Asset Liability Management (ALM) In Determining Solvency and Profitability: A Case Study of CIC Life Assurance

BY

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A PROJECT SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTERS OF SCIENCE IN ACTUARIAL SCIENCE

SCHOOL OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCE

MASENO UNIVERSITY

DECLARATION

I hereby declare that this project is my work and has not been presented for a degree award in any other institution.

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Approval by Supervisor

This project has been submitted for examination with my approval as the university supervisor.

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Acknowledgement

I thank the Almighty God, my source of knowledge, wisdom, inspiration, strength and understanding. I would like to thank Dr. Joshua Were my supervisor, for the guidance that he provided throughout this project report. His advice, wisdom and suggestion really aided this project completion. I would also like to express my appreciation to everyone who gave me the possibility to finish this report.

Dedication

I dedicate this project to my loving parents Abel and Jane, my brothers Jill and Emmanuel, and my sister Rachel. It's through their prayers, love and encouragement that I have accomplished this great milestone.

ABSTRACT

The aim of this research was to analyze the practices of asset Liability Management(ALM) at CIC Life Assurance. The study was significant because it analyzed how ALM practices at CIC Life assurance determined its solvency and profitability. This study's main objective was to show how ALM determined the solvency and profitability of the company. To determine solvency, solvency and liquidity ratios were calculated while for profitability, ROA and ROE were calculated. The financial ratios calculated helped determine the financial position of CIC Life Assurance. Expected returns were calculated based on past data on beta and risk free rate. Expected returns help make investment decisions. Higher expected returns showed that investors would earn well in their returns and the company would also profit. The project specifically employed Capital Asset Pricing Model(CAPM)to calculate expected return and monte carlo simulation to assess fluctuating economic conditions. Data from January 2018 to December 2022 from the CIC database was obtained and used in the calculation of the ratios. The variables used for analysis were: Total assets, total liabilities, current assets, current liabilities, shareholder equity, net income. The results indicated that CIC Life Assurance is solvent and profitable.

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CHAPTER 1

Introduction

1.1 Background of the study

One of the leading insurance Companies in Kenya is CIC Insurance Company. It has a long history of providing financial security to its policyholders. The company offers such insurance products:life, general,health. For its financial stability, CIC is committed to managing its A&L effectively. The ALM framework established in the company is designed to match the maturities of its A&L, diversify investments and curb interest rate risk. Solvency is achieved through calculation of solvency ratio. This ratio is the key determinant in showing whether a company is solvent or not.

ALM involves managing of a company's assets and reduce risk of loss by not being able to pay its liabilities. Therefore, assets and liabilities of CIC Life Assurance were studied and analyzed in this research. The aim of this project was to analyze ALM practices at CIC Life Assurance with a goal to improve the Company's asset liability management. This study used financial ratios, CAPM and monte carlo simulation. The findings of this study helped understand the ALM practices at CIC life assurance and gave recommendation on how to improve its ALM practices. It also gave recommendations for risk management, asset allocation techniques. This was achieved by examining and analyzing the solvency and profitability of CIC Life Assurance.

An insurance company's main goal is to fulfill its responsibilities to its policyholders. By effectively managing its A&L financial stability is achieved. ALM seeks to find the balance between assets and liabilities that ensures company's solvency and financial independence and growth. Risk mitigation plays an important part in the dynamic market, and this helps CIC Life Assurance not go under.

1.2 Statement of the Problem

The Insurance industry is experiencing Challenges that prohibit effective A&L Management. CIC Life assurance is experiencing these same challenges. The economic conditions in Kenya keep fluctuating making the Kenyan market more volatile. Changes in inflation, interest rate risk and stocks make it difficult to effectively manage uncertainty and make great investment decisions. The dynamic nature of customer preference make it difficult for CIC Life Assurance to come up with customized products that meet each customer's needs. The insurance sector is becoming competitive, this makes customer retention difficult and meeting financial goals hard to obtain.

The above challenges are making it difficult for CIC Life Assurance to ensure its financial stability. This project addressed the ALM practices at CIC Life Assurance focusing on the company's A&L. ALM influences decision making in insurance companies. If not well practiced, it results to inefficient investment decisions, inadequate risk mitigation. This threatens the solvency and profitability of the company and can lead to bankruptcy of the company. This research therefore explored ALM practices at CIC Life Assurance and provided recommendations to keep the company afloat.

1.3 Objective of the Study

The main objective of this study was to determine how ALM influences solvency and profitability at CIC Life assurance.

1.3.1 Specific Objective

1. To evaluate how expected return influence investment decision making.

2. To analyze the impact of ALM on investment decision making and risk management.

1.4 Significance of the Study

This study analyzed the ALM practices at CIC Life Assurance. The outcome will enable the company understand the gaps in its existing ALM practices, this will lead to improved ALM practices and infinite solvency. Risk analysis determines investment decisions, by investing in the correct portfolios it makes it possible for CIC life Assurance to meet its financial responsibilities to its policyholders. The result will help the insurance companies in Kenya understand the the role that ALM plays in determining solvency and profitability.

[10], indicated that gross premium is directly proportional to profitability. [16], noted that total assets had positive impact on profitability while total liabilities had negative impact.

1.5 Justification of the study

ALM manages financial risk arising from mismatch of assets and liabilities in an Insurance company. It also deals with regulatory compliance and capital requirement. ALM helps insurers to achieve efficiency, profitability and solvency both short and long term.

Financial security ensures the success of a company and thus this study was done to show how ALM practices determine solvency and profitability at CIC Life assurance.

1.6 Basic Concepts

- Probability distribution: probability is the likelihood of an event happening, it sums up to 1. Probability distribution assigns a probability to every possible outcome of a random variable. For random variables with specified range, it shows possible values and probabilities.

$$probability = \frac{possibility \quad of \quad event \quad number}{Total \quad Possibility \quad number}$$

- Solvency ratios: They determine a company's capability to meet its financial obligations. A higher solvency ratio shows that a company can easily meet its financial responsibilities.

$$\text{Solvency ratio} = \frac{\text{Total Assets}}{\text{Total Liabilities}}$$

- Portfolio theory: It helps investors make investment decisions that have higher return and lower risk. It is used to diversify investment portfolio for different asset classes such as stocks, bonds, real estate. It helps reduce risk exposed to the company by spreading investments across different asset classes.

$$E(r_p) = \sum_i x_i E r_i$$

$$var(r_p) = \sum_i x_i^2 var(r_i) + 2 \sum \sum x_i x_j cov(r_i r_j)$$

where: $E(r_p)$ is the expected return on a specific portfolio

$var(r_p)$ is the variance of a specific portfolio

x_i, x_j = the weight of a specific stock.

- Stochastic modeling: A stochastic process is a collection of random variable that is indexed by some mathematical set. Stochastic modeling is used in ALM to help make investment decision; assess the uncertainty impact on the financial position of an insurance company. For example, an insurance company could use stochastic modeling to estimate the impact of a rise in interest rates on its ability to meet its financial responsibilities to its policyholders.

- Linear programming: Linear programming is used in ALM to determine the optimal number of policies to sell in each region, given the sales resources and target market of the company. For example, an insurance company could use linear programming to determine the optimal number of life insurance policies to sell in urban areas versus rural areas.

$$minimum| \quad maximum \quad of \quad c^T x$$

subject to $Ax \leq b$

where:

c is the vector of coefficients for the objective function, x is the vector of decision variables, A is the matrix of coefficients for the constraints and b is the vector of constants.

Objective function:

$$\text{minimize} \mid \text{maximize} \quad c^T x$$

where:

$$c = \begin{bmatrix} 1 & 1 & 0 \end{bmatrix}, \qquad x = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

Subject to $Ax \leq b$

where:

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad \text{and} \quad b = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$

$c^T(x)$ is the objective function. $x_i s$ are the decision variables. A represents coefficients for the constraint, Vector b contains the right-hand side constants for each constraint.

