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Savings and Credit Co-Operative Societies as investment vehicles to enhancing affordable housing: a case of Kenyan SACCOs.

Wambui, David Nyaga
Strathmore Institute of Mathematical Sciences
Strathmore University

Savings and Credit Co-Operative Societies as Investment Vehicles to Enhancing Affordable Housing: A Case of Kenyan SACCOs

David Nyaga Wambui

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Declaration

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

David Nyaga Wambui

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June, 2020

Approval

The thesis of David Nyaga Wambui was reviewed and approved by the following:

Dr. Lucy Muthoni,
Head of Mathematical Finance Mathematics and Actuarial Science Lecturer Strathmore Institute of Mathematical Sciences (SIMS),
Strathmore University

Mr. Ferdinand Othieno,
Dean, Institute of Mathematical Sciences,
Strathmore University

Dr. Bernard Shibwabo,
Director of Graduate Studies,
Strathmore University

Abstract

The study seeks to explore whether SACCOs can profitably invest in affordable housing through special-purpose investment vehicles such as REITs. The ultimate goal is to increase the domestic funding of the affordable housing agenda.

To carry out the study, we built a hypothetical portfolio for the SACCOs using three asset classes namely: Treasury Bonds, Treasury Bills, and seven stocks from the Nairobi Securities Exchange with the best Sharpe ratio and calculated the expected return and standard deviation of that portfolio. We then added real estate (REITs) as the fourth asset class and calculated the expected return and standard deviation of the portfolio and compared the results.

From the research, we find that though SACCOs can reduce the housing finance deficit as evidenced by their huge asset base, it is not profitable for them to invest in housing through REITs as this declines their portfolio return. However, these results do not bar them from investing directly in housing since they can offer housing loans to their members in their bid to provide affordable housing and in return earn interests from those loans.

Key Words: **Portfolio Optimization, Mean-Variance Optimization, Sharpe ratio**.

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List of Abbreviations

SASRA	Sacco Societies Regulatory Authority
KES	Kenya Shilling
KNBS	Kenya National Bureau of Statistics
CAHF	Centre for Affordable Housing Finance
NSE	Nairobi Securities Exchange
REIT	Real Estate Investment Trust
MVO	Mean-Variance Optimization.

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Chapter 1

Introduction

1.1 Background to the study

1.1.1 Affordable Housing Dynamics

Affordable housing remains a problem, not only for developing countries like Kenya but also for many developed countries in the World. This problem is exacerbated by the rapid increase in urban population, high cost of construction and finance costs, and the escalating prices of urban land. The government of Kenya unveiled an affordable housing program as one of the big four agendas with a proposal to provide housing to all Kenyans by targeting the construction of one million affordable houses by 2022 Kieti (2020).

According to Mungai and Otieno (2011), affordable housing is a term used to describe dwelling whose total housing costs are deemed "affordable" to households such that they will be in a position to satisfy other basic needs on a tenable basis. It is mainly aimed at individuals who fail to qualify for mortgages due to financial constraints. Another definition of affordable housing would be units that can be afforded by individuals who earn Kshs 50,000 and below per month, which is a total of 74.4% of persons employed in the formal sector in Kenya KNBS (2012).

A huge population of the Low and Median-Income earners in Kenya do not afford the high housing prices and thus either share a unit of housing so that they can have pooled resources to cater for housing costs or opt to live in informal settlements which are deemed affordable. However, these settlements lack basic facilities like water, sanitation, and electricity which is below the constitutional threshold. Only 11% of Kenyans can finance a mortgage which implies that most households are unable to purchase an entry-level house Van Noppen (2012).

1.1.2 Demand for Affordable Housing

According to Arucy (2019), Kenya has an estimated housing deficit of over two million units, which increases annually by 200,000 units against an estimated annual supply of 50,000 units leaving the housing deficit growing by 150,000 units per year.

The inadequacy in formal housing causes low-income earners to shift towards informal settlements, which culminates in the development of slums. Arucy (2019) estimates that 61% of urban households live in slums. This housing shortfall also results in a steady rise in prices of property, with Nairobi emerging as among the most priced cities in the African continent. High prices make the housing unaffordable, forcing the people to source for additional finance to cater for their housing. Most low-income earners lack clear credit records and therefore are unable to access mortgage facilities. Instead, they are inclined towards housing loans that are majorly provided by SACCOs.

1.1.3 Housing Developers and Market Players

The private sector housing developers have partially extenuated the housing deficit in Kenya. They have been a key provider of housing, especially in Nairobi Hassanali (2009). They lay their concentration mainly towards the middle and upper-earners' cohort with moderately little focus on the low-income earners' cohort where the need is particularly acute Hassanali (2009).

The National Housing Corporation was set up to revamp the supply of houses in urban areas Hassanali (2009). According to GARDNER et al. (2019), Savings and Credit Cooperative Societies (SACCOs) have overhauled commercial banks and mortgage companies in the purveying of mortgage and housing construction loans.

1.1.4 SACCOs Dynamics

SACCOs are cooperatives whose aim is to pool their members' savings and offering loans to them Lari (2009). The fast growth of SACCOs is attributed to their ability to provide a credit on relatively affordable terms and conditions particularly on the less advantaged groups in the society Alila and Obado (1990).

Cooperatives in Kenya began in 1908 with the establishment of the first cooperative production and Marketing by the European farmers at Lumbwa near Kericho but the growth was curtailed by the colonial government Ongore (2001). However, following independence in 1963, the government supported the Cooperatives and SACCOs' movements as they were seen as the vehicles to modern economic development Mudibo (2006).

SACCOs were usually managed by the government before liberalization in 1997 Oyoo (2002) and they were restricted to only invest in fixed deposits and real estate. Investments in bonds and private companies were dissuaded unless they were guaranteed high returns. The guidelines aimed to ensure excess liquidity. However, due to the current competitive market economy, such policies were not feasible and the partial withdrawal of the government in the SACCOs operations brought about liberation and a surge in the number of SACCOs in Kenya Gachara (1990).

The three broad categories of SACCOs according to Bwana (2013) are:

1. Community-based-SACCOs that are mostly encountered on the village level and provides varying groups and individual loans to members.
2. Employee-based-SACCOs whose members are drawn from one employer and the loans offered are based on the salary of the employees.
3. Agricultural-based-SACCOs whose members are drawn from individual farmers and farmers' associations.

The 2018 SACCOs supervision report, points out that a total of 176 SACCOs were licensed to operate and undertake deposit-taking Sacco business in Kenya at the commencement of the year 2018 with an estimated membership of 14 million and a total assets base of Kshs 495.25 Billion Authority (2018). This is a huge asset base which if a portion of it is directed at providing affordable housing for their members, they would make a significant contribution towards minimizing the housing gap. The majority of SACCOs' clients are from the low and middle-income earners cohort Bwana (2013) and therefore they would be the potential beneficiaries of the housing investment. It is for this reason that the study chose SACCOs over other players in the housing market. According to Mwangi et al. (2015), SACCOs contribute 45% of Kenya's GDP.

