Strathmore UNIVERSITY

MULTI OBJECTIVE OPTIMIZATION OF COMMERCIAL BANK'S BALANCE SHEET IN KENYA: GOAL PROGRAMMING APPROACH

STUDENT NAME: ROTICH, ROLLY KIPKEMOI

STUDENT NO: 079728

A Research Project submitted in partial fulfilment of the requirements for the degree of Bachelor of Business Science, Finance at Strathmore University

Strathmore Institute of Mathematical Sciences

Strathmore University

Nairobi, Kenya

November 2017

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 Research Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.

Rolly Kipkemoi ..... [*Name of Candidate*]

..... [*Signature*]

3 Dec 2017 ..... [*Date*]

This Research Proposal has been submitted for examination with my approval as the Supervisor.

Dr Arnold Othieno ..... [*Name of Supervisor*]

..... [*Signature*]

2 Dec 2017 ..... [*Date*]

Strathmore Institute of Mathematical Sciences

Strathmore University

Table of Contents

Table of Figures

Abstract

This study applies goal programming approach to optimizing the balance sheet of three commercial banks representing the different tiers in Kenya; Barclays Bank of Kenya (Tier 1), Family Bank (Tier 2), Sidian Bank (Tier 3) subject to particular constraints. The constraints used in this study include capital regulatory measures issued by the Central Bank of Kenya under the Prudential Guidelines 2013. Following the Lexicographic Model Approach of allocating priorities to different constraints, the study establishes that optimization of the balance sheet of a commercial bank is possible based on desired goals and constraints. In this optimization study, the core capital ratio was realized to be the most significant constraint when optimizing the balance sheet for a commercial bank. Once an optimum core capital ratio is attained, the other constraint, total capital ratio, can be retained at the regulatory level or slightly above it. With the same results seen across all the three banks, the same procedure can be applied for the other banks. However, caution should be taken for the smaller banks in handling their capital levels.

Key words: *Goal programming, Optimizing, Capital ratios, Lexicographic model, priority*

Chapter 1: Introduction

1.0 Background

A bank's progressive trajectory may be inspired by a number of reasons such as digitization of its channels, improvement of customer experience through Know Your Customer (KYC) intiatives and efficiency of balance sheet management. The asset and liability levels are optimized in the latter. This can be achieved through profit maximization or minimizing the bank's exposure to various risks. Guven and Persentili (1997) stipulates that balance sheet management involves the determination of the size and composition of a bank's asset and liabilities. The process involves aligning balance sheet data which take account of economic scenarios, strategic assumptions and regulatory assumptions. Therefore, it is clear that determination of the optimal structure of the balance sheet is a critical issue in strategic planning of a bank. Fatma and Fathi, (2013) determine the optimal structure of a Tunisian Bank's balance sheet for the year 2006 and does a focus for the year 2007. Given that the aforementioned role is played by the risk management division, it is in line with Philipp, Andras et al., (2016) assessment that by 2025, bank risk functions will probably be even more critical in making banks successful than they are today.

For a long time, balance sheet optimization[1] has been approached by mathematical programming such as linear, quadratic and dynamic programming. Chambers and Charnes (1961) were the first to use linear programming model to determine an optimal porfolio that sertisfies the minimum reserve requirements and the capital adequacy of the of the Federal Reserve Board of an individual bank over several time periods. The linear programming model is a single-objective mathematical programming model. It allows one to maximise or minimise a single goal subject to a set of linear constraints. However, when it comes to balance sheet optimization, a number of counterintuitive goals may be desired. This include: maximisation of profit, minimization of risks and increasing of deposits and loans just to mention a few. This is why multi objective mathematical programming based on Markowitz portfolio theory is invoked as it captures the complexity of the problem. Goal Programming (GP) is the most widely used approach in the field of multi-criteria decision making that enables the decision maker to incorporate numerous variations of constraints and goals (Fatma & Fathi, 2013).

[1] This is one of the ways banks can transform their risk functions through initiatives with an immediate impact. Other initiatives include: i. Digitization of core processes ii. Experiment with advanced analytics and machine learning iii. Enhanced risk reporting and iv. Putting the enablers in place

The aim of this of paper is to apply the GP model to optimize the balance sheet of Barclays Bank of Kenya (BBK)[2], I&M bank and Sidian bank for the year 2016. BBK represents Tier 1 banks, I&M represents Tier 2 banks while Sidian represents Tier 3 banks. The model will have a target of minimizing the exposure of the bank subject to meeting the minimum regulatory requirements imposed on the bank by local and global regulators[3].

1.1 Problem Statement

The fact that the banking sector in Kenya plays a huge role in advancing the economy cannot be overemphasised. This can be seen by the extent to which the sector affects the performance of the Nairobi Securities Exchange(NSE) all share index. It is estimated that 35% of the movement of the NSE all share index is influenced by the sector. This is why the sector is highly regulated. Commercial banks are licensed and regulated in accordance with the provisions of the Banking Act and the Regulations and Prudential Guidelines issued thereunder by the Central Bank of Kenya (CBK). This was revised and new risk management guidelines applicable to commercial banks issued. This was in order to adapt new global best practices in the banking sector such as the revised Basel Core Principles Banking Supervision. All this is done to safeguard the overall soundness and stability of the banking system.

In order to be compliant with the regulations facing the sector, the commercial banks employ a number of risk management strategies especially since 2005 when the CBK adopted risk based supervision. This strategies can be qualitative or quantitative. 44% of the commercial banks in Kenya use both techniques as compared to 28% which use a qualitative approach and 16% which use a quanititative approach (Kamau, 2010). He went further and concluded that the most common technique used in measurement of risk is scenario analysis followed by value at risk technique. Stress test and annual earnings test are also used although these are less popular compared to the first two techniques. This measurement techniques are used to manage and control risk exposures within acceptable limits.

The above techniques fall short in optimising the balance sheet of the commercial banks. This is because the regulatory requirements are so complex and interrelated that it is impossible to find the optimal outcome without the support of an optimization engine. This is where the multi objective goal programming model will come in handy and provide the solution.

---

[2] BBK is a Kenyan commercial bank. Kenya is among the 32 frontier markets in the world as per the indexer MSCI; 8 of which are from Africa. This classification is based on each country's economic development, size, liquidity and market accessibility.

[3] The regulations considered here include those imposed by the Central Bank of Kenya (local regulator) and the regulator that imposed Basel III.

1.2 Research Objective

The objective of the research is to evaluate the utility of using a Goal Programming model to optimize the balance sheet of a Commercial Bank in Kenya. .

1.3 Research Question

Is Goal Programming applicable in optimizing the balance sheet for Kenya's commercial banks?

1.4 Significance

Philipp, Andras et al. (2016) stipulate that there are six structural trends which will transform bank risk management over the next ten years. These are: continued expansion of the breadth and depth of regulation, changing customer expectation, technology and analytics as a risk muscle, emerging of additional non-financial risk types[4], better risk decisions through de-biasing[5] and need for strong cost saving[6]. If by any chance this trends are to be experienced, then the risk functions will be highly valued by banks. This way, the risk divisions will be tasked with the responsibility of being the primary architects of seamless, de-biased risk decisions and monitoring throughout the organisation.

Goal programming models applied in balance sheet optimization will therefore come in handy for the risk functions as a means of performing their role.

[4] These risks include: operational and compliance risk, contagion risk where negative market developments can spread to other parts of a bank, other markets or involved parties and can cause a bank's operating environment to deteriorate quickly and significantly. Others include model risk and cyber-attacks.

[5] Three techniques can de-bias decision making: i. Analytical – providing decision makers with fact-based inputs ii. Debate – De-biasing conversations and meetings and iii. Organizational – Embedding de-biasing into organizational logic.

[6] Once banks have exploited traditional and incremental cost-cutting approaches such as zero-based budgeting, value-added analysis and outsourcing, simplification, standardization and digitization will likely be the only sizable avenues left for substantial cost savings

Chapter 2: Literature Review

2.1 Theoretical Literature

Mathematical programming models are used to achieve different objectives when optimizing the balance sheet of a bank subject to a set of linear constraints. One of the areas researched on is profit maximization although they differ in the treatment of disaggregation, uncertainty and dynamic considerations.

Chambers and Charnes (1961) were the first to use linear programming to maximise profit subject to two constraints; a reserve requirement which states that part of the bank's assets must be held in cash or deposited with the Federal Reserve and maintain a "balanced" portfolio. They make an assumption that the banker is cognizant of demand, time deposits, rates of interest and bank's net worth that will prevail at various dates in the future. This will make him have a choice between various kinds of earning assets with different maturities. Such assets include; government securities, loans and bonds issued by agencies other than the government. To arrive at what can be termed as a balanced portfolio, they try to find the most profitable portfolio plan that can be followed by a bank which at all times follow the set of measures used by the bank examiners[7] of the Federal Reserve System. Given the uncertainities the banking sector is prone to, meeting the banking examiner's requirements is a positive indication that the bank is in a good position to meet the contingencies of fluctuation in its deposits and changes in market rates of interest without running much risk of large losses. In solving the problem, they generate information such as the rate of interest the bank should be willing to pay on its borrowing on different dates in order to attract deposits and lend to other banks on the Federal Funds market[8], the circumstances that is profitable to sell one security before it matures and buy another which affects the initial portfolio plan, the increament in profits which will result from increases in capital at different times and finally the sensitivity of the portfolio plan to changes in the interest rates and the deposit levels expected to prevail on future dates.

Fieltz and Loeffler (1979) applied a linear programming model whose objective function was to maximise the net after tax profit subject to the constraints of the market, risk, return, liquidity capacity, and other legal and regulatory requirements. However, their main constraint was liquidity since they were managing the liquidity of medium and large-sized commercial banks. Capital, tax rates,

[7] Bank examiners gather information on trends in the financial industry which help the Federal Reserve System meet its responsibilities which include supervising and regulating a wide range of financial institutions and activities and determining monetary policy.