1.7 Mathematical Background to CAPM

1.7.1 Mean-Variance(M-V) Theory

Acording to [14], M-V is the foundation of the CAPM. It is a rule used when constructing efficient portfolios out of the individual risky assets that are available. Risk is expressed as variance. It assumes normal distribution of expected returns and risk aversion. M-V rule follows $N(\mu, \sigma^2)$ If $\mu_A > \mu_B$ and $\sigma_A < \sigma_B$, then asset A dominates asset B and is prefered by investors. Investors are risk averse and prefer assets with higher expected return and lower risk(standard deviation).

1.7.2 Modern Portfolio Theory(MPT)

The MPT is used by investors to determine which portfolio they are going to invest in that has high expected return and low risk. It assumes investors are risk averse. The expected return of a portfolio is calculated as:

$$R_p = \sum x_i * R_i$$

where: R_p is the return on portfolio

x_i is the weight of asset i

R_i is the return on asset i

1.7.3 The Capital Market Line(CML)

The CML assumes that there exist a single market portfolio and that investors can lend and borrow at a risk free rate. Therefore, an efficient portfolio can be constructed at any point along the CML.

$$R_p = R_f + \frac{R_m - R_f}{\sigma_m}\sigma_p \tag{1.1}$$

where: R_p is the return on an efficient portfolio

R_f is the risk-free rate

R_m is the return on the market portfolio

σ_m is the standard deviation of returns on the market portfolio

σ_p is the standard deviation of returns on efficient portfolio p.

The CML sets a basis for the derivation of the Capital Asset Pricing Model.

1.7.4 CAPM

CAPM follows risk-return equilibrium. The higher the risk the higher the expected return and vice versa. Invested desire higher risk premium. Risk premium is the rate of return greater than risk free rate.

$$R_p = R_f + \frac{(R_m - R_f)\rho(pm)}{\sigma_m}\sigma_p \tag{1.2}$$

where $\rho(pm)$ is the correlation coefficient between the return of portfolio p and that of the market.

Equation 1.2 transforms into the CAPM equation as follows:

$$R_p = R_f + \frac{\rho(pm)\sigma_p}{\sigma_m}(R_m - R_f) \tag{1.3}$$

Introducing σ_m in the numerator and denominator:

$$R_p = R_f + \frac{\rho(pm)\sigma_p\sigma_m}{\sigma_m^2}(R_m - R_f) \tag{1.4}$$

$$Cov(R_p, R_m) = \rho(pm)\sigma_p\sigma_m, \ equation 1.4 becomes:$$

$$R_p = R_f + \frac{Cov(R_p, R_m)}{\sigma_m^2} * (R_m - R_f) \tag{1.5}$$

$$\beta_p = \frac{Cov(R_p, R_m)}{\sigma_m^2} \tag{1.6}$$

This leads to the CAPM equation

$$R_p = R_f + \beta_p(R_m - R_f) \tag{1.7}$$

CHAPTER 2

Literature Review

2.1 Introduction

This section identified themes, theories and methodology related to ALM practices in insurance companies.

2.2 Effectiveness of ALM in Insurance Sector

[15], investigated he effectiveness of ALM practices within the insurance sector. They did an analysis on the impact of ALM on solvency and profitability. Their study showed that ALM can influence the financial outcome and financial position of an insurance company. They did an empirical analysis which showed ALM strategies contributed to investment decision making and risk mitigation, which in turn influence the financial performance of a company.

2.3 Optimizing Investment Decisions and Managing Risks through ALM

A study was conducted to investigate the role of ALM in optimizing investment decision making in insurance firms. [3], employed quantitative models and analytic techniques to assess the efficacy of ALM strategies in improving solvency and profitability. They analyzed data from insurance companies and the results showed ALM impacts financial stability and performance directly. Their research showed that ALM practices help insurance company navigate dynamic market conditions, risk mitigation and maximized investment returns. Therefore, ALM influences the financial health of an insurance firm.

2.4 Early Studies on ALM in Insurance

[12], emphasized on the importance of a company aligning its assets and liabilities to ensure solvency and profitability.

$$Solvency \quad Ratio = \frac{Aligned \quad Assets}{Total \quad Liabilities}$$

[5] studied risk mitigation in ALM through duration matching techniques.

$$Duration \quad Gap = D_A - D_L$$

where:

$D_A = W(A1)D(A1) + W(A2)D(A2) + \ldots + W(An)D(An)$

$D_L = W(L1)D(L1) + W(L2)D(L2) + \ldots + W(Ln)D(Ln)$

$D(Ai)$ = Duration of Assets

$D(Li)$ = Duration of Liabilities

$W(Ai)$ = (market value of asset i)/(market value of total assets)

$W(Li)$ = (market value of liability j)/(market value of total liabilities)

$$Duration = D = \frac{\sum_{t=1}^{N} tC(t)/(1+y)^t}{P_0}$$

$$P_0 = \sum_{t=1}^{N} \frac{C(t)}{(1+y)^t}$$

where:

Ct is the cash flow received at time t

y is the yield to maturity

P_0 is the current price of specified bond.

These equations measure the difference in the duration of A&L.

Insurers are able to reduce interest rate risk exposure by matching assets and liabilities duration.

2.5 Interest Rate Risk Model

It is a crucial tool for assessing and managing the potential ramification of interest rate fluctuation on the financial health of a company. [17], analysed how interest rate movement impacts on financial metrics such as: zero coupon bonds, net income, equity market value. Additionally, it measures duration and convexity to determine how sensitive bond prices are to changes in interest rates.. Present Value formula is applied in the assessment of interest rate risk:

$$PV = \frac{FV}{(1+r)^n}$$

Where: PV is the present value
FV is the future value
r is the rate of return
n is the number of periods

Financial institutions can develop effective risk mitigation strategies to mitigate interest rate risk and ensure long-term financial stability.

[11], examined the use of derivatives to hedge market risk in ALM. Derivatives are used to tranfer risk from one party to another in insurance. Can be used to hedge against economic fluctuations like interest rates rise. [6], proposed credit default swaps (CDS) as a tool for mitigating credit risk. CDS are contracts used to transfer credit risk of a debt obligation from one party to another.

2.6 Currency Risk Model

Currency Risk Model assesses and manages the exposure to fluctuations in exchange rate which can impact performance and stability of a company significantly. It aims to quantify risk arising from currency exchange rates and come up with strategies to mitigate them. VaR can be used to quantify currency risk model. Value at Risk(VaR) measures the potential loss in the value assets and liabilities. This impacts ALM strategies when there is adverse currency fluctuation. VaR depends on historical simulation, variance-covariance, monte carlo simulation. [2] conducted a study on currency beta and duration to assess the sensitivity of portfolio returns with currency exchange fluctuations.

VaR = Market Price*Volatility under the variance-covariance method

2.7 Liquidity Risk Model

[9] studied the effect of liquidity risk on the financial performance of insurance companies. Their study showed that liquidity risk affects financial performance directly. These models are used to assess and manage risk of being able to meet both short term liabilities. They quantify the probability of liquidity shortages. Liquidity risk arises from unexpected cash outflows, market disruptions. Therefore, liquidity risk must be monitored closely to ensure solvency and stability of a company.

- $$current \quad ratio = \frac{current \quad assets}{current \quad liabilities}$$

- $$quick \quad ratio = \frac{quick \quad assets}{current \quad liabilities}$$

$$quick \quad assets = cash + accounts \quad receivables + marketable \quad securities$$

- $$cash \quad ratio = \frac{cash}{current \quad liabilities}$$

These ratios determine insurer's liability to meet its short-term liabilities. Stress testing and scenario analysis are done to simulate adverse market conditions and assess the impact of liquidity position under different scenarios. Liquidity gaps are identified when both historical and market forecasts are simulated hence cashflow management can be optimized. Robust liquidity risk management strategies must be put in place to mitigate the impact of liquidity risk shocks on the company.

2.8 Credit Risk Model

Insurance companies can make informed decisions regarding investments and underwriting activities after mitigating credit rate risk. Credit ratings are used to determine probability of default based on borrower's financial history, debt to income ratio. Additionally, the model probability of default(PD), loss given default(LGD) and exposure at default(EAD) to estimate potential loss related with credit exposure. [13] credit rate risk can impact the assets of a company negatively leading to poor financial health hence bankruptcy.