1.1.5 SACCOs Investment

The liquidity level maintained by credit unions ought to meet regulatory requirements Easley et al. (1996). Easley et al. (1996) further noted that liquidity ought to be adequate to meet the demand for cash withdrawals, financing commitments for approved loans, and routine operating cash outflows. Excess liquidity on the other hand can be an ineffective use of funds and can hinder the profitability of the credit union. According to Easley et al. (1996), credit unions that have met the legislated liquidity requirements are the ones licensed for regular lending and investment activities.

Credit unions invest their funds in the following investment instruments; loans, liquid investments like money transfer services, financial investments for instance term deposits, bonds, and treasury bills, non-financial investments e.g. buildings and land, and shares WOCCU (2009).

Appendices A and B point out that SACCOs can invest their surplus funds in government securities, shares, stocks, and real estate.

This study seeks to find out if investment in the real estate through REITs is profitable since they provide economies of large scale, diversification, and liquidity advantages over investing directly in the real estate.

1.1.6 Understanding Correlation and Portfolio weights

Stocks correlation is a measurement of the relationship between two or more stocks and their dependency Andersson et al. (2008). The correlation measurement is expressed as a number between +1 and -1. A zero correlation indicates there is no relationship between the stocks. A +1 indicates an absolute positive correlation (they always move together in the same direction). A -1 indicates an absolute negative correlation (they always move together in opposite directions of each other).

According to Perry (1985), stocks in the same industry would have a high positive correlation. They would probably be affected similarly by events. Stock correlation is useful as it enlightens the investor on the level of diversification of his/her portfolio.

Portfolio weights show the fraction of the portfolio's total value held in each asset.

Generally, the weights must sum to one and are assumed to be non-negative, but the latter assumption is sometimes relaxed to allow for borrowing and short selling of assets.

1.2 Problem Statement

There has been a mismatch in supply and demand for housing in Kenya and this has resulted in an increase in housing prices which fuels the mushrooming of slums in the urban areas. The housing deficit is estimated to increase by 150,000 units per year which aggravate the current housing deficit position of approximately two million units Arucy (2019).

The government has set in motion the big four agenda with one agenda focusing on the provision of affordable houses. As outlined in the proposed framework captured in the Kenya economic update, the affordable housing budget is approximated to be Ksh.2.6 trillion with funding expected from the state budget, National Social Security Fund (NSSF), and the private sector with contributions of 10%, 30%, and 60% of the total funding respectively. This depicts that SACCOs whose majority of their clients are from the low and middle-income earners cohort Bwana (2013) have a great role in making the affordable housing agenda feasible.

The study thus seeks to find a sustainable solution to this ballooning housing problem by exploring how SACCOs can profitably invest in affordable housing considering their huge asset base of (KES 495.25 billion) SASRA report (2018). The ultimate goal is to increase the domestic funding of the affordable housing agenda. As with any investment, the required rate of return must at least be equal or surpass the rate of return of the present investments.

1.3 Objectives

The specific objectives of the research are;

1. To compute the optimal weights of the proposed investment.
2. To examine the correlation between the various asset classes in the proposed hypothetical portfolio.
3. To assess the profitability of investment in real estate (REITs) to SACCOs.

1.4 Research Questions

The research questions that motivate the study include:

1. What are the optimal weights of the proposed investment?
2. What is the correlation between assets in the hypothetical portfolio?
3. Is investment in affordable housing through investing in REITs profitable?

1.5 Significance of the Study

The results from this study will guide the SACCOs in ascertaining the best asset classes to incorporate in their portfolio. The study will also form a basis for guiding the government in implementing the Big Four Agenda as well as help in building a pool of literature for the researchers.

1.6 Scope of the Study

In this study, the lack of finance is recognized as the main barrier to the supply of affordable housing. Other factors affecting the supply of affordable housing e.g. land, development, operations, and maintenance are addressed better in other studies.

The Mean-Variance model was chosen because it is the most commonly used model by fund managers in Kenya as they select portfolios in which to invest. Additionally, it is the standard model for solving portfolio problems in finance Steinbach (2001).

1.7 Study Outline

Chapter one orients us to the background of the study, it also covers the problem statement, objectives of the study, significance of the study, and the scope of the study.

Chapter two provides a literature review of the study to lay a firm foundation important in examining the role of SACCOs in enhancing affordable housing.

Chapter three spells out the research methodology selected to address the objectives of the research. In this chapter, Mean-Variance Optimization will be used to obtain an optimal portfolio for the SACCOs.

Chapter four discusses the results and analysis of the study and in chapter five, an outline of the conclusions and recommendations of the study is spelled out.

Chapter 2

Literature review

2.1 Introduction

This chapter presents the literature related to the role of SACCOs and portfolio theory.

2.2 Role of SACCOs in promoting members welfare

SACCOs' main objectives are to promote economic interests as well as the general well-being of their members Cheruiyot et al. (2012).

The SACCOs' contribution to improving the social welfare of people cannot be undermined and therefore both government and development partners need to support them so that they may sustainably serve the population Ng'ondi (2013).

Nahayo et al. (2013) pointed out that the SACCOs' main goal is to profit members via purveying loans to them.

Research by Peace (2011) established that Mitaana SACCO had largely aided in providing a favorable environment for the expansion of businesses in the exurban area of Nyakagyeme in Uganda.

Mwangi (2011) looked into the role of Saccos in financial intermediation in Nairobi County and ratified that embracing co-operative societies can be beneficial to individuals and the entire community as a whole due to the vast financial resources they dominate and their accrescent membership in the formal and informal quarters of the economy.

The remarkable progress made by the SACCOs in the financial sector is attributed to their willingness to offer loans to their members without demanding collaterals Auka and Mwangi (2013).

2.3 Portfolio Theory

Portfolio theory entails the selection of portfolios that maximizes expected returns congruous with the level of risks that are acceptable to an individual Fabozzi et al. (2007).

The theory lays out a framework that specifies and measures investment risk. It also enables the development of the relationship between risk and expected returns, its main assumption being that investors often want to maximize the returns from their investments given a certain level of risk.

According to Reilly and Brown (2011), the full range of investments must be considered due to the interaction of their returns.

Harry Markowitz in the 1950s and early 1960s developed the basic portfolio model. His paper "Portfolio Selection" that was published in the *Journal of Finance* in 1952 laid the foundation for *Mean-Variance Analysis, Mean-Variance Optimization, and the Modern Portfolio Theory.* He was instrumental in the derivation of the portfolio's expected rate of return and the expected risk measure and established the assumption that the variance (or standard deviation) of the expected rate of return was an important measure of portfolio risk. He opined that the portfolio's expected rate of return is the weighted average of the individual assets' expected return in the portfolio. Markowitz argued that investors should select their investment assets based on risk and expected return trade-off. Kenyan stock market commonly uses Mean-variance analysis for portfolio selection Masese (2017).