[8] Federal funds market is where overnight borrowings between banks and other entities to maintain their bank reserves at the Federal Reserve take place.

anticipated demands for loans, withdrawals of deposits are some of the factors sensitive to liquidity that were considered.

Cohen and Hammer (1967), Komar (1971), Lifson and Blackman (1973) and Robertson (1972) also had models that optimized a single objective profit function subject to the relevant linear constraints. However, this models differed in their treatment of disaggregation, uncertainty and dynamic considerations.

A GP model on the other hand would make it possible for more than one conflicting goals be considered at the same time. A case where four conflicting goals are considered is seen when Forston and Dince, (1977) use a GP model to optimize the balance sheet by considering; profit, capital adequacy, loan to deposit ratio and liquidity. Eatman and Sealey (1979) had two goals in mind; profitability and solvency. The constraints of the multiobjective model for a commercial bank's balance sheet were policy and managerial constraints. According to them, profitability of the bank would be measured by net after-tax profit and solvency by the capital adequacy ratio. Giokas and Vassiloglou (1991) introduced a new perspective by raising the number of goals. Their target was to maximise revenues, minimise the risks involved in the allocation of the bank's capital and increase the levels of deposits and loans. Fatma and Fathi (2013) considers the structural, political and regulatory constraints in order to determine the optimal structure of the balance sheet of a Tunisian commercial bank for the year 2007. They introduce a new aspect by forecasting the assets and the liabilities for the following year; 2008. The paper contributed to the development of Asset Liability Management[9] (ALM) as a new alternative to strategic planning in the Tunisian banking sector because its application was very limited then.

In a bid to ensure that banks remain reliable factors for customers, governments and other involved parties, global regulatory standards have been developed. One of the main ones is called Basel III[10] that was developed to counter the ineffectiveness of the financial regulation revealed by the global financial crisis. Many restrictions are specified in the regulation that strengthen bank capital requirements. As a result, banks are earnestly developing models and decision support tools that will play a big role in living up to the new strict regulations of Basel III that will be implemented from 2013 to 2019 while still maximising their profits. This is why Puts, (2012) looks at how a non investment retail bank can optimally compose its balance sheet in order to maximise its profit, while

[9] Asset Liability Management (ALM) is a mechanism to address the risk faced by a bank due to a mismatch between assets and liabilities either due to liquidity or changes in interests.
[10] Basel III or the Third Basel Accord is a global voluntary regulatory framework on bank capital adequacy, stress testing and market liquidity risk.

meeting all restrictions that the Basel III brings along. He looks at the current risk profile and questions: whether a level of conservatism should be applied, the factors that have the greatest impact on a bank's performance, the balance sheet positions that have to be expanded and reduced and the amount of capital that should be held to prepare for unforeseen events.

Schmaltz and Pokutta (2011) provide a modelling framework for banks' business planning under Basel III. They analyze the effect of Basel III on the banks' product mix for a simplified, determinstic two-product case. They generalise the model by incorporating parameter uncertaintly, adjustment cost, multiple time steps and products. This paper is suitable for one who is interested in understanding the graduate process of bank modelling.

Kretzschmar, Mcneil and Kirchner (2009) discusses how a fully integrated risk analysis based on the balance sheet of a representative Eurobank using an economic scenario generation model calibrated to conditions at the end of 2007 was implemented. The results suggest that the more modular, correlation based approaches to economic capital that currently dominate a practise will lead to an under-capitalization of banks. Alexander (2004) discusses why banks hold capital in excess or regulatory requirements in relation to market discipline.

2.2 Empirical Literature

Markowitz (1959) defined linear programming as a computation that seeks the maximum or minimum of a linear function of n variables,

$$\sum_{j=1}^{n} X_J C_J, \tag{1}$$

Subject to m linear constraints,

$$\sum a_{1j} X_J = b_1, \tag{2}$$

……,

$$\sum a_{mj} X_J = b_m, \tag{3}$$

and subject to

(4)

$$X_j \geq 0 \; for \; j = 1, \ldots\ldots, n.$$

He further highlights George Dantzig's simplex method as a general and efficient computing technique for solving an optimization problem (1953). This was further refined by Dantzig, Orden, and Wolfe, (1955) who made a slight variant to the simplex method. The modification does not allow certain pairs of variables in the basis simultanoeusly. It can solve the problem

$$minimize \; f(x) = x'Cx, \tag{5}$$

$$x \geq 0, \tag{6}$$

$$Ax = b, \tag{7}$$

where x is an n by 1 matrix, x' is its transpose, C is an n by n positive semi-definite matrix, and A is an m by n matrix.

In the portfolio selection problem $f(x)$ is minimized subject to the constraints

$$Ax = b; \tag{8}$$

$$x \geq 0, \tag{9}$$

$$\mu x \geq E, \tag{10}$$

Where μ is a 1 by n matrix and E is a scalar. E is not fixed in value; rather the problem is to find min f for all possible values of E.

In applying GP, Fatma and Fathi, (2013) consider 32 structural variables of which 16 correspond to assets ($X_i = 1, \ldots, 16$) and 16 correspond to liabilities ($Y_i = 1, \ldots, 16$). This is as presented in Table 1.

Table 1 The Decision Variables

Assets	Liabilities
X_1: Cash, Balance at Central bank, Post Office accounts and Tunisian Treasury	Y_1: Tunisian Central Bank and Post Office
X_2: Due from Banks	Y_2: Due to Banks
X_3: Due from Financial Institutions	Y_3: Due to Financial Institutions
X_4: Overdraft accounts	Y_4: Demand Deposits
X_5: Fixed asset loans	Y_5: Saving Deposits
X_6: Other loans to customers	Y_6: Term Deposits
X_7: Loans on special resources	Y_7: Other sums due
X_8: Trading Securities	Y_8: Deposits Certificate
X_9: Securities held for sale	Y_9: Borrowings and special resources
X_{10}: Debt Securities held for investment	Y_{10}: Other liabilities
X_{11}: Equity participations	Y_{11}: Share Capital
X_{12}: Interest in associated companies and joint ventures	Y_{12}: Reserves
X_{13}: Interest in subsidiaries and affiliated companies	Y_{13}: Own shares
X_{14}: Managed funds	Y_{14}: Others' equity
X_{15}: Fixed assets	Y_{15}: Retained Earnings
X_{16}: Other assets	Y_{16}: Net Earnings for the period

Fatma and Fathi (2013) have an aim of attaining a number of goals that would optimize the bank's balance sheet. These goals include: solvency, liquidity and maximization of net interest margin which contributes a high percentage to the bank's return. This is guided by the recommendations from the Central Bank of Tunisia and Basel. The optimization process is also subject to policy and structural constraints on specific categories of asset accounts (X') and Liability accounts (Y'). This then leads to goal programming formulation expressed as follows:

$$Min\ Z = \sum_{P} p_k \left(d_k^+ + d_k^-\right) \tag{11}$$

Subject to constraints:

$$\sum_{j\epsilon\pi_1} Y_j - \sum_{i\epsilon E} W_i X_i - d_s^+ + d_s^- = k_1 \tag{12}$$

$$\sum_{j\epsilon\pi_1} X_i - k_2 \sum_{j\epsilon\pi_k} Y_j - d_l^+ + d_l^- = 0 \tag{13}$$

$$\sum_{i=l}^{n} R_i^x X_i - \sum_{j=1}^{m} C_j^y Y_j - d_r^+ + d_r^- = k_3 \tag{14}$$

$$\sum_{i\epsilon\pi_k} X_i - d_p^+ + d_p^- = l_p \forall p \tag{15}$$

$$\sum_{j\epsilon\pi_k} Y_i - d_p^+ + d_p^- = l_p \forall p \tag{16}$$

$$K\,\Phi_X \leq X' \geq A\,\Phi_X \tag{17}$$

$$K\,\Phi_{Y\prime} \leq Y' \geq A\,\Phi_{Y\prime} \tag{18}$$

$$\sum_{i=1}^{n} X_i = \sum_{j=1}^{m} Y_j \quad \forall i = 1, \dots, n\ ;\ \forall j = 1, \dots, m \tag{19}$$

$$\sum_{j\epsilon\pi_{y\prime\prime}}^{n} Y_i - \alpha \sum_{i\epsilon E_{x\prime}} X_i = 0 \tag{20}$$

$$X_i \geq 0, Y_j \geq 0, d_k^+ \geq 0, d_k^- \geq 0, for\ all\ i = 1, \dots, n\ ; j = 1, \dots, m\ and\ k \epsilon P \qquad (21)$$

Where

$K\Phi_X(K\Phi_{Y'})$: is the low bound of specific asset accounts X' (liability accounts Y').

$A\Phi_X(A\Phi_{Y'})$: is the upper bound of specific asset accounts X' (liability accounts Y').

X_i: the element << I >> of assets.

Y_j: the element << j >> of liabilities.

π_Y: are specific categories of liability accounts.

E_x: are specific categories of asset accounts.

α : the desirable ratio of specific asset and liability data.

π_1: the requirement capital

w_i: the degree of riskiness of assets

k_1: the solvency ratio from the Basel committee

$d_{s,l,p}^+$: the over-achievement of the solvency goal, liquidity goal and goal P.

$d_{s,l,p}^-$: the under-achievement of the solvency goal, liquidity goal and goal P.

k_2: the liquidity ratio defined from the Tunisia Central Bank.

d_r^+: the positive deviations.

d_r^-: the negative deviations.

P: the goal achieved by the bank.

l_p: the desirable value of the goal P.