2.9 Regulatory Framework and Compliance

Regulatory frameworks play an important role in ALM. Studies have been conducted to determine how regulatory framework and compliance impact ALM decision making. [7], mathematically expressed how regulatory capital requirements influence risk-return as shown:

$$Risk - Return \quad Tradeoff = \frac{Expected \quad Return}{Regulatory \quad Capital \quad Requirement}$$

[8] investigated the impact of Solvency II regulations on ALM practices and highlighted the challenges and opportunities presented by this regulatory framework. They emphasized the need for insurance companies to adapt their ALM strategies to comply with Solvency II requirements while maintaining profitability. Solvency II was brought

into place to protect policyholders from insurers and ensure their claims are paid. It sets out rules and requirement on how insurance should operate.

2.10 Dynamic and Multi-Objective ALM Model

[1], introduced a multi-objective model that addressed risk mitigation strategies and profit maximization. By considering asset and liability cash flows, market risk, and regulatory requirements, Ding et al.'s model aligns closely with the multifaceted nature of ALM in the insurance sector. Their approach of balancing risk and profitability sets the foundation of the role of ALM in determining solvency and profitability. [4], introduced a dynamic ALM model that aligns with the stochastic nature of asset and liability cash flows. Their model digs into effectively managing dynamic cash flow which is crucial in ALM management. The understanding of how to utilize stochastic element in risk prediction, can be the breakthrough in employing ALM strategies to maximize profitability and remain solvent.

CHAPTER 3

Methodology

3.1 Introduction

This study's methodology encompassed use of mathematical model and simulation techniques to examine ALM practices at CIC Life Assurance. Data analysis was done using CAPM and monte carlo simulation. Data was collected from CIC Insurance Company database for the period January 2018 to December 2022. This data was used to determine the trends of solvency, profitability and investment choices of CIC Life Assurance. Balance sheet and Profit and loss accounts gave the following variable: Total assets, current assets, total liabilities, current liabilities, net income, shareholder equity. These ratios were used in the calculations of key financial ratios to determine solvency and profitability. Three key ratios were used to determine the solvency and profitability of the company:

- Solvency ratio: It was used to measure the solvency of CIC Life Assurance: ability to meet its long term financial responsibility.

$$Solvency \quad ratio = \frac{Total \quad Assets}{Total \quad Liabilities}$$

- Liquidity ratio: It was used to evaluate the ability of CIC Life Assurance to meet its short term financial responsibilities.

$$Liquidity \quad ratio = \frac{Current \quad assets}{Current \quad liabilities}$$

- Profitability ratio: was calculated to show the company's capability to generate profits.

$$ROA = \frac{Net \quad income}{Total \quad assets}$$

$$ROE = \frac{Net \quad Income}{Shareholder \quad Equity}$$

3.2 Simulation and Modeling

I focused on determining how expected return influence investment decision making and the impact of ALM practices on investment decision.

The Capital asset Pricing Model

It is a model used by investors in investment decision making. Investors choose portfolios with higher returns and lower risks.

$$R_p = \sum_{i=1} (x_i R_i)$$

where:

R_p is the return on a portfolio

x_i is the weight an asset i.

R_i is the return on an asset

$$E(R_p) = E \sum_i x_i R_i$$

$E(R_i)$ is the expected return of a given portfolio.

$$Var(R_i) = E(R_i - \bar{R}_i)^2$$

$Var(R_i)$ is the variance of that portfolio.

$$\sigma_i = \sqrt{Var(R_i)}$$

σ is the risk/standard deviation of the portfolio.

$$Cov(Y, Z) = E(YZ) - E(Y)E(Z)$$

Cov(Y,Z) is the covariance between 2 RV Y and Z.

The correlation between 2 RV:

$$\rho(YZ) = \frac{Cov(Y, Z)}{\sigma Y \sigma Z}$$

- The capital asset pricing model (CAPM):

$$ER = r_f + \beta(r_m - r_f)$$

where: ER is the Expected return of the portfolio.

r_f is the Risk-free rate.

β is the beta of the security.

r_m is the market risk.

$(r_m - r_f)$ is the Equity Risk Premium.

Derivation of CAPM

$$R_p = R_f + \frac{(R_m - R_f)\rho(pm)}{\sigma_m}\sigma_p \quad (3.1)$$

where $\rho(pm)$ is the correlation coefficient between the return of portfolio p and that of the market.

Equation 3.1 transforms into the CAPM equation as follows:

$$R_p = R_f + \frac{\rho(pm)\sigma_p}{\sigma_m}(R_m - R_f) \quad (3.2)$$

Introducing σ_m in the numerator and denominator:

$$R_p = R_f + \frac{\rho(pm)\sigma_p\sigma_m}{\sigma_m^2}(R_m - R_f) \quad (3.3)$$

$Cov(R_p, R_m) = \rho_p m \sigma_p \sigma_m$, equation 3.3 becomes:

$$R_p = R_f + \frac{Cov(R_p, R_m)}{\sigma_m^2}(R_m - R_f) \tag{3.4}$$

$\beta_p = \frac{Cov(R_p, R_m)}{\sigma_m^2}$

This leads to the CAPM equation

$$R_p = R_f + \beta_p(R_m - R_f) \tag{3.5}$$

CAPM was used to estimate the expected return of an asset, given its risk. Government bond is an example of risk free rate. The beta of an asset was a measure of its volatility compared to the market. A beta of 1 meant that the asset had the same volatility as the market. A beta greater than 1 meant that the specific asset was more volatile than the market as a whole. A market beta of 1.2 implies that if the market moves by 1.2%, CIC Life assurance will move up or down by 1.2%.

- CAPM Assumptions

  1. Investors are risk averse.
  2. Zero transaction cost.
  3. The investor can sell short any amount of any share.
  4. Presence of a risk less asset.
  5. The market is perfect.
  6. Investors live by the M-V rule ie assumes returns are normally distributed.
  7. The M-V rule is optimal.

- The Monte Carlo simulation

It is a simulation used to model the behavior of a system under uncertainty. In ALM, Monte carlo was used to examine scenarios of solvency and profitability of CIC LIfe Assurance. The simulation process started by generating a large number of random variable. These variables represented solvency and profitability ratios. Given uncertainty such as interest rate and currency fluctuation, it showed how they impacted solvency and profitability of the company.

10,000 iterations were performed using monte carlo simulation. Mean and standard deviation of both total assets and total liabilities were calculated. Solvency analysis was done by generating random total assets and total liabilities that fell between the standard deviation and mean. Example:

number of simulations = 10000

asset's mean = 16514170800

asset's standard deviation= 3373379580

liabilities mean = 14459949600

liabilities standard deviation = 3355186432

The same was done for liquidity ratio, ROA and ROE. The simulation showed instances out of the CIC Life assurance when it would be solvent and profitable. The results obtained using CAPM and Monte Carlo simulation to give recommendation on how to improve ALM practices in the company.

3.3 Data Analysis

The collected data were analyzed using the R programming language, which provided statistical tools and functions for data manipulation and analysis. I applied quantitative data analysis techniques;calculated financial ratios, estimated expected returns using the CAPM formula, and assessed the risk-return characteristics of investment portfolios. Descriptive statistics, such as mean, median, standard deviation summarized and interpreted the quantitative data.

The CAPM Formula:

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f)$$

$E(Ri)$ is the expected return of capital asset

R_f=risk-free interest rate

$\beta_{(i)}$ is the sensitivity

$E(Rm)$ is expected return of the market

CHAPTER 4

Results and Discussion

4.1 Solvency Analysis

Data in KES

Year	Total Assets	Total Liabilities	Current Assets	Current Liabilities
2018	12185535000	10125574000	2613232000	1340080000
2019	14579491000	12566608000	3363114000	1661839000
2020	16452096000	14346797000	4059412000	1815994000
2021	18446104000	16503156000	5125600000	2227826000
2022	20907628000	18757639000	3942391000	1966593000

Solvency Analysis: Solvency is a critical aspect of an insurance company's financial health. In insurance, it measures the company's ability to pay claims to policyholders. A solvency ration of above 1.0 indicates a company is solvent.

$$Solvency \quad Ratio = \frac{Total \quad Assets}{Total \quad Liabilities}$$

Solvency Ratio: The solvency ratio is a fundamental measure of an insurance company's financial status. It quantifies the company's capacity to cover its liabilities with its assets.