2.3.1 Refinements to Mean-Variance Optimization

Incorporation of constraints in the Mean-Variance Optimization problem may yield better performance as compared to portfolios created devoid of constraints. Constraints such as Long-Only (short selling not allowed), guideline (limits or conditions specified by client), exposure constraints made at the discretion of the portfolio manager, trading constraints (discretionary limits on positions or trades) are in practice incorporated in the MVO problem Kolm et al. (2014). However, the constraints ought to be imposed diligently to avoid distorting the robustness of the portfolio allocation Markowitz (2010).

Chapter 3

Research Methodology

3.1 Introduction

This chapter presents the research methodology. First, a presentation of the research design is provided. This is followed by an explanation of the description of data collection procedures, conceptual framework, and a description of data analysis procedures.

3.2 Research Design

The study adopted a quantitative research design. It is quantitative since it is focused on the collection and analysis of stocks, treasury bonds, and REITs data statistics to construct optimal portfolios.

3.3 Data Collection

Secondary data on stocks listed on the NSE all share index (NASI) was sourced from the Thompson Reuters terminal. Data on REITs and Treasury Bonds was sourced from Investing.com and the Treasury Bill interest rate was obtained from the Central Bank of Kenya website.

Information regarding SACCOs' investment policies was obtained from the SACCO Societies Act, 2008.

3.4 Conceptual Framework

3.4.1 Determining the Optimal Portfolio

We shall refer to Fabozzi et al. (2007) while developing the classical framework for mean-variance optimization. Firstly, we suppose that investors have to choose a portfolio comprising of N risky assets. The investor's choice is encapsulated in an N-vector $W = (w_1, w_2, ..., w_N)^T$ of weights, with each weight j representing the percentage of the j-th asset held in the portfolio, and

$$\sum_{j=1}^{N} w_j = 1$$

Suppose the assets returns $r = (r_1, r_2, ..., r_N)^T$ have expected returns $\mu = (\mu_1, \mu_2, ..., \mu_N)^T$ and an $N \times N$ covariance matrix given by

$$\mathbf{\Sigma} = \begin{bmatrix} \sigma_{11} & \cdots & \sigma_{1N} \\ \vdots & & \vdots \\ \sigma_{N1} & \cdots & \sigma_{NN} \end{bmatrix}$$

Where σ_{ji} represents the covariance between asset j and asset i such that $\sigma_{ii} = \sigma_i^2$, $\sigma_{ji} = \rho_{ij}\sigma_i\sigma_j$ and ρ_{ji} represents the correlation between asset j and asset i

By holding the above assumptions, the portfolio's return with weights $W = (w_1, w_2, ..., w_N)^T$ is a random variable $R_p = W^T R$. The portfolio's expected return and variance are given below;

$$\mu_p = W^T \mu$$

$$\sigma_p^2 = W^T \sum W$$

Once the investor chooses the portfolio's weights, he proceeds and chooses among the available mean-variance pairs.

The objective of MVO in portfolio selection is:

$$\min_{w} W^T \sum W$$

subject to the below constraints:

$$\mathrm{W}^T\mu \geq \mu_0$$
$$\sum_{i=1}^{N} w_i = 1$$
$$w_i \geq 0$$

Where μ_0 is the target mean return required by an investor and Σ in the minimization problem is the covariance matrix. By setting $w_i \geq 0$, it implies that no short-selling is allowed. This is important since this study focuses on maximizing returns and having a bounded variance which short-selling does not allow. The study uses the highest average return amongst the assets forming the portfolio as the target mean return required by an investor.

3.4.2 Sharpe Ratio

The reward-to-variability ratio (more commonly known as the Sharpe ratio (SR)) was introduced by William Sharpe in 1966 and it compares the return of an asset against the return of T-bills Israelsen et al. (2005).

It describes how much excess return you receive for the extra volatility you endure for holding a riskier asset.

It is calculated as $SR = \frac{E(R)-R_f}{\sigma}$

E(R) represents the expected return while R_f represents the risk-free rate(i.e. T-bills) and σ is the standard deviation of the excess returns.

The Sharpe ratio is based on mean-variance theory and consequently valid only for normal distributions or quadratic preference Ziemba (2005). In this study, investment returns are assumed to follow a normal distribution and thus the Sharpe ratio becomes ideal.

3.5 Data Analysis Procedure

This study proposes investment by SACCOs in real estate to reduce the housing finance deficit as long as the investment yields a higher return as compared to the one yielded by the current investment.

This study adopted a buy-and-hold investment strategy i.e. buying a stock and holding for a long period notwithstanding the market fluctuations. There is an empirical observation that investing in a good company, in the long run gives a superior rate of return Perold and Sharpe (1988).

To perform Mean-Variance Optimization of the portfolio, we built a hypothetical portfolio for SACCOs that included four asset classes. When forming an asset class, the rule of thumb is that the select group of securities in each asset class must be similar and react consistently with macroeconomic drivers Sharpe (1992). The asset classes chosen were those specified in the investment policies of the SACCOs.

The two scenarios considered while obtaining optimal weights using the Microsoft Excel Solver function are listed below:

1. Maximizing returns given a specific level of risk (standard deviation of returns). This study chose the standard deviation of returns of the asset class with the highest average return to be the level of risk.
2. Minimizing risk for a given specific level of return. This study chose the return of the asset class bearing the highest average return to be the level of return.

Weights obtained from the best scenario (with the highest Sharpe ratio) was then used to obtain the time series of optimal returns.

The main constraints while obtaining the optimal weights were:

1. The weights must sum to unity (one).
2. The weights allocated must be non-negative (no short selling).
3. The portfolio return must be greater or equal to the target mean.

4. The portfolio's standard deviation must be less than or equal to the target standard deviation (level of risk).

The asset classes formed were as below:

1. **Asset Class 1**

   This comprised of seven stocks traded in the Nairobi Securities Exchange (NSE) with the best Sharpe ratio from different sectors for diversification purposes. Firstly, we obtained the daily returns of all the NSE traded stocks and calculated their Sharpe ratio by dividing the stocks' average returns by their corresponding standard deviations. Secondly, we selected all the stocks with a positive Sharpe ratio and picked the stock with the highest Sharpe ratio per sector. We then obtained their monthly returns for portfolio optimization purposes. The selected stocks were:

   - Kakuzi from the Agricultural sector.
   - Equity Group Holdings from the Banking sector.
   - Sameer Africa PLC from the Commercial and Services sector.
   - Crown Paints Kenya from the Construction and Allied sector.
   - Total Kenya from the Energy and Petroleum sector.
   - Unga Group Ltd from the Manufacturing and Allied sector.
   - Safaricom PLC from Telecommunication and Technology sector.