The forecast goal programming problem is modulated as follows:

$$Min\ Z = 3d_1^- + 2d_2^- + \sum_{k=3}^{5} d_k^+ + \sum_{k=3}^{5} d_k^- \qquad (22)$$

Subject to constraints:

(23)

$$Y_{11} + Y_{12} + Y_{14} + Y_{15} + 0.57Y_{16} - Y_{13} - 0.016X_2 - 0.016X_3 - 0.08X_4 - 0.04X_5 - 0.08X_6 - 0.08X_7 - 0.08X_8 - 0.08X_9 - 0.08X_{11} - d_1^+ + d_1^- = 0$$

(24)

$$X_1 + X_2 + 0.07X_4 + X_8 + X_9 + X_{11} - Y_1 - Y_2 - Y_3 - 0.6Y_4 - 0.03Y_5 - 0.13Y_6 - Y_7 - 0.4Y_8 - Y_9 - d_2^+ + d_2^- = 0$$

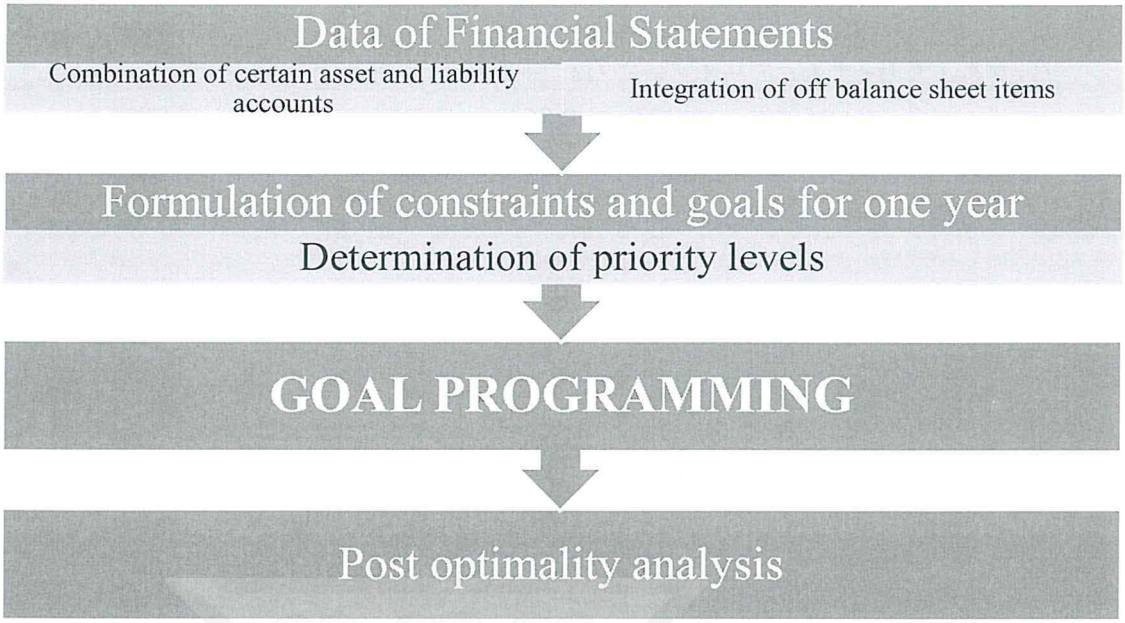
Puts (2012) optimization problem is to maximise the return on equity subject to Basel III constraints. His model seizes from being a linear programming proble because of a quadratic component. This is because of a penalty function that puts a cap on the extent to which each position on the balance sheet may change by applying a penalty for increasing or decreasing a certain position in a short time interval. He uses Solver, an excel function and OptQuest, a global optimization software that works with Crystal Ball models to find the optimal level of the bank's balance sheet.

2.3 Research Gap

This research will check on the applicability of balance sheet optimization through goal programming as a tool in risk management in a frontier market. This comes at a time when regulation plays a significant role in laying down the strategies of the bank globally. In order to carry out this task, Barclays Bank of Kenya, a tier 1 bank in Kenya is sampled out.

2.4 Conceptual Framework

Overally, the entire process of balance sheet optimization can be summarized in the flow chart below:


Data of Financial Statements
Combination of certain asset and liability accounts
Integration of off balance sheet items
Formulation of constraints and goals for one year
Determination of priority levels
GOAL PROGRAMMING
Post optimality analysis

Chapter 3: Research Methodology

3.1 Research Design

The research adopts a descriptive and quantitative form of research design. A descriptive research is a research that is meant to depict the variables in an accurate way and thus in the process describes the behavior of the subject at hand. The description aspect will be enabled by the quantifiable and measurable form of data that will be analyzed by the quantitative model to arrive at results.

3.2 Population

The desired data will be obtained from the financial statements of Barclays Bank of Kenya (BBK), Family Bank and Sidian Bank for the year 2016. Barclays Bank is a Tier 1 bank, Family Bank a Tier 2 bank and Sidian Bank a Tier 3 bank. Given how lengthy balance sheet optimization procedure is, one bank is chosen as a representative of all three tiers in Kenya. The three banks perform their banking operations in Kenya without other subsidiaries outside Kenya. The regulatory constraints that will be adhered to will be obtained from the January 2013 prudential guidelines issued by the Central Bank of Kenya. Given that the risk focused on is that which will prevent the Bank from meeting capital requirements, capital adequacy guidelines is what will be focused in the prudential guidelines.

3.3 Sampling

Tier 1 banks in Kenya are seven in number. These are: KCB, Equity, Co-operative, Standard Chartered, Barclays, CBA and Diamond Trust banks. Out of this, Barclays Bank of Kenya is chosen. Out of the other Tiers, Family bank is selected out of Tier 2 banks while Sidian Bank is selected out of the Tier 3 banks. The sampling method adopted in this case is a purposive (selective) type of sampling. This is a type of a judgmental, non-probability sampling technique.

3.4 Data collection

The research will heavily rely on secondary form of data. This data include Barclays Bank of Kenya's financial statements as stated in the bank's 2016 annual integrated report. The bank is a publicly listed company in the Nairobi Securities Exchange and as such the annual report is public. We will also rely on 2016 financial statements belonging to Family Bank and Sidian Bank. The prudential guidelines issued by the Central Bank of Kenya is also public information.

3.5 Data and preliminary analysis

The variables of the research will be as follows: The balance sheet will be the dependent variable while the capital adequacy regulatory requirements will be the independent variable. Starting off with the balance sheet items, the following shows 28 structural variables of which of which 15 correspond to assets ($X_i = 1, \dots, 15$) and 13 correspond to liabilities ($Y_i = 1, \dots, 13$)

Table 2 Balance Sheet Decision Variables

Assets	Liabilities
X_1: Cash, Balance at Central Bank of Kenya	Y_1: Derivative financial liabilities
X_2: Financial assets at fair value through profit or loss	Y_2: Deposits and balances due to banking institutions
X_3: Derivative financial assets	Y_3: Due to group companies
X_4: Financial assets available-for-sale	Y_4: Customer deposits
X_5: Deposits and balances due from banking institutions	Y_5: Borrowings
X_6: Due from group companies	Y_6: Other liabilities and accrued expenses
X_7: Loans and advances to customers	Y_7: Current income tax
X_8: Other assets and prepaid expenses	Y_8: Share capital
X_9: Investment in subsidiaries	Y_9: Available-for-sale reserve
X_{10}: Current income tax	Y_{10}: Share-based payment reserve
X_{11}: Deferred income tax	Y_{11}: Regulatory reserve
X_{12}: Property and Equipment	Y_{12}: Retained earnings
X_{13}: Intangible assets	Y_{13}: Proposed dividend
X_{14}: Prepaid operating lease rentals	
X_{15}: Retirement benefit asset	

3.6 Goals and constraints

3.6.1 Policy constraints

Section 18 of the Banking Act in the Kenyan Constitution empowers the Central Bank of Kenya to prescribe the minimum capital adequacy ratios that shall be maintained by institutions. The capital

components include core capital[11] and total capital[12] on one hand and their risk weighted assets and off-balance sheet items on the other.

i. Minimum ratios

The CBK has stipulated minimum capital adequacy ratios in reference to core capital and total capital. Therefore, banks operating in Kenya are required to meet the standard. They will be denoted as follows:

$$\Phi \geq 8\% \, of \; total \; risk \; weighted \; assets \; (RWA) \; plus \; risk \; weighted \; off - balance \; sheet \; items; \tag{25}$$

$$\Phi \geq 8\% \, of \; its \; total \; deposit \; liabilities \tag{26}$$

$$\theta \geq 12\% \, of \; its \; total \; risk \; weighted \; assets \; plus \; risk \; weighted \; off - balance \; sheet \; items \tag{27}$$

Where,

Φ represents core capital and

θ represents total capital

ii. Capital Conservation Buffer

Given how tragic the financial crisis of 2007/08 was together with the fact that the banking sector is sensitive to economic turbulence, the CBK saw it wise to introduce a capital conservation

[11] Core capital refers to Tier 1 capital. This constitutes permanent shareholders' equity (issued and fully paid-up ordinary shares and perpetual non-cumulative preference shares), disclosed reserves such as ordinary share capital and perpetual non-cumulative share premium, retained earnings and 50% un-audited after-tax profits less investments in subsidiaries conducting banking business, investment in equity instruments of other institutions, intangible assets (excluding computer software) and goodwill. The current year to date 50% un-audited after-tax profits will qualify as part of core capital, if and only if, the institution has made adequate provisions for loans and advances, proposed dividends and other appropriations have been deducted.

