend to retention of all environmental predictor variables in the final model of this study.

This study finding in Table 8 also indicates that women on the board decrease results to increases in NOCF inefficiency although insignificant. The influence of macroeconomic variables to dependent variable of NOCF slack is also insignificant.

A predictor variable of capital adequacy had a strong positive effect on NOCF slack with coefficient of + 0.4077 (p-value, 0.028). This result is contrary to efficient holding of excess funds available in form of reserves with a core objective of stability and loan issue to Sacco members. This kind of relationship may be possible where excess cash reserve is kept in banks instead of issue to members in form of loans. However, a contrary finding is seen with the relationship between NPTA with NOCF slack, that is negative, with coefficient of 2.8567(p-value 0.001). The Gamma of 1.13E-23 is not far away from zero. Therefore, hypothesis H_{01} is accepted, H_{02} is also accepted while H_{03}

is rejected, all at 95% level of confidence. The result utilized 88 observations out of a total of 368 and indicates all predictors jointly influence inefficiency given Wald Chi sq. (20) =47.78 (p-value 0.0005). However, the influence of control variables on NOCF slack variable is insignificant. The mean of truncated-normal distribution (m_u) value of 17.6 is far from zero, thus a reflection of inability for study data to reduce to OLS regression Stata (2015).

Table-7. Regress Predictors: CPI, GDP, GOKLB, INSP, & FLIB

Dependent Variables	Adj. R^2	Prob. > F	OBS. (95% Conf.Int.)
Age	0.04	0.0011	368
Ca	0.01	0.122	368
Ta	0.06	0.0001	368
Npta	0.012	0.097	368
Ao	-0.014	1.000	368
Lp	0.118	0.000	368
Mp	-0.0005	0.439	368
Clr	**0.868**	0.000	368
Atech	0.046	0.0005	368
W	-0.010	0.93	368
Ncfma	-0.006	0.699	368
Ms	0.065	0.000	368
Wc	-0.0005	0.441	368
Bond	-0.0000	0.419	368
Fi	0.0371	0.0022	368

Source: Research (2015)

Table-8. Time Varying Inefficiency Model-Regression of Net Operating Cash flows Output Slack to Predictor Variables: with Control Variables

Observations =88				**Wald chi**	**^{2}(20) =**	**47.78**
Log likelihood	=0.00			Prob > c	hi^2 =	0.0005*
Slack nocf	Coef.	Std Err.	Z	P>|z|	[95% Conf.	Interval]
age	0.157067	0.433208	0.36	0.717	-0.692	1.00614
ca	0.407726	0.185043	2.2	0.028**	0.045049	0.770403
ta	-0.03452	0.151889	-0.23	0.82	-0.33221	0.263181
npta	-2.85672	0.893375	-3.2	0.001*	-4.6077	-1.10573
ao	0.168374	0.301135	0.56	0.576	-0.42184	0.758589
lp	-0.02537	0.013373	-1.9	0.058***	-0.05158	0.00084
mp	-0.02307	0.131165	-0.18	0.86	-0.28014	0.234012
clr	1.138453	1.380186	0.82	0.409	-1.56666	3.843569
atech	0.015717	0.012384	1.27	0.204	-0.00856	0.039988
w	-0.23711	0.191488	-1.24	0.216	-0.61242	0.138194
ncfma	-0.23542	0.146404	-1.61	0.108	-0.52237	0.051525
ms	-0.08677	0.107158	-0.81	0.418	-0.2968	0.123253
cpi	0.349355	0.297242	1.18	0.24	-0.23323	0.931938
gdp	0.169315	0.139593	1.21	0.225	-0.10428	0.442912
goklb	-0.39739	0.357685	-1.11	0.267	-1.09844	0.303663
insp	2.304661	2.155104	1.07	0.285	-1.91927	6.528587
flib	-0.78406	0.495805	-1.58	0.114	-1.75582	0.187702
wc	-0.04933	0.385944	-0.13	0.898	-0.80577	0.707104
bond	0.011092	0.116058	0.1	0.924	-0.21638	0.238562
fi	0.151101	0.07507	2.01	0.044**	0.003967	0.298235
cons	-27.8296	11.68292	-2.38	0.017**	-50.7277	-4.93146
/mu	17.60023	.	.	.	.	.
/eta	0.005481	0.00319	1.72	0.086	-0.00077	0.011733
/lnsigma^2	-0.88651	0.00544	-162.98	0	-0.89717	-0.87584
/ilgtgamma	-52.8397	.	.	.	.	.
sigma^2	0.412093	0.002242			0.407723	0.41651
gamma	1.13E-23	.			.	.
sigma_u^2	4.65E-24	.			.	.
sigma_v^2	0.412093	.			.	.