The solvency analysis was conducted for CIC Life Assurance over the years 2018 to 2022. The solvency ratio was calculated. The solvency ratio was 1.20 for the year 2018, 1.16 for 2019, 1.15 for 2020, 1.12 for 2021 and 1.11 for 2022. The solvency ratio through the years was above 1.0 which implied that CIC Life insurance had more assets than liabilities. The results indicated that it has maintained a relatively stable solvency ratio

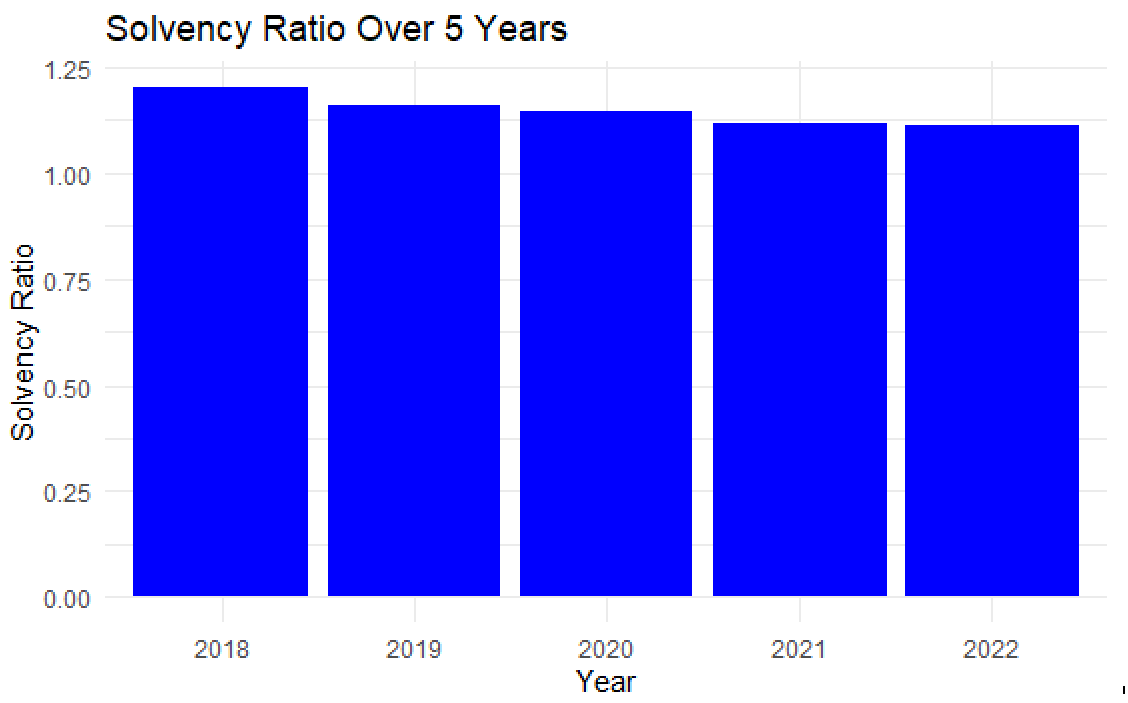

Figure 4.1: solvency ratio figure

over the five-year period, suggesting a strong financial position with assets exceeding liabilities. This meant that CIC Life Assurance Company is solvent.

4.2 Liquidity Analysis

The liquidity analysis was performed using the Current Ratio. Current ratio determines the company's ability to pay claims within a year.

$$Current \quad Ratio = \frac{Current \quad Assets}{Current \quad Liabilities}$$

The current ratio was calculated. The liquidity analysis helps to identify trends in the management of short-term financial resources. Consistency or improvements in the

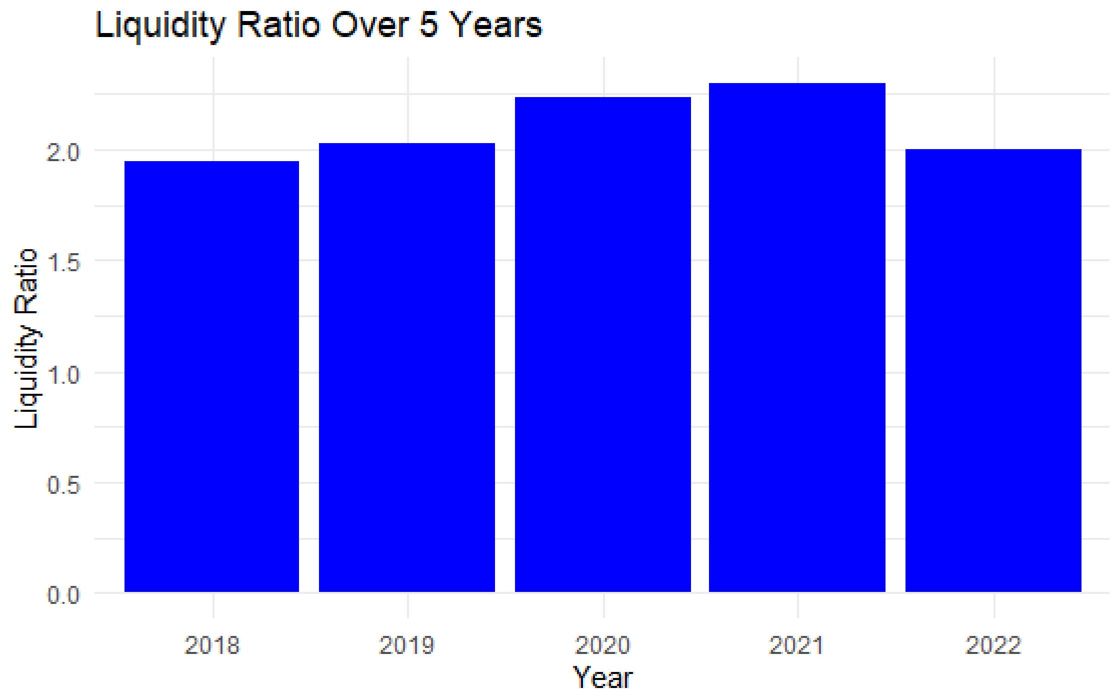

Figure 4.2: Current ratio figure

Current Ratio over the years indicate sound liquidity management, whereas decreasing ratios may signal challenges in meeting short-term obligations.

The year 2018 had a current ratio of 1.95, 2019 had 2.02, 2020 had 2.24, 2021 had 2.30 and 2022 had current ratio of 2.00.The findings revealed that CIC Life Assurance maintained a current ratio greater than 1.5, signifying healthy liquidity levels throughout the five-year period. Liquidity analysis outperformed solvency ration, this implied that CIC Life Assurance can easily meet its short term financial obligations compared to the long term.