[12] This is the sum of Tier 1 capital and Tier 2 capital which is also known as supplementary capital which includes 25% of asset revaluation reserves which have received prior Central Bank's approval, subordinated debt, issued and paid-in hybrid (debt equity) capital instruments or any other capital instrument approved by Central Bank.

buffer to enable the institutions to withstand future periods of stress. The buffer will be denoted as follows:

$$r \geq 2.5\% \; over \; and \; above \; the \; core \; capital \; to \; total \; RWA \; ratio \tag{28}$$

$$r \geq 2.5\% \; over \; and \; above \; the \; total \; capital \; to \; RWA \; ratio \tag{29}$$

This brings the minimum core capital to RWA ratio and total capital to RWA ratio requirements to 10.5% and 14.5% respectively. It is a requirement that the capital conservation buffer be made up of high quality capital which should comprise mainly of common equity, premium reserves and retained earnings.

iii. Minimum absolute core capital requirement

Banks in Kenya have a minimum absolute core capital as stipulated by the CBK. This is represented as follows:

$$\Lambda \geq KES \; 1{,}000 \; million \; (1 \; billion) \tag{30}$$

Risk weighted assets play a big role in determining the capital adequacy levels. The CBK has stipulated a guideline for how it will be constituted by weighting differently for both on-balance sheet items and off-balance sheet items. It will be as follows:

On-balance sheet items

i. Zero (0) % weight
   a. Cash (both domestic and foreign)
   b. Loans and advances secured by cash
   c. Balances with the CBK (including repo purchase transactions)
   d. Claims on the Kenya Government through government securities
   e. Loans duly guaranteed by the Government of Kenya[13]
   f. Loans duly guaranteed by OECD[14] Central Governments

ii. 20% weight

[13] Such Government guarantees should have been approved by the appropriate authorities in accordance with applicable laws and Government procedures

[14] OECD members are Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

a. Deposits and balances due from commercial banks, financial institutions, mortgage finance companies and building societies in Kenya.
b. Securities issued by foreign governments and balances due from foreign banks.
c. Loans duly guaranteed by other EAC[15] member states approved by the appropriate authorities in accordance with applicable laws and government procedures
d. Claims guaranteed by Multi-Lateral Development Banks (MDBs) as stipulated by the CBK

iii. 50% weight

Mortgage loans fully secured by first legal charge over residential properties located within cities and municipalities in Kenya that are either occupied by the borrower or rented.

iv. 100% weight

All other claims on the public and private sector which are not covered under the other categories, including deposits in institutions under statutory management, balances from other foreign entities other than banks, premises and other fixed assets, loans and advances, bills discounted and all other assets of the institution.

Off-balance sheet items

i. Zero (0%) conversion factor

Short term commitments with an original maturity of up to one year and cancellable unconditionally at any time

ii. 20% conversion factor

Short-term self-liquidating trade related contingencies arising from movement of goods

iii. 50% conversion factor

Transactions related to contingent items and other commitments with an original maturity exceeding one year.

iv. 100% conversion factor

These are off-balance sheet items, which are substitutes for loans

[15] The other EAC member states are Burundi, Rwanda, Tanzania and Uganda

3.6.2 Lexicographic Goal Programming Model

This model also known as a preemptive model or a non-Archimedean goal programming model, should be used when there exists a clear priority ordering amongst the goals to be achieved. The goal of this model in this case would be to minimize deviations of the balance sheet elements at a certain level of priority subject to the policy constraints. The first priority would be to meet the requirements of core capital. Secondly, would be to meet the Tier 2 capital requirements and finally the capital conservation buffer and minimum absolute core capital requirement.

The goal of the model can be stated as:

$$Min\ Z\ for\ P_i = \sum_{i=1}^{m} (d_i^+ + d_i^-) \tag{31}$$

Subject to the policy or regulatory constraints:

$$\sum_{i=1}^{m} \Pi_i - d_i^+ + d_i^- \tag{32}$$

Where,

P_i refers to the different priority levels

d_i^+ refers to the positive deviation variable from the ith goal (overachievement)

d_i^- refers to the negative deviational variable from the ith goal (underachievement)

Π_i refers to the different balance sheet variables levels in order of priority.

3.7 Optimization technique

Given that we have described the balance sheet model, we will fit it into Excel Solver, making use of VBA to program the optimization in the right way. Excel Solver is an optimization add-in of Excel. It falls under the category of what-if analysis. This means that Solver determines what happens with the outcome of a problem if one parameter is changed. Within a spreadsheet, solver makes use of three types of cell ranges, namely:

i. Target function range: This is typically one cell in a spreadsheet. It is usually a function that inputs other values that are found within the same spreadsheet. These cells fall within the next two categories. The goal is to maximize, minimize or set equal the value of this cell.

ii. Adjustable Cells: These cells must be given an initial value. When Solver is run, it will change the values of these cells in order to reach the optimum solution in the target cell.

iii. Constraint Cells: These are set values that will restrict values that Solver will use. They can refer to other cells in the spreadsheet.

Chapter 4: Data Analysis

4.1 Introduction

This chapter will focus on answering the research question by putting the research methodology into practice. The analysis will be done in two phases. The first phase will focus on the calculation of the different capital ratios of the three banks bearing in mind the different policy constraints that exist as stipulated by the Central Bank of Kenya. The second phase will involve optimizing the capital ratios to more realistic figures.

4.2 Capital Ratios Calculations

The first step was to import the 2015 and 2016 balance sheet for Barclays Bank of Kenya, Family Bank and Sidian Bank to MS Excel. The next step was to allocate the weights that would be applicable in calculating the Risk Weighted Assets (RWA) for the different balance sheet items. Step 3 involves calculating the RWA for the years 2015 and 2016. The final step was to calculate the different capital ratios with the order being based on priority levels. Before arriving at the ratio calculations, the different components of the ratios had to be calculated. This are; Tier 1 capital (otherwise known as core capital) and RWA for Core capital to RWA ratio, Tier 2 capital (otherwise known as total capital) and RWA for Total capital to RWA ratio and core capital and deposit liabilities for core capital to deposit liabilities ratio.

4.2.1 Importation of data and allocation of weights

The main data sets constitute of the financial statements for the year ended December 2016 for Barclays Bank of Kenya, Family Bank and Sidian Bank. The relevant financial statement for this case is the Statement of Financial position. The balance sheet for the year ending December 2015 is also included for comparison purposes.

The CBK has stipulated a guideline for how RWA will be constituted by weighting differently for both on-balance sheet items and off-balance sheet items. This can be seen in section 3.7.1 below

Table 3 Barclays Bank's Consolidated Statement of Financial Position

Barclays Bank of Kenya Consolidated Statement of Financial Position		
Step 1		
	2016	**2015**
	Shs'millions	**Shs'millions**
Assets		
Cash and balances with Central Bank of Kenya	13,378	18,180
Financial assets at fair value through profit or loss	7,345	2,161
Derivative financial assets	26	84
Financial assets available-for-sale	48,699	45,347
Deposits and balances due from banking institutions	219	253
Due from group companies	5,568	13,951
Loans and advances to customers	168,510	145,838
Other assets and prepaid expenses		
Prepaid expenses	3,190	2,747
Items in course of collection from banks	792	791
Other	6,152	5,292
Investment in subsidiaries	263	275
Current income tax	-	134
Deferred income tax	614	475
Property and Equipment	3,081	3,258
Intangible assets	1,568	2,054
Prepaid operating lease rentals	55	56
Retirement benefit asset	65	256
Total assets	**259,525**	**241,152**
Equity and liabilities		
Derivative financial liabilities	69	42
Deposits and balances due to banking institutions	3,264	187
Due to group companies	19,736	22,689
Customer deposits	178,448	165,358
Borrowings	5,159	5,133
Other liabilities and accrued expenses	10,379	8,032
Current income tax	375	-
Total liabilities	**217,430**	**201,441**
Equity		
Share capital	2,716	2,716
Available-for-sale reserve	(152)	(962)
Share-based payment reserve	285	223
Regulatory reserve	-	927
Retained earnings	34,901	32,462
Proposed dividend	4,345	4,345
Total equity	**42,095**	**39,711**
Total equity and liabilities	**259,525**	**241,152**

Table 4 Family Bank's Statement of Financial Position

Family Bank Statement of Financial Position		
Step 1		
	2016	**2015**
	Shs'millions	**Shs'millions**
Assets		
Cash (both local & Foreign)	3,392	2,780
Balances with Central Bank of Kenya	2,101	3,387
Kenya Government & other securities held for dealing purposes	-	-
Financial Assets at Fair Value through Profit & Loss	-	-
Investment Securities:		
i. Held to Maturity		
a. Kenya Government Securities	4,754	7,240
b. Other Securities	842	1,568
ii. Available for Sale		
a. Kenya Government Securities	251	450
b. Other Securities		
Deposits and balances due from banking institutions abroad	184	204
Deposits and balances due from local banking institutions	2	4,688
Tax recoverable	777	-
Loans and advances to customers	50,164	55,854
Balances due from Banking Institutions in the Group	-	-
Investment in associates	-	-
Investment in subsidiary companies	-	-
Investment in joint ventures	-	-
Investment properties	18	108
Property and equipment	4,168	3,176
Prepaid lease rentals	153	158
Intangible assets	451	319
Deferred tax asset	-	3
Retirement benefit asset	-	-
Other assets	2,234	1,347
Total assets	**69,491**	**81,282**
liabilities		
Balances due to Central Bank of Kenya	4,394	-
Customer deposits	41,395	62,711
Deposits and balances due to local banking institutions	923	132
Deposits and balances due to foreign banking institutions	-	-
Other money market deposits	-	-
Borrowed funds	8,933	5,588

Balances due to Banking Institutions Group Companies	-	-
Tax payable	-	30
Dividends payable	5	29
Deferred tax liability	25	-
Retirement benefit liability	-	-
Other liabilities	1,062	750
Total liabilities	**56,737**	**69,240**
Equity		
Paid up/ Assigned capital	1,287	1,245
Share premium	5,875	5,063
Revaluation reserves	197	70
Retained earnings	4,955	5,137
Statutory loan reserve	442	527
Other Reserves	-	-
Proposed dividends	-	-
Capital grants	-	-
Total equity	**12,756**	**12,042**
Total equity and liabilities	**69,493**	**81,282**

Table 5 Sidian Bank's Statement of Financial Position

Sidian Bank		
Statement of Financial Position		
Step 1		
	2016	**2015**
	Shs'millions	**Shs'millions**
Assets		
Cash (both local & Foreign)	641	516
Balances with Central Bank of Kenya	1,575	954
Kenya Government & other securities held for dealing purposes	-	-
Financial Assets at Fair Value through Profit & Loss	-	-
Investment Securities:		
i. Held to Maturity		
a. Kenya Government Securities	2,523	2,362
b. Other Securities	-	-
ii. Available for Sale		
a. Kenya Government Securities	-	-
b. Other Securities		
Deposits and balances due from banking institutions abroad	538	925
Deposits and balances due from local banking institutions	348	584
Tax recoverable	104	90
Loans and advances to customers	13,571	12,519