Source: Research (2015).
Significance levels: 1%*, 5%** and 10%***

5. Conclusion

The general objective of this study was to establish the determinants of technical inefficiency of deposit taking Saccos in Kenya, given a net operating cash flow slack (an output inefficiency) as a dependent variable. To attain this objective, eight years panel data for 46 Saccos was analyzed by the help of data envelopment analysis and stochastic frontier model using Stata14.1 software. Therefore, the effect of five macro-economic variables, thirteen specific Saccos' predictors and two control variables against dependent variable of NOCF slack were evaluated. The dependent variable slacks (inclusive of NOCF) were determined using data envelopment analysis model in Stata14.1. It was found that 13 out of 46 Saccos scored strong technical efficiency of 1 with an average technical efficiency of 0.976 for the whole census of the study.

It was also found that specific variables influence Saccos' inefficiency given NOCF slack at 95% level of confidence. A unique result to this study is that FI specific variable is negatively correlated to dependent variable

although regression indicates FI having a strong positive coefficient of 0.1511 (p-value, 0.044); at 95% level of confidence, given NOCF output slack with control variables. This direction of influence is expected in an emerging sub-sector where investments are regulated and pegged at a certain percentage point.

The study further indicates that capital adequacy had significant positive effect on the NOCF slack with control variables, which is not as per the expectation unless a high incidence of cash reserves is idle in the banks instead of being loaned to members. However, the correlation between capital adequacy and NOCF slack variable was as expected at -0.4108 (negatively correlated) at 95% level of confidence.

Generally, this study indicates that Saccos' specific variables given NOCF slack variable are significant determinants of the technical inefficiency of Saccos in Kenya and that the Saccos operation is not influenced by the management influence given NOCF slack.

6. Contribution to Theory

This study conclusion is in line with efficiency theory which states that inefficiency of decision making unit decreases as cost reduces and banks' intermediation theory that postulates that banks' efficiency is positively related to profitability. The study further strengthens the existing prior studies on influence of capital adequacy on inefficiency or efficiency of organizations. It supports the theory of inefficiency.

Further, it can be concluded that random error (lack of management influence) is observed given NOCF slack with control variables presence as indicated by the level of Gamma. This random error aspect signify the little influence of management in Saccos, as members' active participation may override the agency problem in management of Saccos' cash flows or resources.

6.1. Contribution to Practice and Recommendations

It can be concluded that the identification of strong Saccos' inefficiency or efficiency over different years can be used as benchmark. Those Saccos' unique features can be adopted as the best management practices. Further, another key contribution to practice is the evidence showing that NOCF slack with control variables is a key contributor in determining non-management inefficiencies as expressed by gamma factor. The study also concludes that large size Saccos exhibit less inefficiency characteristics and therefore the regulators should encourage merger of small or medium size Saccos in the economy. The result also indicates that financial investments strongly and positively influences NOCF slack, which agrees with a short run expectation in practice, although Saccos have a core objective of issuing loans to members in both short and long run, thus limiting a possibility of the idle cash reserve. The introduction of variables such as NPTA, CA, and FI in the financial reports of Saccos and efficiency benchmarking using DEA and stochastic mechanism are important in regulation.

6.2. Suggestions for Further Research

The identified limitation to this study is in the area of drilling down to specific efficient Saccos using a similar approach of study to find out at micro level what actually influences the individual inefficient or efficient Saccos in the sector. It is expected that this will invite more researches in this area as the inefficiency of Saccos over the two eras remained constant. Other reasons as to why NOCF slack is not relevant in identifying management influence (agency problem) should further be researched. It may be essential to consider other predictors such as stock price real index, growth domestic product real index, income of individual members and the square of age. The comparative inefficiency study on non-deposit and deposit taking Saccos should also be studied in the future research.