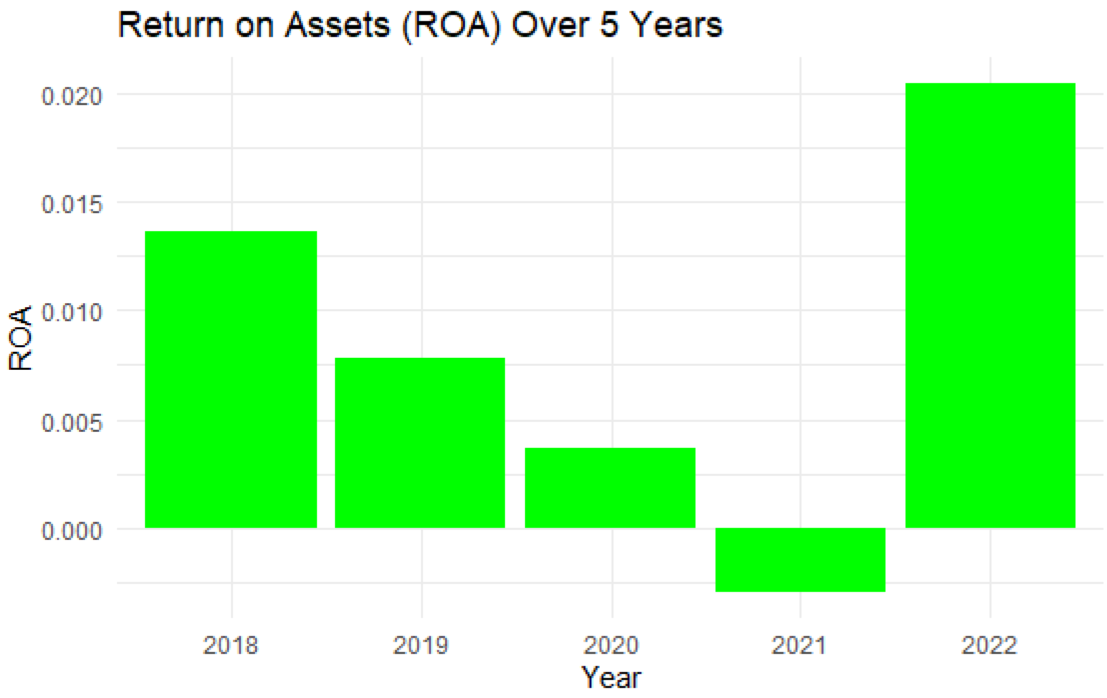

Figure 4.3: ROA figure

4.3 Profitability analysis

In KES

Year	2018	2019	2020	2021	2022
Total Assets	121855350000	145794910000	16452096000	18446104000	20907628000
Net Income	166368000	114064000	60204000	-55006000	427616000
Total Revenue	4761309000	4938935000	4774298000	5651654000	6727035000
Shareholder Equity	2059961000	2012883000	2105299000	1942948000	2149989000

I calculated key profitability ratios: Return on Assets (ROA) Return on Equity (ROE).

$$ROA = \frac{Net \quad Income}{T \ otal \quad Assets}$$

$$ROE = \frac{Net \quad Income}{Shareholder \quad Equity}$$

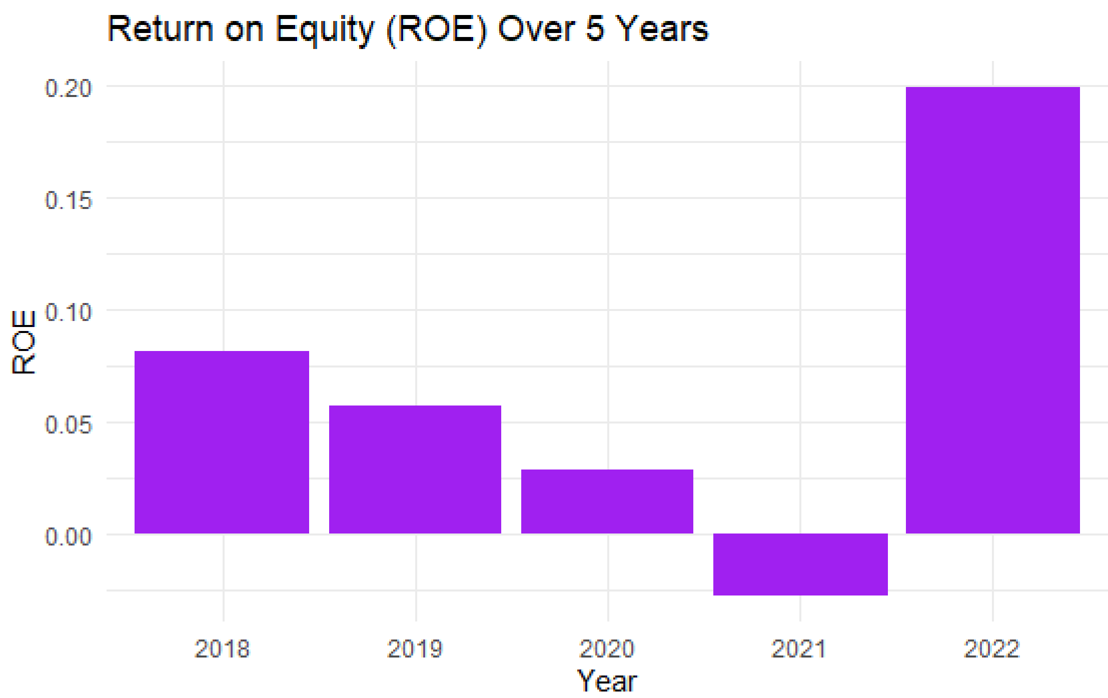

Figure 4.4: ROE figure

In the profitability analysis, two key metrics were examined: ROA and ROE. ROA measured the company's capability to generate profit from its assets, while ROE assessed profit generation concerning shareholder equity. ROA for 2018 was 0.0137, 2019 it was 0.0078, 2020 it was 0.0037, 2021 it was -0.00298 and 2022 had a ROA of 0.02. This showed that returned earned on assets were very low: 1.37%, 0.78%, 0.37%, -0.298% and 2%. The results from 2018 to 2021 indicated that the company might have heavily invested in assets that failed to produce revenue growth. However, ROA increased significantly in 2022 indicating that for every shilling CIC Life Assurance Company invested, profits were made.

ROE on the other hand was 0.081 in 2018, 0.057 in 2019, 0.029 in 2020, -0.028 in 2021 and 0.199 in 2022. This showed that the company was not converting its equity into profits fully between 2018 and 2021. This implied that the company did not utilize the capital invested by its shareholders efficiently. In 2022 a ROE of 19.9% was achieved implying that equity given by shareholders was invested efficiently.

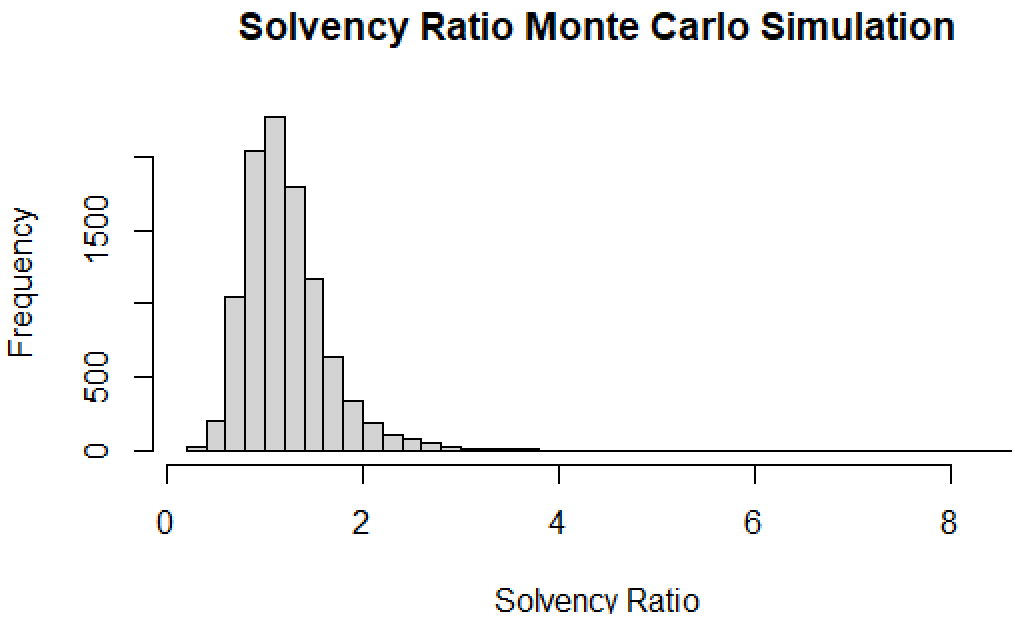

Figure 4.5: solvency ratio through monte carlo simulation

4.4 Monte Carlo Simulation

The solvency analysis was performed using Monte Carlo simulations. The ratios served as crucial indicators for solvency management. The solvency ratios aided in understanding the balance between total assets and total liabilities.