2. **Asset Class 2**

   It solely comprised of the 364-Day Treasury Bill. Our choice for the 364-Day T-bills was guided by their high returns as compared to 91-Day and 182-Day T-bills. They are considered risk free because the Kenyan government backs them hence rendering them safe for investment.

3. **Asset Class 3**

   It solely comprised of Treasury bonds. They are occasionally tax-exempt and therefore become a very attractive investment. The study considered investing in a 4-year bond to match the investment horizon i.e. January 2016 to December 2019.

4. **Asset Class 4**

   Investment in housing (Real Estate) was considered as the fourth asset class. We used the STANLIB Fahari I-REIT prices to obtain the REITs' return. It was introduced to the Kenyan investment market in November 2015. This hugely dictated the choice of our investment horizon i.e. to commence in January 2016.

To generate the optimal weights using the Microsoft Excel Solver function, we set the objectives (maximizing return given a specific level of risk or minimizing risk given a specific level of return) and added the constraints that had been outlined before. By clicking on **solve**, Excel executes the requested operation and returns the optimal weights.

To ascertain the impact of investing in real estate on the SACCOs portfolio returns, we built a hypothetical portfolio A for the SACCOs using three asset classes comprising of Treasury Bond, Treasury Bills, and seven stocks from the Nairobi Securities Exchange. We added REITs as the fourth asset class to portfolio A and formed portfolio B. Then, via the mean-variance optimization technique, we compared the results for the two portfolios analyzed separately.

Chapter 4

Presentation of Research Findings and Discussion

4.1 Portfolio Optimization Exclusive of REITs Asset Class

4.1.1 Asset Class 1 Risk Return Analysis

Table 4.1: Asset Class 1 Risk Return Analysis

Individual Assets			
	μ (Average Return)	σ (Std Dev of Returns)	μ/σ (Sharpe Ratio)
EQUITY	1.10%	9.95%	0.11
TOTAL KENYA	1.14%	7.68%	0.15
KAKUZI	0.41%	7.33%	0.06
CROWN BERGER	0.71%	11.59%	0.06
UNGA LTD	0.40%	9.43%	0.04
SAFARICOM	1.53%	5.46%	0.28
SAMEER	0.39%	11.07%	0.04

The results from Table 4.1 show that Safaricom is the best stock to invest in since it has the highest Sharpe ratio.

4.1.2 Optimal weights for Asset Class 1

Table 4.2: Optimal weights for Asset Class 1

Class 1 portfolio			
	Equal Weights	Max Return	Min Std Dev
Constraining Variable	None	at σ<=	at μ=
Constraint Value	N/a	5.46%	1.53%
EQUITY	0.143	0.000	0.000
TOTAL KENYA	0.143	0.179	0.000
KAKUZI	0.143	0.030	0.000
CROWN BERGER	0.143	0.055	0.000
UNGA LTD	0.143	0.000	0.000
SAFARICOM	0.143	0.639	1.000
SAMEER	0.143	0.097	0.000
∑ WEIGHTS	1.000	1.000	1.000
μP (Portifolio Return)	0.81%	1.27%	1.53%
σp (Portifolio Std Dev)	4.12%	4.12%	5.46%
μ/σ (Sharpe Ratio)	0.20	0.31	0.28

The results from Table 4.2 shows that the highest Sharpe ratio is obtained when returns are maximized at a given specific level of risk (standard deviation of less than 5.46%). Further, they suggest that SACCOs should invest as follows: 63.9% in Safaricom , 17.9% in Total Kenya, 3% in Kakuzi, 5.5% in Crown Berger, and 9.7% in Sameer to realize high returns per unit increase in risk.

4.1.3 Tests for statistical differences between time series of returns obtained by using optimal weights and equal weights (Asset Class 1)

We ran an F-Test Two-Sample for variances to get clarity on whether to conduct a Two-Sample T-Test assuming equal variances or Two-Sample T-Test assuming unequal variances.

Table 4.3: F-Test

F-Test Two-Sample for Variances		
	Time Series of Returns with optimal weights	*Time Series of Returns with Equal Weights*
Mean	0.012707495	0.006539881
Variance	0.001730542	0.00119436
Observations	48	48
df	47	47
F	1.448927847	
P(F<=f) one-tail	0.103690056	
F Critical one-tail	1.623755476	

The null hypothesis (H_0) and the alternative hypothesis (H_1) are given as:

H_0: Variances of the two portfolios are equal; reject if $\alpha < 0.05$

H_1: Variances of the two portfolios are not equal.

From Table 4.3, at a 5% significance level, the two-tailed p-value (α) is 0.20738 and therefore we do not reject the null hypothesis. This guides us into running a Two-Sample T-Test assuming equal variances.

To ascertain if the mean returns while using optimal weights are statistically different from the mean returns while using equal weights, we carried a Two-Sample T-Test assuming equal variances.

The null hypothesis (H_0) and the alternative hypothesis (H_1) are given as:

H_0: Mean returns of the two portfolios are equal; reject if t stat>t critical two-tail

H_1: Mean returns of the two portfolios are not equal.

Table 4.4: T-Test

t-Test: Two-Sample Assuming Equal Variances		
	Time Series of Returns with optimal weights	*Time Series of Returns with Equal Weights*
Mean	0.012707495	0.006539881
Variance	0.001730542	0.00119436
Observations	48	48
Pooled Variance	0.001462451	
Hypothesized Mean Difference	0	
df	94	
t Stat	0.790100154	
P(T<=t) one-tail	0.215728983	
t Critical one-tail	1.661225855	
P(T<=t) two-tail	0.431457965	
t Critical two-tail	1.985523442	

From Table 4.4, at a 5% significance level, t stat is 0.790100154 while t critical two tail is 1.985523442. We, therefore, do not reject the null hypothesis and conclude that there is no enough evidence to infer that Time Series of returns with optimal weights are statistically different from those of equal weights. This implies that though the optimal weights yield higher mean returns compared to equal weights, the difference in their mean returns is not statistically significant.

4.1.4 Variance Covariance Matrix and Correlation Matrix for Asset Class 1 Returns

Table 4.5: Variance Covariance Matrix

VARIANCE-COVARIANCE MATRIX							
	EQUITY	TOTAL KENYA	KAKUZI	CROWN BERGER	UNGA LTD	SAFARICOM	SAMEER
EQUITY	0.009896596	0.002347289	0.001648187	-0.000925639	0.000958139	0.002400534	0.001485861
TOTAL KENYA	0.002347289	0.0058917	0.000369154	0.000264525	0.002063395	0.000678205	0.000179873
KAKUZI	0.001648187	0.000369154	0.005376382	0.000293395	0.000361248	0.000796003	-0.00143541
CROWN BERGER	-0.000925639	0.000264525	0.000293395	0.013430423	0.001161461	0.000675191	-0.002454951
UNGA LTD	0.000958139	0.002063395	0.000361248	0.001161461	0.008891772	0.000132306	0.0018591
SAFARICOM	0.002400534	0.000678205	0.000796003	0.000675191	0.000132306	0.002980704	-0.000700489
SAMEER	0.001485861	0.000179873	-0.00143541	-0.002454951	0.0018591	-0.00070049	0.012247407

The results obtained from Table 4.5 shows the variances of the individual stocks along the diagonal and the covariances between all possible pairs of the stocks off-diagonal.