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Appendixes:

Table-AP.1. Predictor Variables Correlation Coefficient

		Correlation	**Coefficient**						
Spearman,	(rho)								
	age	ca	ta	npta	ao	lp			
age	1								
ca	0.8186	1							
ta	0.7933	0.6833	1						
npta	0.5654	0.45	0.5667	1					
ao	0.5241	0.1035	0.6211	0.414	1				
lp	0.1772	0.0667	-0.4167	-0.6	-0.5175	1			
mp	0.3967	0.25	0.8167	0.3833	0.6211	-0.65			
clr	0.0957	0.1632	0.0344	-0.1288	0.0533	0.1546			
atech	0.5466	0.3598	0.3096	0.6109	0.5717	-0.5272			
w	0.4979	0.2907	0.4189	0.1966	0.7434	0.094			
ncfma	0.3713	-0.0333	0.5	0.2833	0.5175	-0.7333			
ms	0.5739	0.65	0.8667	0.2667	0.414	-0.0833			
cpi	0.3463	-0.1624	0.0171	0	-0.3717	-0.3762			
gdp	0.4762	0.2821	0.1197	-0.0171	0.4779	0.342			
goklb	0.7966	-0.5215	-0.3591	-0.342	-0.4779	-0.1026			
insp	0.7793	-0.6754	-0.4788	-0.3762	-0.2655	0.1026			
flib	0.8226	0.4873	0.4446	0.3249	0.5841	0.0342			
wc	0.9283	0.9333	0.75	0.5667	0.414	-0.0833			
bond	0.8405	-0.6299	-0.5533	-0.5193	-0.3701	0.4086			
fi	0.6583	0.7	0.9167	0.3833	0.414	-0.1667			
Slack tr	-0.3467	-0.4108	-0.4108	-0.4108	0.189	0.4108			
Slack lm	-0.5547	-0.2739	-0.5477	0	-0.6614	0.1369			
Slack nocf	-0.3467	-0.4108	-0.4108	-0.4108	0.189	0.4108			
Slack div	-0.2017	-0.2988	-0.5179	0.1594	-0.3093	-0.1295			
	mp	Clr	atech	w	ncfma	ms	cpi	gdp	goklb
mp	1								
clr	0.2147	1							
atech	0.1506	0.0561	1						
w	0.1453	0.1542	0.4507	1					
ncfma	0.6833	-0.3177	0.2176	-0.1111	1				
ms	0.6833	0.1889	0.0251	0.436	0.1333	1			
cpi	0.2992	-0.163	-0.3391	-0.7193	0.2137	0.1197	1		
gdp	-0.1453	0.2952	0.4164	0.7807	-0.1453	0.0513	-0.9474	1	
goklb	0.1111	0.2687	-0.5881	-0.6842	-0.0769	-0.1881	0.6842	-0.7368	1
insp	-0.1111	0.2247	-0.5538	-0.2982	-0.1624	-0.4104	0.0526	-0.2456	0.7193
flib	0.0256	-0.2687	0.5624	0.7105	0.1966	0.2736	-0.6316	-0.7193	0.9825
wc	0.3167	0.1288	0.5941	0.5386	0.1	0.6167	-0.3762	-0.4959	0.7182
bond	-0.2894	0.2105	-0.671	-0.1528	-0.5703	-0.1788	0.2183	-0.3057	0.655
fi	0.7167	0.1116	0.0753	0.3676	0.2333	0.9833	0.1624	-0.0085	0.2308
Slack tr	-0.4108	0.1411	0	0.562	-0.5477	-0.1369	-0.4215	0.4215	-0.1405
Slack lm	-0.5477	-0.2117	-0.275	-0.4917	-0.4108	-0.5477	0.1405	-0.4215	0.4215
Slack nocf	-0.4108	0.1411	0	0.562	-0.5477	-0.1369	-0.4215	0.4215	-0.1405
Slack div	-0.5179	-0.3746	0.18	-0.3934	0.0697	-0.8367	-0.1737	-0.0511	-0.0307
	insp	flib	wc	bond	Fi	slacktr	Slack lm	slackno cf	slackd iv
insp	1								
flib	-0.7368	1							
wc	-0.7182	0.7011	1						
bond	0.69	-0.655	-0.7406	1					
fi	-0.4873	0.3163	0.6667	-0.2979	1				
Slack tr	0.1405	0.1405	-0.2739	0.5595	-0.2739	1			
Slack lm	0.562	-0.562	-0.4108	0.3497	-0.5477	-0.125	1		
Slack nocf	0.1405	0.1405	-0.2739	0.5595	-0.2739	1	-0.125	1	
Slack div	0.2453	-0.0818	-0.249	-0.2086	-0.757	-0.2455	0.6547	-0.2455	1