The solvency ratio was simulated with 10,000 iterations. The results indicated a stable and normally distributed solvency ratio, reflecting the company's financial stability. Out of the 10,000 simulations, the solvency ratio was 1.0 in 2000 scenarios, 1.2 in over 2000 scenarios, 1.4 in 750 scenarios, 1.6 in 600 scenarios and 2.0 in 200 scenarios. The findings indicated that Life Assurance at CIC is solvent.

The liquidity analysis was done using monte carlo simulation. The current ratio showed that Life insurance at CIC company is able to meet its short-term liability.

Current ratio of 1.5 was observed in 200 scenarios, 1.8 in 1000 scenarios, 2.0 in 1100 scenarios, 2.1 in 1400 scenarios, 2.2 in 1400 scenarios, 2.3 in 1100 scenarios 2.5 in 600 scenarios and 3.0 in 50 scenarios. This implied that CIC Life met its short term liabilities through the years 2018 to 2022. Monte Carlo simulations were conducted to assess finan-

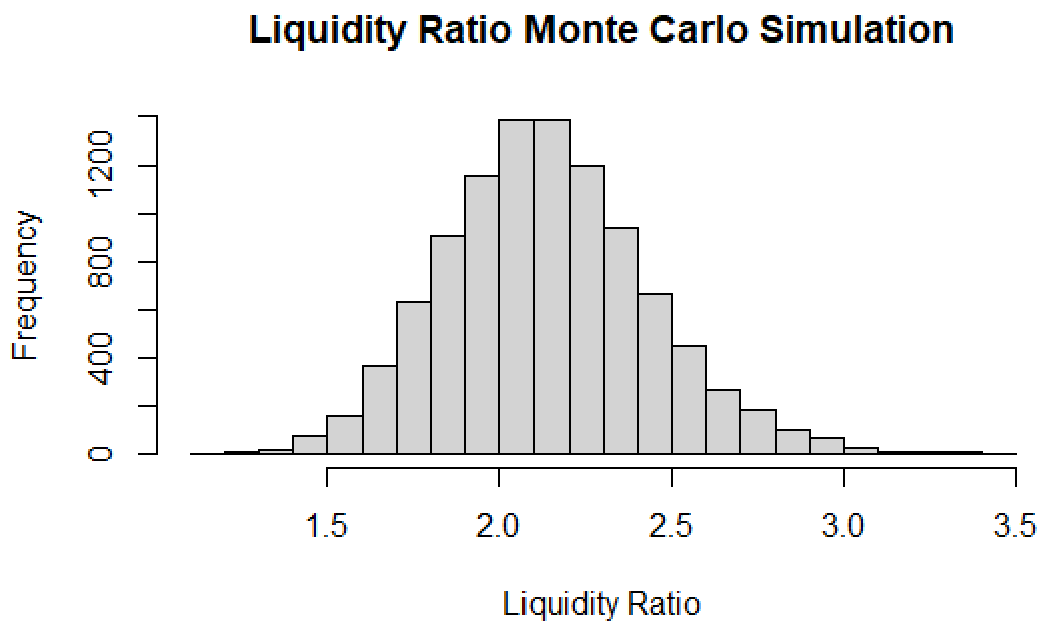

Figure 4.6: Current ratio through Monte Carlo Simulation

cial risk and estimate possible outcomes. Liquidity ratios were generated, with results showing consistent and positive liquidity throughout the simulations.

The profitability analysis included ROA and ROE assessments through Monte Carlo simulations.

The simulations offered a spectrum of profitability scenarios over the five-year period. ROA is an essential metric for evaluating how efficiently the company utilizes its assets to generate income. The company had a ROA of 0.01 in 1500 scenarios, and 0.02 in 200 scenarios. This implied that CIC Life Assurance is profitable.

The ROE analysis revealed how the company's performance impacted profitability and shareholder equity. ROE determined the company's ability to generate returns for its shareholders based on its equity. These findings help inform strategies to enhance profitability through effective asset-liability management and investment decisions. The company had a ROE of 0.05 in 1000 scenarios, 0.1 in 900 scenarios,and 0.15 in 150 sce-

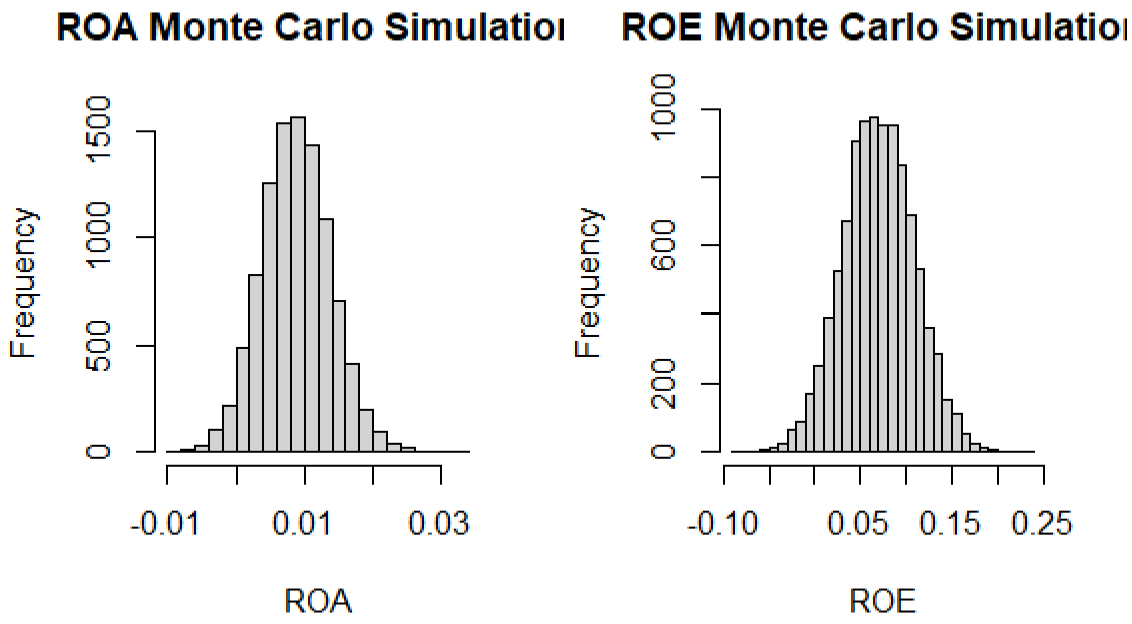

Figure 4.7: ROA ROE through monte carlo simulation

narios.

4.5 Capital Asset Pricing Model(CAPM)

Year	2018	2019	2020	2021	2022
R.F	12.6%	12.5%	11.975%	13.168%	14.326%

$$\beta = 1.5$$

Market Risk Premium(MRP) = 14.86% The CAPM analysis aimed to estimate expected returns based on historical risk-free rates from 2018 to 2022. In 2018 the expected return was 34.89%, 34.79% in 2019, 34.265% in 2020, 35.458% in 2021 and 36.616% in 2022. The CAPM suggested that expected returns for the asset exceeded the risk-free rates over the years. This finding implied that the asset was expected to yield a return higher