Balances due from Banking Institutions in the Group	-	-
Investment in associates	-	-
Investment in subsidiary companies	1	-
Investment in joint ventures	-	-
Investment properties	-	-
Property and equipment	537	374
Prepaid lease rentals	-	-
Intangible assets	336	295
Deferred tax asset	57	60
Retirement benefit asset	-	-
Other assets	644	427
Total assets	**20,875**	**19,106**
liabilities		
Balances due to Central Bank of Kenya	-	-
Customer deposits	13,685	13,380
Deposits and balances due to local banking institutions	2,270	831
Deposits and balances due to foreign banking institutions	-	-
Other money market deposits	-	-
Borrowed funds	589	642
Balances due to Banking Institutions Group Companies	-	-
Tax payable	-	-
Dividends payable	-	-
Deferred tax liability	-	-
Retirement benefit liability	-	-
Other liabilities	463	416
Total liabilities	**17,007**	**15,269**
Equity		
Paid up/ Assigned capital	1,470	1,469
Share premium	706	704
Revaluation reserves	69	69
Retained earnings	1,609	1,583
Statutory loan reserve	15	13
Other Reserves	-	-
Proposed dividends	-	-
Capital grants	-	-
Total equity	**3,869**	**3,838**
Total equity and liabilities	**20,876**	**19,107**

4.2.2 Calculation of RWA

Once the correct weights are identified for each asset, then a multiplication between the weight and the asset follows resulting in a risk weighted asset. RWA are important because they show how much of a bank's assets are susceptible to market forces.

Table 6 Barclays Bank's RWA

Step 2 & 3			
	RWA Weights	**RWA 2016**	**RWA 2015**
		Shs'millions	**Shs'millions**
Assets			
Cash and balances with Central Bank of Kenya	0%	-	-
Financial assets at fair value through profit or loss	0%	-	-
Derivative financial assets	100%	26	84
Financial assets available-for-sale	0%	-	-
Deposits and balances due from banking institutions	20%	44	51
Due from group companies	20%	1,114	2,790
Loans and advances to customers	100%	168,510	145,838
Other assets and prepaid expenses		-	-
Prepaid expenses	100%	3,190	2,747
Items in course of collection from banks	20%	158	158
Other	100%	6,152	5,292
Investment in subsidiaries	100%	263	275
Current income tax	100%	-	134
Deferred income tax	100%	614	475
Property and Equipment	100%	3,081	3,258
Intangible assets	100%	1,568	2,054
Prepaid operating lease rentals	100%	55	56
Retirement benefit asset	100%	65	256
Total RWA		**184,840**	**163,468**

Table 7 Family Bank's RWA

Step 2 & 3			
	RWA Weights	**RWA 2016**	**RWA 2015**
		Shs'millions	**Shs'millions**
Assets			
Cash (both local & Foreign)	0%	-	-
Balances with Central Bank of Kenya	0%	-	-
Kenya Government & other securities(dealing)	0%	-	-
Financial Assets at FV through Profit & Loss		-	-
Investment Securities:		-	-
i. Held to Maturity		-	-
a. Kenya Government Securities	0%	-	-
b. Other Securities	100%	842	1,568
ii. Available for Sale		-	-
a. Kenya Government Securities	0%	-	-
b. Other Securities	100%	-	-
Due from banking institutions abroad	20%	37	41
Due from local banking institutions	20%	0	938
Tax recoverable	100%	777	-
Loans and advances to customers	100%	50,164	55,854
Due from Banking Institutions in the Group	20%	-	-
Investment in associates	100%	-	-
Investment in subsidiary companies	100%	-	-
Investment in joint ventures	100%	-	-
Investment properties	100%	18	108
Property and equipment	100%	4,168	3,176
Prepaid lease rentals	100%	153	158
Intangible assets	100%	451	319
Deferred tax asset	100%	-	3
Retirement benefit asset	100%	-	-
Other assets	100%	2,234	1,347
Total RWA		**58,844**	**63,511**

Table 8 Sidian Bank's RWA

Step 2 & 3			
	RWA Weights	**RWA 2016**	**RWA 2015**
		Shs'millions	**Shs'millions**
Assets			
Cash (both local & Foreign)	0%	-	-
Balances with Central Bank of Kenya	0%	-	-
Kenya Government & other securities held for dealing purposes	0%	-	-
Financial Assets at Fair Value through Profit & Loss		-	-
Investment Securities:		-	-
i. Held to Maturity		-	-
a. Kenya Government Securities	0%	-	-
b. Other Securities	100%	-	-
ii. Available for Sale		-	-
a. Kenya Government Securities	0%	-	-
b. Other Securities	100%	-	-
Deposits and balances due from banking institutions abroad	20%	108	185
Deposits and balances due from local banking institutions	20%	70	117
Tax recoverable	100%	104	90
Loans and advances to customers	100%	13,571	12,519
Balances due from Banking Institutions in the Group	20%	-	-
Investment in associates	100%	-	-
Investment in subsidiary companies	100%	1	-
Investment in joint ventures	100%	-	-
Investment properties	100%	-	-
Property and equipment	100%	537	374
Prepaid lease rentals	100%	-	-
Intangible assets	100%	336	295
Deferred tax asset	100%	57	60
Retirement benefit asset	100%	-	-
Other assets	100%	644	427
Total RWA		15,427	14,067

4.2.3 Calculation of the Capital Adequacy Ratios

This is the main section of this phase. The calculations are based on priority. The formulas and results of each bank are shown below:

$$Core\ capital\ to\ RWA\ ratio = \frac{Core\ Capital}{RWA + RW\ off\ balance\ sheet\ items} \quad (33)$$

$$Total\ capital\ to\ RWA\ ratio = \frac{Total\ Capital}{RWA + RW\ off\ balance\ sheet\ items} \quad (34)$$

$$Core\ capital\ to\ Deposit\ liabilities = \frac{Core\ Capital}{Deposit\ Liabilities} \quad (35)$$

Table 9 Barclays Banks Capital Ratios

Barclays Bank of Kenya		
Step 4		
	2016	**2015**
	Shs'millions	**Shs'millions**
Tier 1 capital	37,617	35,178
RWA	184,840	163,468
Off balance sheet items	64,881	60,288
RWA + Off balance sheet items	249,721	223,756
Core capital/RWA	15.06%	15.72%
Tier 2 capital	5,159	5,133
Total capital	42,776	40,311
Total capital/RWA	17.13%	18.02%
Deposit liabilities	201,448	188,234
Core capital/Deposit liabilities	18.67%	18.69%

Table 10 Family Bank's Capital Ratios

Family Bank		
Step 4		
	2016	**2015**
	Shs'millions	**Shs'millions**
Tier 1 capital	11,980	11,330
RWA	58,844	63,511
Off balance sheet items	3,935	3,636
RWA + off balance sheet items	62,779	67,147
Core capital/RWA	19.08%	16.87%
Tier 2 capital	2,469	2,555
Total capital	14,449	13,885
Total capital/RWA	23.02%	20.68%
Deposit liabilities	42,318	62,843

Core capital/Deposit liabilities	28.31%	18.03%

Table 11 Sidian Bank's Capital Ratios

Sidian Bank		
Basle II Calculation		
Step 4		
	Shs'millions	**Shs'millions**
	2016	2015
Tier 1 capital	3,785	3,756
RWA	15,427	14,067
Off balance sheet items	1,526	1,087
RWA + Off balance sheet items	16,953	15,154
Core capital/RWA	22.33%	24.79%
Tier 2 capital	32	30
Total capital	3,817	3,786
Total capital/RWA	22.51%	24.98%
Deposit liabilities	13,685	13,380
Core capital/Deposit liabilities	27.66%	28.07%

4.3 Optimization of the Capital Ratios

With the lexicographic model advocating for priority levels in achieving a particular goal, achieving the optimum core capital ratio is ranked as priority one while achieving an optimum Total capital to RWA ratio is ranked priority 2. This is achieved by using the solver tool on MS Excel.

4.3.1 Objective

The objective for priority 1 is to achieve a minimum core capital ratio while the objective for priority 2 is to achieve a minimum total capital to RWA plus risk weighted off balance sheet items ratio.

4.3.2 Variable cells

The cells that will change when optimizing the balance sheet are the cells containing the risk weighted assets for the different asset levels in the Statement for Financial position. This will be the same case when achieving both priority one and priority two.

4.3.3 Constraints

There are four main constraints that are taken into account when achieving both priority one and priority two. The constraints are as follows:

i. The core capital ratio should be equal or greater than 10.5%.

ii. The total capital to RWA plus risk weighted off balance items should be equal to or greater than 14.5%.

iii. The core capital to deposit liabilities ratio should be equal to or greater than 8%.

iv. The absolute core capital should be equal to or greater than one billion.

4.3.4 Barclays Bank of Kenya Results: Priority 1

The table below shows the extent to which Barclay's Risk Weighted Assets changes upon optimization after priority 1. The next table indicates the new calculated capital ratios. Finally, is the table that shows the changes in the asset section of the balance sheet.