Source: Research (2015)

AP.II: Operational Definition of Terms

Common Bond Size: Number of entities through which Sacco members contribute funds (or share common interest) to the Sacco where they own shares and deposits (Research, 2015).

Cost Inefficiency: Saccos' excessive cost relative to the frontier. It is the difference between a benchmark and achieved performance i.e. x-efficiency (or proxy of agency costs) (Pagano *et al.*, 1997).

Credit and Savings Co-operatives: Saccos relying too much on external source of funds than share capital, reserves and member deposits (Research, 2015).

DEA: Data envelopment analysis
Earnings Management: In an organization when a governor fidgets with accounting numbers in order to report higher profits and subsequently pay high dividends is what is known as earnings management (Barth *et al.*, 2007).
Financial liberalization (FL): Measured by monetary aggregate (money supply or M3XT) to GDP (Cooper *et al.*, 2007; Research, 2015).
GOK Net Lending/Borrowing as % of GDP (**GOKLB):** It measures the extent government is either putting financial resources at the disposal of other sectors in the economy (World Bank, 2014). This is a proxy for financial depth and innovative activities in Kenya.
Inefficiency (**Management Inefficiency):** The proportion by which the observed outcome or goal attainment fall short of optimum level. It is represented by one-sided error term (U_{rjt}) with a non-zero mean. U_{rjt} is normally assumed to be truncated-normal (Aigner *et al.*, 1977; Greene, 2012).
Inflation Consumer Price Index (CPI): Measures changes in prices of goods and services that households consume that affect the consumers' real purchasing power and their welfare in Kenya. CPI and GDP deflator are cross-correlated (Reis and Mankiw, 2001). A *proxy for market condition.*
Interest Spread (INSP): Average lending rate minus average borrowing rate (World Bank, 2014). *A proxy for risk pricing in Kenya*
Liberalization Period (LP): Era of economic reforms specifically 1980s-1990s and after (Research, 2015).
Money Supply (M3XT): M3XT is the currency in circulation measure in Kenya that is all-encompassing (Khainga, 2014).
Post-Liberalization: After amendment of Co-operatives Act, 2004 (Research, 2015).
Pre-Regulation Period: 2010 and before SASRA time-from 2007 (Research, 2015).
Regulation Period: During SASRA from 2011 and after - to 2014 (Research, 2015).
SASRA License: Saccos operating FOSA were required by Saccos Societies Regulation 2010 of the Sacco Societies Act, 2008 to have applied for license by 17 June 2011 (SSA, 2008).
Slack: Amount by which either an output or input fail to attain the optimal efficiency. It is an equivalent of *inefficiency* level (Cooper *et al.*, 2007).
Specific Predictor Variables: Independent study variables (variance regressors) that exclude the macro-economic independent variables (Research, 2015).
Stochastic Frontier Analysis (SFA): A parametric method that can test hypotheses and can accommodate single output with multiple inputs. It also uses maximum likelihood econometric estimation and decomposes the error term (e_i) into two components (Aigner *et al.*, 1977).
Technically Efficient: A firm operates on the frontier of the production technology (Coelli *et al.*, 1997).
Urban Areas: Town or Municipality area. The Urban Areas are separated from Cities according to Kenya Urban Areas and Cities Act, No.13 of 2011, revised in 2015 (Research, 2015).