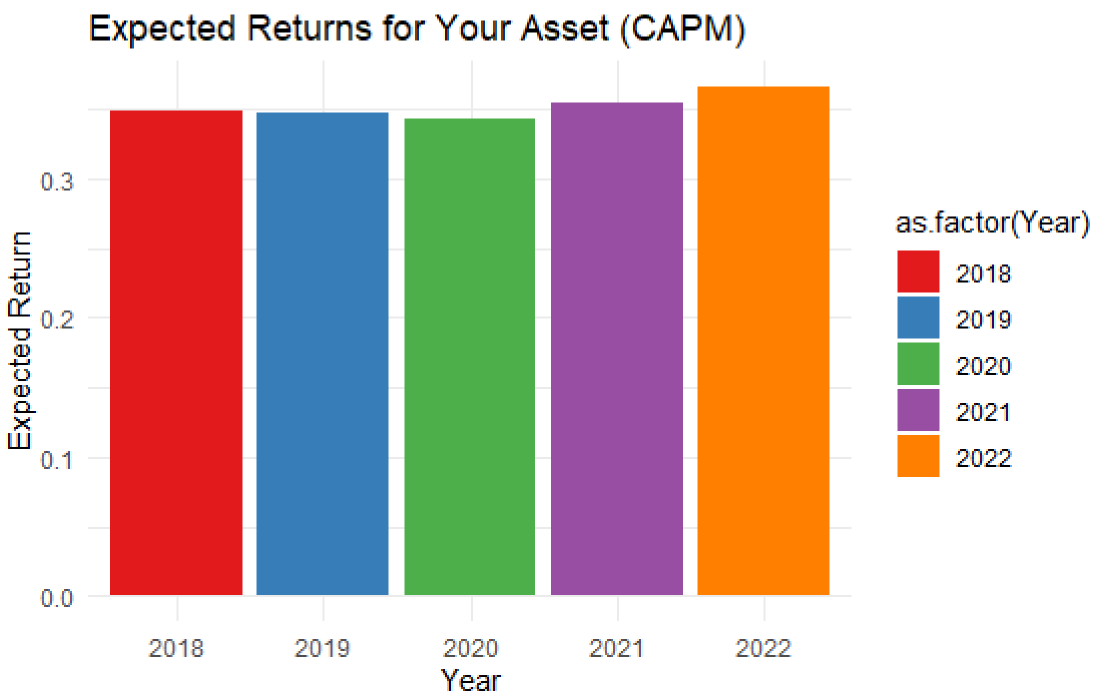

Figure 4.8: Capital Asset Pricing Model

than the risk-free rate, indicating the potential for investment gain.

The analysis also revealed that expected returns gradually increased over the five-year period. This trend implied that investors anticipated higher returns from investments in subsequent years, encouraging favorable investment decisions.

CAPM was also analysed using different betas and the results were as follows: With a beta of 0.9, expected returns in 2018 was 26%, 2019 was 28%, 2020 was 30%, 2021 was 26% and 2022 was 28%. A beta of 1.0, 2018's expected return was 30%, 2019 was 25% , 2020 was 27%, 2021 was 29.5% and 2022 was 27%. At 1.2 beta, 2018 had expected return of 28%, 2019 had 31%, 2020 had 28%, 2021 had 29% and 2022 had 32%. This implies that expected return is sensitive to the risk of the market and beta. The higher the risk the higher the expected return and the higher the expected loss. Expected returns offer insights on which portfolio is best to be invested in. Investors prefer investing in portfolios with higher expected returns and lower risk.

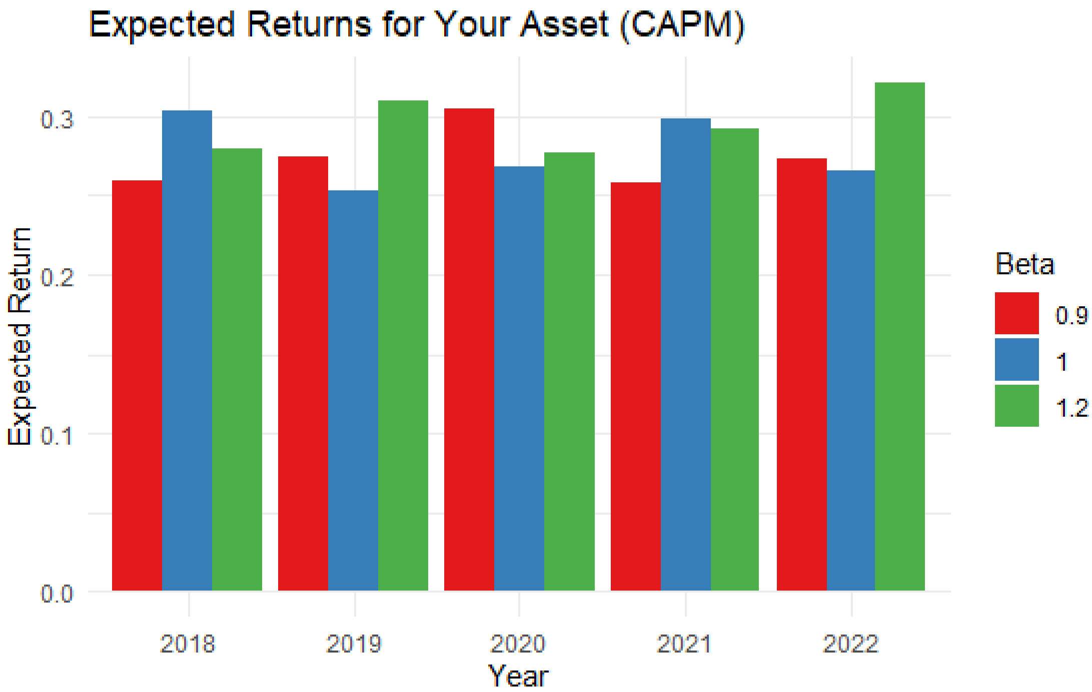

Figure 4.9: CAPM with diff betas

CHAPTER 5

Conclusion and Recommendation

5.1 Conclusion

The financial analysis of CIC Life Assurance spanning the five-year period from 2018 to 2022 reveals a company that is positioned for stability and growth. The following in-depth conclusions are drawn from the various facets of the analysis:

CIC Life Insurance demonstrates exceptional solvency and stability. Although the solvency ratio calculated for the five-year period exceeded 1.0, it had a downward trend. This shows that in a few years to come CIC Life Assurance will not be able to meet its long-term liabilities, ie, CIC will not be solvent. The liquidity analysis underscores CIC Insurance's ability to meet its short-term financial commitments. The current ratio consistently exceeded 1.5, signifying the company's adeptness at covering its immediate liabilities. The profitability metrics reveal a well managed company but with proper investment it can do better.

The Monte Carlo Simulation results consistently show that CIC Life Insurance maintains its stability and financial health even in the face of simulated financial shocks. The application of the CAPM revealed a nuanced understanding of expected returns for CIC Insurance's assets. The expected returns were high indicating high returns on investment portfolios. Expected returns impact investment decision making because investors like portfolios with higher expected and lower risk. Risk mitigation enhances proper financial planning and prevents the company from becoming insolvent.

In summary, the findings appear promising but it is essential for CIC Life Assurance to remain vigilant and adaptable in the face of evolving economic conditions and market forces. Continued fiscal prudence and strategic planning are fundamental for ensuring the company's enduring financial vitality and enhancing its standing in the insurance industry.

5.2 Recommendations

Based on the financial analysis of CIC Life Insurance over the five-year period from 2018 to 2022, several recommendations emerge to further strengthen the company's financial health and ensure its continued growth and success: CIC Life Insurance should explore opportunities for diversifying its investment portfolio. Investing in a well diversified portfolio in different geographical markets and assets may help reduce potential losses during economic fluctuation. Proper investment leads to profitability which in turn ensures solvency. Capitalization on emerging opportunities in the dynamic market is vital. CIC Life Assurance penetrate the market deeper and reach new customers. More policyholders increases the gross premium which result in increased profits and in turn strengthen the financial position of the company.

CIC Life Assurance should offer digital solutions to enhance customer experience and reach a broader clientele. The company should conduct stress testing scenarios regularly to assess its resilience upon subjection to different economic conditions.

These recommendations serve as suggestion to CIC Life Assurance to sustain its growth, enhance resilience and cement its reputation as a leading insurance company in Kenya. The company can navigate future challenges by making prudent investment decisions. This results in proper financial management that leads to financial growth of the company.