Table 4.6: Correlation Matrix

CORRELATION MATRIX							
	EQUITY	TOTAL KENYA	KAKUZI	CROWN BERGER	UNGA LTD	SAFARICOM	SAMEER
EQUITY	1	0.307399661	0.225953161	-0.080288644	0.102138942	0.441983011	0.134962495
TOTAL KENYA	0.307399661	1	0.065590681	0.029737353	0.285080769	0.161838235	0.021174989
KAKUZI	0.225953161	0.065590681	1	0.034527343	0.052247645	0.198842849	-0.17689224
CROWN BERGER	-0.080288644	0.029737353	0.034527343	1	0.106283483	0.106714279	-0.191414997
UNGA LTD	0.102138942	0.285080769	0.052247645	0.106283483	1	0.025699643	0.178150312
SAFARICOM	0.441983011	0.161838235	0.198842849	0.106714279	0.025699643	1	-0.115936457
SAMEER	0.134962495	0.021174989	-0.17689224	-0.191414997	0.178150312	-0.11593646	1

Table 4.6 shows that the correlations between the individual stocks are not significant. This implies that the price movements of the stocks are uncorrelated. Correlation coefficients are considered insignificant if the values are greater than -0.8 of less than +0.8, this can be viewed by clicking the link https://www.investopedia.com.

4.1.5 Optimal Weight Time Series of Returns Versus Equally Weighted Time Series of Returns (Asset Class 1)

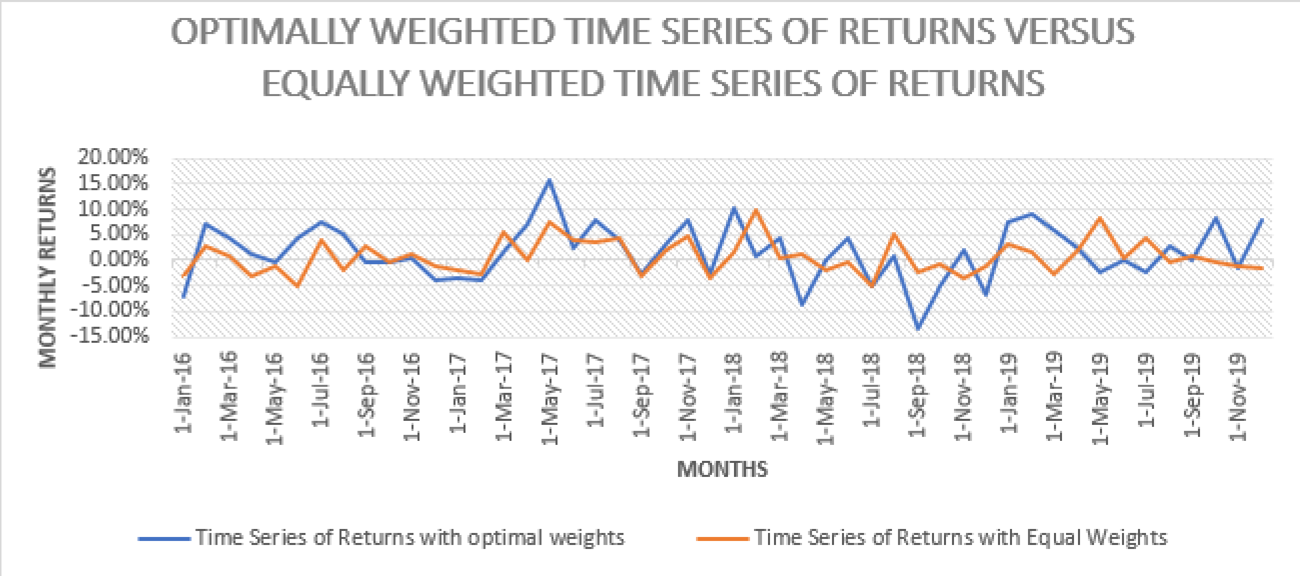

Figure 4.1: Returns for optimal weights vs Equal weights

The results from Figure 4.1 shows a huge decline in stock performance in 2018 specifically in April and September, the effect was felt hard on the optimally weighted returns since Safaricom which had the highest allocation percentage was the most affected over those periods. This could have been attributed to the political instability in the country due to the elections held in March 2018. The decline shows that the stock market acquires all the available information and considers them when pricing assets at any given time.

4.1.6 Monthly Returns of T-Bills (Asset Class 2)

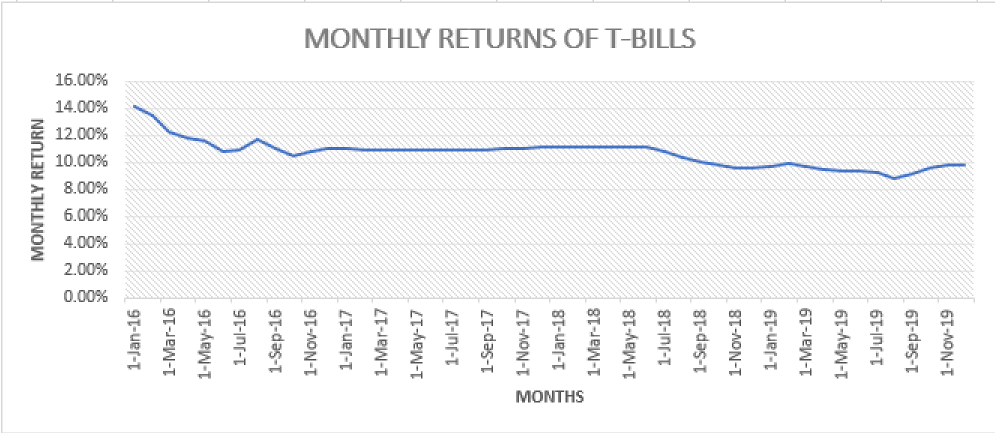

Figure 4.2: Movements of the monthly returns

From Figure 4.2, T-Bill returns exhibit a Flat Yield Curve. The curve indicates that the market environment is sending diverse signals to investors, who are interpreting interest rate movements in various ways. Through that period, it is difficult for the market to determine whether interest rates will move significantly in either direction into the future Muthoni (2017).