Table 12 Barclay's Bank's RWA Calculation Under Priority 1

	Step 2 & 3 RWA Weights	RWA 2016 Shs'millions	RWA 2015 Shs'millions
Assets			
Cash and balances with Central Bank of Kenya	0%	-	-
Financial assets at fair value through profit or loss	0%	-	-
Derivative financial assets	100%	15	84
Financial assets available-for-sale	0%	-	-
Deposits and balances due from banking institutions	20%	27	76
Due from group companies	20%	1,116	2,810
Loans and advances to customers	100%	214,447	200,372
Other assets and prepaid expenses		-	-
Prepaid expenses	100%	3,206	2,766
Items in course of collection from banks	20%	79	158
Other	100%	6,212	5,363
Investment in subsidiaries	100%	263	138
Current income tax	100%	-	134
Deferred income tax	100%	-	-
Property and Equipment	100%	3,096	3,285
Intangible assets	100%	1,572	2,065
Prepaid operating lease rentals	100%	27	84
Retirement benefit asset	100%	65	384
Total RWA		**230,126**	**217,719**

Table 13 Barclays Bank's Capital Ratios Under Priority 1

Barclays Bank of Kenya		
Ratio Calculation: Priority 1		
Step 4		
	2016	**2015**
	Shs'millions	**Shs'millions**
Tier 1 capital	37,617	35,178
RWA	230,126	217,719
Off balance sheet items	64,881	60,288
RWA + Off balance sheet items	295,007	278,007
Core capital/RWA	12.75%	12.65%
Tier 2 capital	5,159	5,133
Total capital	42,776	40,311
Total capital/RWA	14.50%	14.50%
Deposit liabilities	201,448	188,234
Core capital/Deposit liabilities	18.67%	18.69%

Table 14 Barclay's Banks Changes in Balance Sheet after Priority 1 of Optimization

Barclays Bank of Kenya		
Changes in Balance Sheet After Priority 1 of Optimization		
Step 5		
	2016	**2015**
Assets	**Shs'millions**	**Shs'millions**
Cash and balances with Central Bank of Kenya	-	-
Financial assets at fair value through profit or loss	-	-
Derivative financial assets	(11)	0
Financial assets available-for-sale	-	-
Deposits and balances due from banking institutions	(82)	127
Due from group companies	10	99
Loans and advances to customers	45,937	54,534
Other assets and prepaid expenses	-	-
Prepaid expenses	16	19
Items in course of collection from banks	(396)	0
Other	60	71
Investment in subsidiaries	0	(137)

Current income tax	-	0
Deferred income tax	(614)	(475)
Property and Equipment	15	27
Intangible assets	4	11
Prepaid operating lease rentals	(28)	28
Retirement benefit asset	0	128
Total Change	44,911	54,432

4.3.5 Barclays Bank of Kenya Results: Priority 2

The table below shows the extent to which Barclay's Risk Weighted Assets changes upon optimization after priority 1. The next table indicates the new calculated capital ratios. Finally, is the table that shows the changes in the asset section of the balance sheet.

Table 15 Barclays Bank's RWA Calculation Under Priority 2

Step 2 & 3			
	RWA Weights	**RWA 2016**	**RWA 2015**
		Shs'millions	**Shs'millions**
Assets			
Cash and balances with Central Bank of Kenya	0%	-	-
Financial assets at fair value through profit or loss	0%	-	-
Derivative financial assets	100%	15	84
Financial assets available-for-sale	0%	-	-
Deposits and balances due from banking institutions	20%	27	76
Due from group companies	20%	1,116	2,810
Loans and advances to customers	100%	214,447	200,372
Other assets and prepaid expenses		-	-
Prepaid expenses	100%	3,206	2,766
Items in course of collection from banks	20%	79	158
Other	100%	6,212	5,363
Investment in subsidiaries	100%	263	138
Current income tax	100%	-	134
Deferred income tax	100%	-	-
Property and Equipment	100%	3,096	3,285
Intangible assets	100%	1,572	2,065
Prepaid operating lease rentals	100%	27	84
Retirement benefit asset	100%	65	384
Total RWA		**230125.78**	**217719.15**

Table 16 Barclay's Bank's Capital Ratios Under Priority 2

Step 4		
	2016	2015
	Shs'millions	Shs'millions
Tier 1 capital	37,617	35,178
RWA	230,126	217,719
Off balance sheet items	64,881	60,288
RWA + Off balance sheet items	295,007	278,007
Core capital/RWA	12.75%	12.65%
Tier 2 capital	5,159	5,133
Total capital	42,776	40,311
Total capital/RWA	14.50%	14.50%
Deposit liabilities	201,448	188,234
Core capital/Deposit liabilities	18.67%	18.69%

Table 17 Barclays Bank's Changes in Balance Sheet Under Priority 2 of Optimization

Step 5		
	2016	2015
	Shs'millions	Shs'millions
Assets		
Cash and balances with Central Bank of Kenya	-	-
Financial assets at fair value through profit or loss	-	-
Derivative financial assets	(11)	0
Financial assets available-for-sale	-	-
Deposits and balances due from banking institutions	(82)	127
Due from group companies	10	99
Loans and advances to customers	45,937	54,534
Other assets and prepaid expenses	-	-
Prepaid expenses	16	19
Items in course of collection from banks	(396)	0
Other	60	71
Investment in subsidiaries	0	(137)
Current income tax	-	0
Deferred income tax	(614)	(475)
Property and Equipment	15	27
Intangible assets	4	11
Prepaid operating lease rentals	(28)	28

Retirement benefit asset	0	128
	44,911	54,432

4.3.6 Family Bank Results: Priority 1

The table below shows the extent to which Family Bank's Risk Weighted Assets changes upon optimization after priority 1. The next table indicates the new calculated capital ratios. Finally, is the table that shows the changes in the asset section of the balance sheet.

Table 18 Family Bank's RWA Calculation Under Priority 1

Step 2 & 3			
	RWA Weights	**RWA 2016**	**RWA 2015**
		Shs'millions	**Shs'millions**
Assets			
Cash (both local & Foreign)	0%	-	-
Balances with Central Bank of Kenya	0%	-	-
Government & other securities held: Dealing	0%	-	-
Financial Assets at Fair Value through Profit & Loss			
Investment Securities:			
i. Held to Maturity			
a. Kenya Government Securities	0%	-	-
b. Other Securities	100%	852	1,591
ii. Available for Sale			
a. Kenya Government Securities	0%	-	-
b. Other Securities	100%	-	-
Due from banking institutions abroad	20%	18	0
Due from local banking institutions	20%	0	946
Tax recoverable	100%	786	-
Loans and advances to customers	100%	87,815	85,150
Balances due from Banking Institutions in the Group	20%	-	2
Investment in associates	100%	-	2
Investment in subsidiary companies	100%	-	2
Investment in joint ventures	100%	-	2
Investment properties	100%	2	108
Property and equipment	100%	4,423	3,269
Prepaid lease rentals	100%	0	158
Intangible assets	100%	454	320
Deferred tax asset	100%	-	-
Retirement benefit asset	100%	-	2
Other assets	100%	2,307	1,364

		96,658	**92,916**

Table 19 Family Bank's Capital Ratio Calculation Under Priority 1

Step 4		
	2016	**2015**
	Shs'millions	**Shs'millions**
Tier 1 capital	12,117	11,445
RWA	96,658	92,916
Off balance sheet items	3,935	3,636
RWA + off balance sheet items	100,593	96,552
Core capital/RWA	12.05%	11.85%
Tier 2 capital	2,469	2,555
Total capital	14,586	14,000
Total capital/RWA	14.50%	14.50%
Deposit liabilities	42,318	62,843
Core capital/Deposit liabilities	28.63%	18.21%

Table 20 Family Bank's Changes in Balance Sheet after Priority 1 of Optimization

Step 5	**2016**	**2015**
	Shs'millions	**Shs'millions**
Assets		
Cash (both local & Foreign)	-	-
Balances with Central Bank of Kenya	-	-
Government & other securities (dealing)		
Financial Assets at Fair Value through Profit & Loss		
Investment Securities:		
i. Held to Maturity	-	-
a. Kenya Government Securities	-	-
b. Other Securities	10	23
ii. Available for Sale	-	-
a. Kenya Government Securities	-	-
b. Other Securities	-	-
Due from banking institutions abroad	(92)	(204)
Due from local banking institutions	(1)	41
Tax recoverable	9	-
Loans and advances to customers	37,651	29,296
Due from Banking Institutions in the Group	-	10
Investment in associates	-	2

Investment in subsidiary companies	-	2
Investment in joint ventures	-	2
Investment properties	(16)	0
Property and equipment	255	93
Prepaid lease rentals	(153)	0
Intangible assets	3	1
Deferred tax asset	-	(3)
Retirement benefit asset	-	2
Other assets	73	17
Total assets change	**37,740**	**29,281**

4.3.7 Family Bank Results: Priority 2

The table below shows the extent to which Family Bank's Risk Weighted Assets changes upon optimization after priority 2. The next table indicates the new calculated capital ratios. Finally, is the table that shows the changes in the asset section of the balance sheet.