4.1.7 Daily Returns of 4-Year Bond (Asset Class 3)

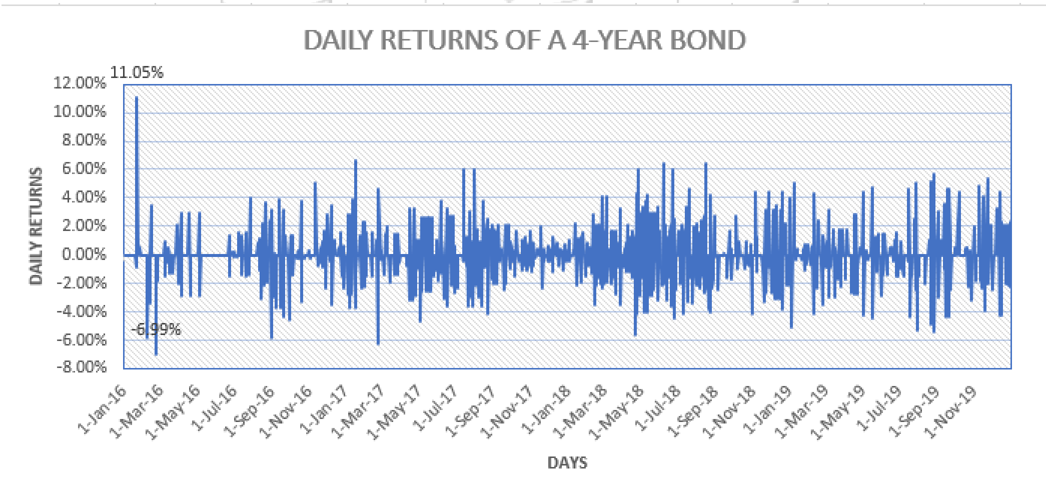

Figure 4.3: Movements of the daily returns

From Figure 4.3, the 4-Year bond had the best daily return at 11.05% on 22nd January 2016 while its worst performance in the market was on 23rd February 2016 where it registered a decline of 6.99% in its return.

4.1.8 Monthly Returns of 4-Year Bond (Asset Class 3)

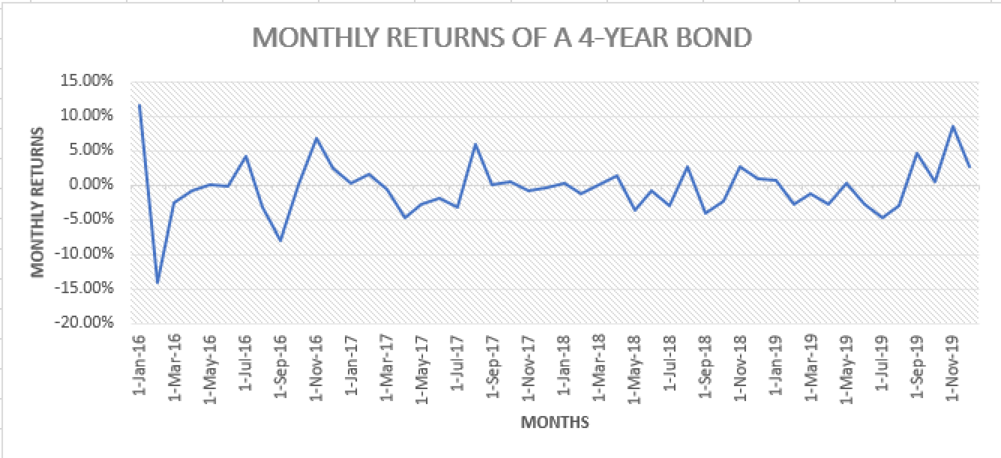

Figure 4.4: Movements of the Monthly returns

From Figure 4.4, the 4-Year bond registered the highest and lowest returns in January 2016 and February 2016 respectively.

4.1.9 Risk Return Analysis of Portfolio A (Without Reits)

Table 4.7: Portfolio Risk-Return Analysis

Individual Assets			
	μ (Average Return)	σ (Std Dev of Returns)	μ/σ (Sharpe Ratio)
STOCKS	1.27%	4.12%	0.31
T-BILLS	10.66%	1.02%	10.47
4-YEAR BOND	-0.38%	4.04%	-0.09

From Table 4.7, T-Bills have the best Sharpe ratio and, notably, the 4-Year bond has a negative Sharpe ratio attributed to its negative monthly return.

4.1.10 Variance Covariance Matrix and Correlation Matrix of Portfolio A

Table 4.8: Variance covariance matrix of Portfolio A

VARIANCE COVARIANCE MATRIX			
	STOCKS	T-BILLS	4-YEAR BOND
STOCKS	0.001694489	-1.13068E-05	-0.000317944
T-BILLS	-1.13068E-05	0.000103583	-1.48005E-05
4-YEAR BOND	-0.000317944	-1.48005E-05	0.001631897

The results obtained from Table 4.8 shows the variances of the individual asset classes along the diagonal and the covariances between all possible pairs of the asset classes off-diagonal.

Table 4.9: Correlation Matrix of Portfolio A

CORRELATION MATRIX			
	STOCKS	T-BILLS	4-YEAR BOND
STOCKS	1	-0.026988424	-0.191198481
T-BILLS	-0.026988424	1	-0.035998713
4-YEAR BOND	-0.191198481	-0.035998713	1

From Table 4.9, the three asset classes are negatively correlated although these coefficients are greater than -0.8 and thus considered not significant https://www.investopedia.com.

4.2 Portfolio Optimization of Portfolio B (REITs Augmented to Portfolio A)

4.2.1 Risk-Return Analysis of Portfolio B.

Table 4.10: Risk-Return Analysis of Portfolio B

Individual Assets			
	µ (Average Return)	σ (Std Dev	µ/σ (Sharpe Ratio)
STOCKS	1.27%	4.12%	0.31
T-BILLS	10.66%	1.02%	10.47
4-YEAR BOND	-0.38%	4.04%	-0.09
REITS	-1.22%	9.98%	-0.12

Results from Table 4.10 shows evidently that Treasury Bills are the safest investments with the Sharpe ratio being 10.47 which indicates that return on investment is 10.47 times greater than the risk taken.

4.2.2 Weighting of the Assets in portfolio B

Table 4.11: Weights of Asset Classes in Portfolio B

Portifolio B			
	Equal Weights	Max Return	Min Std Dev
Constraining Variable	None	at σ<=	at μ=
Constraint Value	N/a	1.02%	10.66%
STOCKS	0.250	0.000	0.000
T-BILLS	0.250	1.000	1.000
4-YEAR BOND	0.250	0.000	0.000
REITS	0.250	0.000	0.000
∑ WEIGHTS	1.000	1.000	1.000
μP (Portifolio Return)	2.58%	10.66%	10.66%
σp (Portifolio Std Dev)	2.64%	1.02%	1.02%
μ/σ (Sharpe Ratio)	0.98	10.47	10.47

From Table 4.11, when equal weights were assigned to the four asset classes, the portfolio's return and standard deviation were found to be 2.58% and 2.64% respectively. Through mean-variance optimization using solver tool in Microsoft Excel, the new weights indicate that SACCOs should invest solely towards T-Bills in their bid to maximize the portfolio returns.