Table 21 Family Bank's RWA Under Priority 2

	Step 2 & 3		
Assets	**RWA Weights**	**RWA 2016**	**RWA 2015**
		Shs'millions	**Shs'millions**
Cash (both local & Foreign)	0%	-	-
Balances with Central Bank of Kenya	0%	-	-
Government & other securities held (dealing)	0%	-	-
Financial Assets at Fair Value through Profit & Loss		-	-
Investment Securities:		-	-
i. Held to Maturity		-	-
a. Kenya Government Securities	0%	-	-
b. Other Securities	100%	852	1,591
ii. Available for Sale		-	-
a. Kenya Government Securities	0%	-	-
b. Other Securities	100%	-	-
Due from banking institutions abroad	20%	18	0
Due from local banking institutions	20%	0	946
Tax recoverable	100%	786	-
Loans and advances to customers	100%	87,815	85,150
Balances due from Banking Institutions in the Group	20%	-	2
Investment in associates	100%	-	2
Investment in subsidiary companies	100%	-	2
Investment in joint ventures	100%	-	2
Investment properties	100%	2	108

Property and equipment	100%	4,423	3,269
Prepaid lease rentals	100%	0	158
Intangible assets	100%	454	320
Deferred tax asset	100%	-	-
Retirement benefit asset	100%	-	2
Other assets	100%	2,307	1,364
		96,658	**92,916**

Table 22 Family Bank's Capital Ratios Under Priority 2

Step 4		
	2016	**2015**
	Shs'millions	**Shs'millions**
Tier 1 capital	12,117	11,445
RWA	96,658	92,916
Off balance sheet items	3,935	3,636
RWA + off balance sheet items	100,593	96,552
Core capital/RWA	12.05%	11.85%
Tier 2 capital	2,469	2,555
Total capital	14,586	14,000
Total capital/RWA	14.50%	14.50%
Deposit liabilities	42,318	62,843
Core capital/Deposit liabilities	28.63%	18.21%

Table 23 Changes in Balance Sheet after Priority 2 of Optimization

Step 5		
	2016	**2015**
	Shs'millions	**Shs'millions**
Assets		
Cash (both local & Foreign)	-	-
Balances with Central Bank of Kenya	-	-
Government & other securities (dealing)		
Financial Assets at Fair Value through Profit & Loss		
Investment Securities:	-	-
i. Held to Maturity	-	-
a. Kenya Government Securities	(4,754)	(7,240)
b. Other Securities	10	23
ii. Available for Sale	-	-

a. Kenya Government Securities	-	-
b. Other Securities	-	-
Due from banking institutions abroad	(166)	(204)
Due from local banking institutions	(2)	(3,742)
Tax recoverable	9	-
Loans and advances to customers	37,651	29,296
Due from Banking Institutions in the Group	-	2
Investment in associates	-	2
Investment in subsidiary companies	-	2
Investment in joint ventures	-	2
Investment properties	(16)	0
Property and equipment	255	93
Prepaid lease rentals	(153)	0
Intangible assets	3	1
Deferred tax asset	-	(3)
Retirement benefit asset	-	2
Other assets	73	17
Total assets change	**32,911**	**18,251**

4.3.8 Sidian Bank Results: Priority 1

The table below shows the extent to which Sidian Bank's Risk Weighted Assets changes upon optimization after priority 1. The next table indicates the new calculated capital ratios. Finally, is the table that shows the changes in the asset section of the balance sheet.

Table 24 Sidian Bank's RWA Under Priority 1

	Step 2 & 3		
	RWA Weights	**RWA 2016**	**RWA 2015**
		Shs'millions	**Shs'millions**
Assets			
Cash (both local & Foreign)	0%	205	0
Balances with Central Bank of Kenya	0%	205	0
Government & other securities (Dealing)	0%	205	0
Financial Assets at Fair Value through Profit & Loss			
Investment Securities:			
i. Held to Maturity			
a. Kenya Government Securities	0%	205	0
b. Other Securities	100%	205	0
ii. Available for Sale			
a. Kenya Government Securities	0%	205	0

b. Other Securities	100%	205	0
Due from banking institutions abroad	20%	108	187
Due from local banking institutions	20%	70	118
Tax recoverable	100%	105	91
Loans and advances to customers	100%	18,551	23,443
Due from Banking Institutions in the Group	20%	205	0
Investment in associates	100%	205	0
Investment in subsidiary companies	100%	105	0
Investment in joint ventures	100%	205	0
Investment properties	100%	205	0
Property and equipment	100%	552	384
Prepaid lease rentals	100%	205	0
Intangible assets	100%	342	301
Deferred tax asset	100%	-	60
Retirement benefit asset	100%	205	0
Other assets	100%	665	440
Total RWA		**23,160**	**25,023**

Table 25 Sidian Bank's Capital Ratios Under Priority 1

Sidian Bank		
Ratio Calculation Priority 1		
Step 4		
	2016	**2015**
	Shs'millions	**Shs'millions**
Tier 1 capital	3,785	3,756
RWA	23,160	25,023
Off balance sheet items	1,526	1,087
RWA + Off balance sheet items	24,686	26,110
Core capital/RWA	15.33%	14.39%
Tier 2 capital	32	30
Total capital	3,817	3,786
Total capital/RWA	15.46%	14.50%
Deposit liabilities	13,685	13,380
Core capital/Deposit liabilities	27.66%	28.07%

Table 26 Sidian Bank's Changes in Balance Sheet Under Priority 1 of Optimization

Sidian Bank		
Changes in BS after Priority 1 of Optimization		
Step 5		
	2016	**2015**
	Shs'millions	**Shs'millions**
Cash (both local & Foreign)	19,839	-
Balances with Central Bank of Kenya	18,905	-
Kenya Government & other securities held for dealing purposes	20,480	0
Financial Assets at Fair Value through Profit & Loss		
Investment Securities:		
i. Held to Maturity		
a. Kenya Government Securities	17,957	-
b. Other Securities	205	0
ii. Available for Sale	-	-
a. Kenya Government Securities	20,480	-
b. Other Securities	205	0
Deposits and balances due from banking institutions abroad	3	12
Deposits and balances due from local banking institutions	1	5
Tax recoverable	1	1
Loans and advances to customers	4,980	10,924
Balances due from Banking Institutions in the Group	1,024	0
Investment in associates	205	0
Investment in subsidiary companies	104	0
Investment in joint ventures	205	0
Investment properties	205	0
Property and equipment	15	10
Prepaid lease rentals	205	0
Intangible assets	6	6
Deferred tax asset	(57)	0
Retirement benefit asset	205	0
Other assets	21	13
Total assets	**105,192**	**10,970**

4.3.9 Sidian Bank Results: Priority 2

The table below shows the extent to which Sidian Bank's Risk Weighted Assets changes upon optimization after priority 2. The next table indicates the new calculated capital ratios. Finally, is the table that shows the changes in the asset section of the balance sheet.

Table 27 Sidian Bank's RWA Calculation Under Priority 1

Step 2 & 3			
	RWA Weights	**RWA 2016**	**RWA 2015**
		Shs'millions	**Shs'millions**
Assets			
Cash (both local & Foreign)	0%	205	0
Balances with Central Bank of Kenya	0%	205	0
Government & other securities (Dealing)	0%	205	0
Financial Assets at Fair Value through Profit & Loss			
Investment Securities:			
i. Held to Maturity			
a. Kenya Government Securities	0%	205	0
b. Other Securities	100%	205	0
ii. Available for Sale			
a. Kenya Government Securities	0%	205	0
b. Other Securities	100%	205	0
Due from banking institutions abroad	20%	108	187
Due from local banking institutions	20%	70	118
Tax recoverable	100%	105	91
Loans and advances to customers	100%	18,551	23,443
Due from Banking Institutions in the Group	20%	205	0
Investment in associates	100%	205	0
Investment in subsidiary companies	100%	105	0
Investment in joint ventures	100%	205	0
Investment properties	100%	205	0
Property and equipment	100%	552	384
Prepaid lease rentals	100%	205	0
Intangible assets	100%	342	301
Deferred tax asset	100%	-	60
Retirement benefit asset	100%	205	0
Other assets	100%	665	440
		23,160	**25,023**

Table 28 Sidian Bank's Capital Ratios Under Priority 2

Step 4		
	2016	**2015**
	Shs'millions	**Shs'millions**
Tier 1 capital	3,785	3,756
RWA	23,160	25,023
Off balance sheet items	1,526	1,087
RWA + Off balance sheet items	24,686	26,110
Core capital/RWA	15.33%	14.39%
Tier 2 capital	32	30
Total capital	3,817	3,786
Total capital/RWA	15.46%	14.50%
Deposit liabilities	13,685	13,380
Core capital/Deposit liabilities	27.66%	28.07%

Table 29 Sidian Bank's Changes in Balance Sheet Under Priority 2

Step 5		
	Shs'millions	**Shs'millions**
	2016	**2015**
Cash (both local & Foreign)	19,839	-
Balances with Central Bank of Kenya	18,905	-
Government & other securities (Dealing)	20,480	0
Financial Assets at Fair Value through Profit & Loss		
Investment Securities:		
i. Held to Maturity		
a. Kenya Government Securities	17,957	-
b. Other Securities	205	0
ii. Available for Sale	-	-
a. Kenya Government Securities	20,480	-
b. Other Securities	205	0
Due from banking institutions abroad	3	12
Due from local banking institutions	1	5
Tax recoverable	1	1

Loans and advances to customers	4,980	10,924
Due from Banking Institutions in the Group	1,024	0
Investment in associates	205	0
Investment in subsidiary companies	104	0
Investment in joint ventures	205	0
Investment properties	205	0
Property and equipment	15	10
Prepaid lease rentals	205	0
Intangible assets	6	6
Deferred tax asset	(57)	0
Retirement benefit asset	205	0
Other assets	21	13
Total assets	**105,192**	**10,970**

4.4 Implication of results

4.4.1 Capital ratios

After optimizing for the three Kenyan banks, a lot of caution should be taken by banking institutions not only in Kenya but also in the rest of Sub Saharan Africa when assigning different capital levels for the bank. The importance of capital strength cannot be underscored more however a banking institution should not be excessively capitalized since the capital could be channeled to more revenue generating activities.

It is for this reason that after optimizing the asset side of the balance sheet, all the capital ratios reduced by a particular extent. Starting off with the core capital ratio, the following is the extent to which the ratio reduced for the three banks when optimized for the year 2016:

Table 30 Core Capital Ratio Comparison Before and After Optimization

Bank	Core Capital Ratio Before	Core Capital Ratio After	Difference
Barclays Bank of Kenya	15.06%	12.75%	2.31%
Family Bank	19.30%	12.05%	7.25%
Sidian Bank	22.33%	15.33%	7.00%

Notice that the optimized levels of the core capital ratio for the three banks are all different. This will be unlike for the total capital to RWA plus risk weighted off-balance sheet items as shown below for the year 2016:

Table 31 Total Capital Ratio Comparison Before and After Optimization

Banks	Total capital to RWA plus off balance sheet items before	Total capital to RWA plus off balance sheet items after	Difference
Barclays Bank of Kenya	17.13%	14.50%	2.63%
Family Bank	23.23%	14.50%	8.73%
Sidian Bank	22.51%	15.46%	7.05%

The result show considerable reduction in both capital ratios. The optimized core capital ratio was arrived under priority one. However, in the process of optimizing it under priority one, the total capital to RWA plus off-balance sheet items ratio changed to the required regulatory level for Barclays Bank of Kenya and Family Bank. It was over and above the regulatory level for Sidian Bank by 0.96%.