4.2.3 Variance Covariance Matrix and Correlation Matrix of Portfolio B

Table 4.12: Variance Covariance Matrix

VARIANCE COVARIANCE MATRIX				
	STOCKS	T-BILLS	4-YEAR BOND	REITS
STOCKS	0.001694489	-1.13068E-05	-0.000317944	8.05804E-05
T-BILLS	-1.1307E-05	0.000103583	-1.48005E-05	-7.60154E-05
4-YEAR BOND	-0.00031794	-1.48005E-05	0.001631897	-0.000789283
REITS	8.05804E-05	-7.60154E-05	-0.000789283	0.009951095

The results obtained from Table 4.12 shows the variances of the individual asset classes along the diagonal and the covariances between all possible pairs of the asset classes off-diagonal.

Table 4.13: Correlation Matrix

CORRELATION MATRIX				
	STOCKS	T-BILLS	4-YEAR BOND	REITS
STOCKS	1.00000000	-0.02698842	-0.19119848	0.01962343
T-BILLS	-0.02698842	1.00000000	-0.03599871	-0.07487252
4-YEAR BOND	-0.19119848	-0.03599871	1.00000000	-0.19586230
REITS	0.01962343	-0.07487252	-0.19586230	1.00000000

From Table 4.13, the correlations amongst the four asset classes do not exceed $>|0.7|$ (an appropriate benchmark that shows when collinearity starts to severely pervert model estimations and subsequent predictions) see https://onlinelibrary.wiley.com.

4.3 Statistical Tests To Ascertain The Differences Between Portfolio A and Portfolio B

4.3.1 F-Test

We ran an F-Test Two-Sample for variances to get clarity on whether to conduct a Two-Sample T-Test assuming equal variances or Two-Sample T-Test assuming unequal variances.

Table 4.14: F-Test

F-Test Two-Sample for Variances		
	PORTFOLIO A	*PORTFOLIO B*
Mean	0.038508042	0.025839365
Variance	0.000311134	0.000710012
Observations	48	48
df	47	47
F	0.438209064	
P(F<=f) one-tail	0.0027607	
F Critical one-tail	0.615856276	

The null hypothesis (H_0) and the alternative hypothesis (H_1) are given as:

H_0: Variances of the two portfolios are equal; reject if $\alpha < 0.05$

H_1: Variances of the two portfolios are not equal.

From Table 4.14, at a 5% significance level, the two-tailed p-value (α) is 0.0055214 and therefore we reject the null hypothesis. This guides us into running a Two-Sample T-Test assuming unequal variances.

4.3.2 T-Test

To ascertain whether there are significant differences in the mean returns between portfolio A and portfolio B, we carried a Two-Sample T-Test assuming unequal variances.

Table 4.15: T-Test

t-Test: Two-Sample Assuming Unequal Variances		
	PORTFOLIO A	*PORTFOLIO B*
Mean	0.038508042	0.025839365
Variance	0.000311134	0.000710012
Observations	48	48
Hypothesized Mean Difference	0	
df	82	
t Stat	2.74667927	
P(T<=t) one-tail	0.003699272	
t Critical one-tail	1.663649184	
P(T<=t) two-tail	0.007398544	
t Critical two-tail	1.989318557	

The null hypothesis (H_0) and the alternative hypothesis (H_1) are given as:

H_0: Mean returns of the two portfolios are equal; reject if t stat>t critical two-tail

H_1: Mean returns of the two portfolios are not equal. From Table 4.15, at a 5% significance level, the t stat is 2.74667927 while t critical two-tail is 1.989318557. T stat>t critical two-tail and therefore we reject the null hypothesis and conclude that the mean returns of the two portfolios are statistically different. The inclusion of the REITs reduces the portfolio return from 3.85% to 2.58%.

Chapter 5

Conclusion and Recommendations

5.1 Thesis Conclusion

The main intention of this study was to assess the profitability of investment in housing to SACCOs by investing in Real Estate Investment Funds. This study involved:

- Selection of the asset classes.
- Computation of optimal weights of the proposed investment.
- Examining the correlation between the various asset classes in the proposed investment.

To compute the optimal weights of the proposed investment, we first assigned equal weights to the various asset classes in the portfolio and then used the Solver function in Microsoft Excel subject to the constraints outlined in Chapter 3 of this work.

To compute the correlation of the various asset classes in the proposed portfolio, we first generated a variance-covariance matrix by using the matrix multiplication function in Microsoft Excel and then divided by the standard deviation matrix.

Concerning portfolio optimization, we set the return and standard deviation of the asset with the highest Sharpe ratio to be the benchmark and therefore the investment portfolio should yield a return greater or equal to that benchmark while setting the portfolio's standard deviation to be smaller than the benchmark.

The impact of adding the housing (real estate) asset class to the hypothetical portfolio was used to assess the profitability of investment in housing through REITs to SACCOs based on the risk-return analysis.

The results obtained indicated a decline in the portfolio returns when the REIT asset class was added to the hypothetical portfolio. The results are congruous with the research done in 2019 by Audrey Aidi, BBS Financial Economics student from Strathmore University. She looked at Pension Funds as investment vehicles towards affordable housing and found that investment in REITs lowered the portfolio return of the Pension Fund. Therefore, as guided by the results of this study, it is not profitable for the SACCOs to invest in housing through REITs as they lower their portfolio return. However, these results do not bar them from investing directly in housing since they can offer housing loans to their members in their bid to provide affordable housing and in return earn interests from those loans.

5.2 Recommendations for further studies

We used the Sharpe ratio in our asset class selection. We would be interested to see what other performance metrics such as Sortino ratio yields.

The effect of transaction costs-brokerage fees and taxes, on portfolio optimization can also be considered for further study.

The approach of the study was historical, additional studies can be conducted on a forward-looking design.

Further studies can also be done by considering other new risk measures like Conditional Value at Risk, Mean Absolute Deviation and semi-variance which takes investor's views into account in a risk-return analysis as an improvement over MVO as suggested by Chen et al. (2015).

Bibliography

Alila, P. O. and Obado, P. O. (1990). Co-operative credit: the kenyan saccos in a historical and development perspective.

Andersson, M., Krylova, E., and Vähämaa, S. (2008). Why does the correlation between stock and bond returns vary over time? *Applied Financial Economics*, 18(2):139–151.

Arucy, K. (2019). Affordable housing policy in kenya: The big four transformation agenda 2017–2022. *Management and Economic Journal*, pages 593–596.

Auka, D. O. and Mwangi, J. K. (2013). Factors influencing sacco members to seek services of other financial service providers in kenya. *International Review of management and business research*, 2(2):610–626.

Authority, S. S. R. (2018). The sacco supervision annual report 2018. *Nairobi. SASRA*.

Bwana, K. M. (2013). Issues in saccos development in kenya and tanzania: The historical and development perspectives.

Chen, Z., Li, Z., and Wang, L. (2015). Concentrated portfolio selection models based on historical data. *Applied Stochastic Models in Business and Industry*, 31(5):649–668.