The result for the total capital to RWA plus off balance sheet items and core capital ratio as a constraint remained unchanged under priority 2 of optimization. This implies that Banks should focus on optimizing the core capital ratio first and that it would be okay if the total capital to RWA plus off-balance sheet items ratio remains at the regulatory level or a little bit above that.

4.4.2 Balance sheet

With the Risk Weighted Assets playing a big role in arriving at the new capital ratios, it basically implies that components of the balance sheet will also not be the same with different components moving either up or down. There are particular components of the balance sheet that will stand out as the ones that changed by huge margins making different implications to the banking sector.

For the balance sheet optimization done above for the three different banks, the component that was greatly affected and essentially the driver of the optimization objective is essentially loans and advances to customers. For all the three cases, loans and advances increase as shown below:

Table 32 Loans and Advances Before and After Optimization

Bank	Loans and advances to Customers Before Shs. millions	Loans and advances to Customers After Shs. millions	Increase in percentage
Barclays Bank of Kenya	168, 510	214,447	27.26%
Family Bank	50,164	87,815	75.06%
Sidian Bank	13,571	18,551	36.70%

Even though non-interest income is slowly becoming an important source of revenue for many banks, interest income is still a major source and as a result capitalizing on it carefully and diligently will almost assure significant results. Channeling the excess capital to revenue generating activities such as disbursement of loans and advances to customers as alluded to in section 4.4.1 might turn out to be positive for both big banks and small banks. However, caution must be taken by the small banks to

ensure that they have enough capital first to at least meet the minimum regulatory requirement and then channel the excess capital to revenue generating activities.

For the statement of financial position to balance once again since the assets component changed by some extent is that entries in the liabilities and equity sections must change. The options are diverse and since it is mostly likely going to be an increase, different banks may try to capitalize on this opportunity from different angles. It could be in the form of increasing its share capital or vouching for more customer deposits from its client base.

Chapter 5 Conclusion

Having looked at the entire process of balance sheet optimization, it is indeed prudent to say that the goal programming approach can be used to arrive at an optimum balance sheet that has healthy capital ratios with the excess funds being channeled to other revenue generating activities. This is especially important for a bank for the long term with the results being mainly witnessed because of the continuous resilience over the years of maintaining appropriate capital ratios and efficient use of resources.

With the approach being dependent on very many steps, it is important to choose an appropriate model, in this case the lexicographic approach that guides on allocating different priorities to different entries. In the case of this paper, priority is given to the core capital ratio over the other capital ratio. It becomes clear that once the first and most important criteria has been achieved then the other can just but meet the bare minimum.

With almost the same entries of the statement of financial position being affected for the three banks from different tiers, the same process can be applicable for other banks bearing in mind the different options the bank can take in the equity and liabilities section so that the overall statement of financial position can balance. Therefore, it is paramount that such methods be applicable in the banking sector to enable healthier statements of financial positions.

Bibliography

Alexander, S. K. (2004). Why banks hold capital in excess of regulatory requirements, the role of market discipline. *Journal of International Banking Regulation, Vol. 6, No. 1*, 6-9.

Chambers, D., & Charnes, A. (1961). Inter-Temporal Analysis and Optimisation of Bank Portfolios. *Journal of Management Science, Vol. 7, No. 4*, 393-410.

Cohen, K. J., & Hammer, F. S. (1967). Linear Programming Models for Optimal Bank Asset Management Decisions. *Journal of Finance, 22*, 42-61.

Dantzig, G. (1953). *Notes on linear programming.* Santa Monica: Rand Corporation.

Dantzig, G. B., Orden, A., & Wolfe, P. (1955). The generalized simplex method for minimizing a linear form under linear inequality restraints. *Pacific Journal of Mathematics, Vol. 5, No. 2*, 183-195.

Eatman, L., & Sealey, J. (1979). A Multi-objective Linear Programming Model for Commercial Bank Liquidity Management. *Journal of Bank Research, Vol.9, No. 4*, 227-236.

Fatma, C., & Fathi, A. (2013). A Multiobjective Model for Bank Asset Liability Management: The Case of a Tunisian Bank. *Journal of Financial Risk Management*, 35-56.

Fieltz, D. B., & Loeffler, A. T. (1979). A Linear Programming Model for Commercial Bank Liquidity Management. *Journal of Financial Management, Vol. 8, No.3*, 44-50.

Forston, C., & Dince, R. (1977). An Application of Goal Programming to management of a Country Bank. *Journal of Bank Research, Vol.7, No.4*, 311-319.

Giokas, D., & Vassiloglou, M. (1991). A Goal Programming Model for Asset Liability Management. *European Journal of Operational Research, Vol.50, No. 1*, 48-60.

Guven, S., & Persentili, E. (1997). A linear programming model for bank balance sheet management. *Omega*, 449-459.

Kamau, P. (2010). *Adoption of risk management by commercial banks in Kenya.* Nairobi: University of Nairobi.

Komar, R. (1971). Developing a Liquidity Management Model. *Journal of Bank Research*, 38-53.

Kretzschmar, G., Mcneil, A., & Kirchner, A. (2009). *Intergrated models of capital adequacy: Why banks are undercapitalsed.* Edinburgh: University of Edinburgh.

Kyriaki, K., & Constantin, Z. (2004). Combining Goal Programming Model with Simulation Analysis for Bank Asset Liability Management. *INFOR*, 175-187.

Lifson, K. A., & Blackman, B. R. (1973). Simulation and Optimization Models for Asset Deployment and Funds Sources Balancing Profit, Liquidity and Growth. *Journal of Bank Research*, 239-255.

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance, Vol. 7, No. 1*, 77-91.

Markowitz, H. (1959). *Portfolio Selection: Efficient Diversification of Investments.* New York: John Wiley & Sons, Inc.

Philipp, H., Andras, H., Andreas, K., Daniel, R., & Hamid, S. (2016). The future of bank risk management. *McKinsey Working Papers on Risk*, 3-25.

Puts, J. (2012). *Bank Balance Sheet Optimization Under Basel III.* Amsterdam: Vrije Universiteit Amsterdam.

Robertson, M. (1972). A Bank Asset Management Model. In S. Eilon, & T. R. Fowkes, *Applications of Management Science in Banking and Finance* (pp. 149-158). Epping, Essex: Gower Press.

Schmaltz, C., & Pokutta, S. (2011, August 23). Optimal Bank Planning Under Basel III Regulations.

Appendix

1. 2016 balance sheet for Barclays Bank of Kenya.

Table 3 Barclays Bank's 2016 Balance Sheet

	2016 KES millions
Assets	
Cash and balances with Central Bank of Kenya	13,378
Financial assets at fair value through profit or loss	7,345
Derivative financial assets	26
Financial assets available-for-sale	48,699
Deposits and balances due from banking institutions	219
Due from group companies	5,568
Loans and advances to customers	168,510
Other assets and prepaid expenses	10,134
Investment in subsidiaries	263
Current income tax	0
Deferred income tax	614
Property and Equipment	3,081
Intangible assets	1,568
Prepaid operating lease rentals	55
Retirement benefit asset	65
Total assets	**259,525**
Equity and liabilities	
Derivative financial liabilities	69
Deposits and balances due to banking institutions	3,264
Due to group companies	19,736
Customer deposits	178,448
Borrowings	5,159
Other liabilities and accrued expenses	10,379
Current income tax	375
Total liabilities	**217,430**
Equity	
Share capital	2,716
Available-for-sale reserve	-152
Share-based payment reserve	285
Regulatory reserve	0
Retained earnings	34,901
Proposed dividend	4,345
Total equity	**42,095**
Total equity and liabilities	**259,525**

2. 2016 balance sheet for Family Bank

	2016 KES millions
Assets	
Cash and balances with Central Bank of Kenya	5,493
Kenya government securities	5,005
Other securities	842
Deposits and balances due from banking institutions abroad	184
Deposits and balances due from local banking institutions	2,341
Loans and advances to customers	50,164
Investment properties	18
Investment in subsidiary companies	1
Tax recoverable	738
Property and Equipment	4,159
Intangible assets	445
Prepaid operating lease rentals	153
Other assets	2,227
Total assets	**69,432**
Equity and liabilities	
Balances due to Central Bank of Kenya	4,394
Deposits and balances due to banking institutions	923
Customer deposits	41,473
Borrowed funds	8,933
Dividends payable	5
Deferred tax liability	25
Other liabilities	1,061
Total liabilities	**56,813**
Equity	
Paid up/ Assigned capital	1,287
Share premium	5,875
Revaluation reserve	197
Retained earnings	4,818
Statutory loan reserve	442
Total equity	**12,618**
Total equity and liabilities	**69,432**

3. 2016 balance sheet for Sidian Bank

	2016 KES millions
Assets	
Cash and balances with Central Bank of Kenya	2,216
Investment securities: Kenya Government Securities	2,523
Deposits and balances due from local banking institutions	348
Deposits and balances due from banking institutions abroad	538
Tax recoverable	104
Loans and advances to customers	13,571
Investment in subsidiaries	1
Property and Equipment	537
Intangible assets	336
Deferred tax asset	57
Other assets	644
Total assets	**20,875**
Equity and liabilities	
Balances due to Central Bank of Kenya	13,685
Customer deposits	2,270
Borrowed funds	589
Other liabilities	463
Total liabilities	**17,007**
Equity	
Paid up/ Assigned capital	1,470
Share premium/ (discount)	706
Revaluation reserve	69
Retained earnings/ Accumulated losses	1,609
Statutory loan loss reserves	15
Total equity	**3,869**
Total equity and liabilities	**20,875**

VT OMNES
VNVM SINT