Cheruiyot, T. K., Kimeli, C. M., and Ogendo, S. M. (2012). Effect of savings and credit co-operative societies strategies on member's savings mobilization in nairobi, kenya. *International Journal of Business and Commerce*, 1(11):40–63.

Easley, D., Kiefer, N. M., O'hara, M., and Paperman, J. B. (1996). Liquidity, information, and infrequently traded stocks. *The Journal of Finance*, 51(4):1405–1436.

Fabozzi, F. J., Kolm, P. N., Pachamanova, D. A., and Focardi, S. M. (2007). *Robust portfolio optimization and management*. John Wiley & Sons.

Gachara, J. (1990). An investigation into the investment of reserve funds in savings and credit co-operatives in nairobi. *Unpublished MBA Project, University of Nairobi.*

GARDNER, D., LOCKWOOD, K., PIENAAR, J., and MAINA, M. (2019). Assessing kenya's affordable housing market.

Hassanali, F. M. (2009). *Understanding reduced private-sector participation in low-income housing delivery in Nairobi*. PhD thesis, Strathmore University.

Israelsen, C. L. et al. (2005). A refinement to the sharpe ratio and information ratio. *Journal of Asset Management*, 5(6):423–427.

Kieti, R. M. (2020). Affordable housing in kenya. *AFRICA HABITAT REVIEW*, 14(1):1677–1687.

KNBS, R. (2012). Kenya national bureau of statistics.

Kolm, P. N., Tütüncü, R., and Fabozzi, F. J. (2014). 60 years of portfolio optimization: Practical challenges and current trends. *European Journal of Operational Research*, 234(2):356–371.

Lari, L. (2009). The power of financial ratios in detecting fraudulent financial reporting. the case of saccos in kenya. *Unpublished Thesis. Strathmore University. Kenya.*

Markowitz, H. M. (2010). Portfolio theory: as i still see it. *Annu. Rev. Financ. Econ.*, 2(1):1–23.

Masese, J. M. (2017). *Portfolio optimization in the Kenyan stock market: a comparison between mean-variance optimization and threshold accepting*. PhD thesis, Strathmore University.

Mudibo, E. (2006). Challenges and opportunities facing the kenyan savings and credit co-operative movement. In *Presentation during the Africa Savings and Credit Cooperatives Conference 3rd-6th October*.

Mungai, E. and Otieno, H. (2011). The challenges of housing development for the low income market. *Management Research Project. Strathmore University.*

Muthoni, L. (2017). *Construction of a zero-coupon yield curve for the Nairobi Securities Exchange and its application in pricing derivatives*. PhD thesis, Strathmore University.

Mwangi, J. K., Nyachwaya, Z. O., and Cheruyoit, R. K. (2015). Effect of corporate governance practices on financial performance of saccos in kericho municipality. *Journal of Economics and Finance*, 6(3):57–75.

Mwangi, J. M. (2011). *The role of savings and credit cooperative societies (saccos) in financial intermediation in Nairobi county.* PhD thesis, University of University.

Nahayo, A., GiseleMukakimenyi, I. E., and Mutandwa, E. (2013). Assessing the contribution of umurenge saving and credit cooperative (sacco) loans to the household income: a case study of nyabihu district, western rwanda, from 2010 to 2011. *Global Journal of Current Research*, 2(1):6–18.

Ng'ondi, M. J. (2013). *The Contribution of SACCOs in improving social welfare in Iramba district: evidence from Nyasamaja and Ukombozi SACCOs.* PhD thesis, Mzumbe University.

Ongore, V. (2001). Managerial response to deregulation of the co-operative sector. the case study of nairobi. *Unpublished Thesis. University of Nairobi.*

Oyoo, M. (2002). Evaluation of financial performance of savings and credit co-operative societies before and after deregulations: The case of saccos based in nairobi. *Unpublished MBA project report, School of Business, University of Nairobi.*

Peace, K. (2011). Small savings and credit schemes and financial accessibility in rural areas: A case study of mitaana sacco in rukungiri district. *Unpublished Master Thesis, Kampala: Makerere University.*

Perold, A. F. and Sharpe, W. F. (1988). Dynamic strategies for asset allocation. *Financial Analysts Journal*, 44(1):16–27.

Perry, P. R. (1985). Portfolio serial correlation and nonsynchronous trading. *Journal of Financial and Quantitative Analysis*, pages 517–523.

Reilly, F. K. and Brown, K. C. (2011). *Investment analysis and portfolio management.* Cengage Learning.

Sharpe, W. F. (1992). Asset allocation: Management style and performance measurement. *Journal of portfolio Management*, 18(2):7–19.

Steinbach, M. C. (2001). Markowitz revisited: Mean-variance models in financial portfolio analysis. *SIAM review*, 43(1):31–85.

Van Noppen, A. (2012). The abc's of affordable housing in kenya.

WOCCU, R. (2009). Prepared for the united nations expert group meeting on cooperatives april 28–30, 2009. *New York*.

Ziemba, W. T. (2005). The symmetric downside-risk sharpe ratio. *The Journal of Portfolio Management*, 32(1):108–122.

Appendix A

Sacco Societies Act No. 14 of 2008

38. Investments by Sacco societies

(1) The funds of a Sacco society may be invested in—

(a) securities, obligations or other debt instruments issued or guaranteed by the government or any agency of the government;

(b) deposits, obligations or other accounts of deposit-taking institutions under the Banking Act (Cap. 488);

(c) shares, stocks, deposits in, loans to or other obligations of any Sacco society or co-operative society.

(2) An investment made under this section shall not in the aggregate, exceed such proportion of the total core capital and deposits of a Sacco society as the Authority may prescribe.

(3) A Sacco society shall not purchase or acquire any land or any interest or right therein except as may be reasonably necessary for the purpose of conducting its deposit-taking business and where such investments do not exceed such proportion of the total assets of the society as the Authority may prescribe.

Appendix B

SACCOs Investment Policy

48. Limits on property, equipment financial assets

(1) A Sacco Society shall not invest in non-earning assets or property and equipment in excess of ten percent of total assets, of which land and buildings shall not exceed five percent unless a waiver to that effect has been obtained from the Authority:

Provided donated assets and foreclosed assets shall be excluded in arriving at this percentage.

(2) The request for such waiver shall include a detailed investment appraisal showing the cost and justification for the investment, including how it will improve members' service and an analysis of expected impact on the profitability and capital adequacy requirements.

(3) A Sacco Society shall be required to dispose of the investment in property acquired for the purpose of future expansion, if the property remains unutilised for two years from the date of acquisition and an extension shall only be granted with prior approval of the Authority.

(4) A Sacco Society shall not make financial investments in non-government securities in excess of forty percent of its core capital or five percent of its total deposits liabilities.

(5) For the purposes of these Regulations, financial investments mean investments in government securities, shares and stocks, deposits in institutions licensed under the banking Act, and licensed Sacco societies.