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Appendix A

R codes

ParametersforT otalAssets

$total_{a}ssets_{d}ata$ <- c(12185535000, 14579491000, 16452096000, 18446104000, 20907628000)

$total_{l}iabilities_{d}ata$ <- c(10125574000, 12566608000, 14346791000, 16503136000, 18757639000)

Calculate Solvency Ratios

$solvency_{r}atios$ <- $total_{a}ssets_{d}ata$ / $total_{l}iabilities_{d}ata$

Create a data frame with the years and calculated Solvency Ratios

data <- data.frame(Year = 2018:2022, SolvencyRatio = $solvency_{r}atios$)

Visualize Solvency Ratios

library(ggplot2)

$solvency_{p}lot$ <- ggplot(data, aes(x = as.factor(Year), y = SolvencyRatio)) + $geom_{b}ar$(stat = ”identity”, fill = ”blue”) + labs(title = ”Solvency Ratio Over 5 Years”, x = ”Year”, y = ”Solvency Ratio”) + $theme_{m}inimal$()

Display the Solvency Plot print(solvency_plot) # Parameters for Total Liabilities

Provided data for Current Liabilities

$current_{l}iabilities_{d}ata$ <- c(1340080000, 1661831000, 1815994000, 2227826000, 1966593000)

Provided data for Current Assets

$current_{a}ssets_{d}ata$ <- c(2613232000, 3363114000, 4059412000, 5125600000, 3942391000)

Calculate Liquidity Ratios using the formula

$liquidity_{r}atios$ <- $current_{a}ssets_{d}ata$ / $current_{l}iabilities_{d}ata$

Create a data frame with the years and calculated Liquidity Ratios

data <- data.frame(Year = 2018:2022, LiquidityRatio = $liquidity_{r}atios$)

Visualize Liquidity Ratios

library(ggplot2)

$liquidity_{p}lot$ <- ggplot(data, aes(x = as.factor(Year), y = LiquidityRatio)) + $geom_{b}ar$(stat

= ”identity”, fill = ”blue”) + labs(title = ”Liquidity Ratio Over 5 Years”, x = ”Year”, y = ”Liquidity Ratio”) +$theme_{m}inimal$()

Display the Liquidity Plot

print($liquidity_{p}lot$)

Provided data for Net Income

$net_{i}ncome_{d}ata$ <- c(166368000, 114064000, 60204000, -55006000, 427616000)

Provided data for Total Revenue

$total_{r}evenue_{d}ata$ <- c(4761309000, 4938935000, 4774298000, -5651654000, 6727035000)

Provided data for Shareholder Equity

$shareholder_{e}quity_{d}ata$ <- c(2059961000, 2012883000, 2105299000, 1942948000, 2149989000)

Provided data for Total Assets

$total_{a}ssets_{d}ata$ <- c(12185535000, 14579491000, 16452096000, 18446104000, 20907628000)

Create a data frame for profitability analysis

$profitability_{d}ata$ <- data.frame(Year = 2018:2022, NetIncome = $net_{i}ncome_{d}ata$,TotalRevenue = $total_{r}evenue_{d}ata$, ShareholderEquity = $shareholder_{e}quity_{d}ata$, TotalAssets = $total_{a}ssets_{d}ata$)

Calculate Return on Assets (ROA)

$profitability_{d}ata$ROA <- $profitability_{d}ata$\$NetIncome / $profitability_{d}ata$\$TotalAssets

Calculate Return on Equity (ROE)

$profitability_{d}ata$ROE <- $profitability_{d}ata$\$NetIncome / $profitability_{d}ata$\$ShareholderEquity

Load the ggplot2 library

library(ggplot2)

Create a ROA Plot

$roa_{p}lot$ <- ggplot($profitability_{d}ata$, aes(x = as.factor(Year), y = ROA)) + $geom_{b}ar$(stat = ”identity”, fill = ”green”) + labs(title = ”Return on Assets (ROA) Over 5 Years”,x = ”Year”, y = ”ROA”) + $theme_{m}inimal$()

Create a ROE Plot

$roe_{p}lot$ <- ggplot($profitability_{d}ata$, aes(x = as.factor(Year), y = ROE)) + $geom_{b}ar$(stat = ”identity”, fill = ”purple”) + labs(title = ”Return on Equity (ROE) Over 5 Years”, x = ”Year”,y = ”ROE”) +$theme_{m}inimal$()

Display the ROA and ROE Plots

print(roa_plot)

print(roe_plot)

Assumptions

$num_simulations$ <- 10000 # Number of simulations

$assets_mean$ <- 16514170800 # Mean of Total Assets

$assets_sd$ <- 3373379580 # Standard Deviation of Total Assets

$liabilities_mean$ <- 14459949600 # Mean of Total Liabilities

$liabilities_sd$ <- 3355186432 # Standard Deviation of Total Liabilities

Initialize vectors to store results

$solvency_ratios$ <- numeric($num_simulations$)

Perform Monte Carlo simulation for (i in 1:num_simulations)

Generate random values

$total_assets$ <- rnorm(1, mean = $assets_mean$, sd = $assets_sd$)

$total_liabilities$ <- rnorm(1, mean = $liabilities_mean$, sd = $liabilities_sd$)

Calculate Solvency Ratio

$solvency_ratio < -total_assets/total_liabilities$

Store the result

$solvency_ratios[i] < -solvency_ratio$

} # Visualize the distribution of Solvency Ratios

hist($solvency_ratios$, breaks = 30, main = ”Solvency Ratio Monte Carlo Simulation”, xlab = ”Solvency Ratio”)

Assumptions

$num_simulations$ <- 10000 # Number of simulations

$current_assets_mean$ <- 3820749800 # Mean of Current Assets

$current_assets_sd$ <- 927620617 # Standard Deviation of Current Assets

$current_liabilities_mean$ <- 1802464800 # Mean of Current Liabilities

$current_liabilities_sd$ <- 332276551 # Standard Deviation of Current Liabilities

Initialize vectors to store results

$liquidity_{r}atios < -numeric(num_{s}imulations)$

Perform Monte Carlo simulation for (i in 1:$num_{s}imulations$)

Generate random values for Current Assets and Current Liabilities

$random_{c}urrent_{a}ssets$ <- rnorm(5, mean = $current_{a}ssets_{m}ean$, sd = $current_{a}ssets_{s}d$)

$random_{c}urrent_{l}iabilities$ <- rnorm(5, mean = $current_{l}iabilities_{m}ean$, sd = $current_{l}iabilities_{s}d$)

Calculate Liquidity Ratio

$liquidity_{r}atio$ <- sum($random_{c}urrent_{a}ssets$) / sum($random_{c}urrent_{l}iabilities$)

Store the result

$liquidity_{r}atios$[i] <- $liquidity_{r}atio$

Visualize the distribution of Liquidity Ratios

hist($liquidity_{r}atios$, breaks = 30, main = ”Liquidity Ratio Monte Carlo Simulation”, xlab = ”Liquidity Ratio”)

Assumptions

$num_{s}imulations$ <- 10000 # Number of simulations

$net_{i}ncome_{m}ean$ <- 142649200 # Mean of Net Income

$net_{i}ncome_{s}d$ <- 179200001 # Standard Deviation of Net Income

$total_{a}ssets_{m}ean$ <- 16514170800 # Mean of Total Assets

$total_{a}ssets_{s}d$ <- 3373379580 # Standard Deviation of Total Assets

$shareholder_{e}quity_{m}ean$ <- 2054216000 # Mean of Shareholder’s Equity

$shareholder_{e}quity_{s}d$ <- 80473490 # Standard Deviation of Shareholder’s Equity

Initialize vectors to store results

$roa_{v}alues$ <- numeric($num_{s}imulations$)

$roe_{v}alues$ <- numeric($num_{s}imulations$)

Perform Monte Carlo simulation for (i in 1:$num_{s}imulations$)

Generate random values for Net Income, Total Assets, and Shareholder’s Equity

$random_{n}et_{i}ncome$ <- rnorm(5, mean = net$_{i}ncome_{m}ean$, sd = $net_{i}ncome_{s}d$)

$random_{t}otal_{a}ssets$ <- rnorm(5, mean = $total_{a}ssets_{m}ean$, sd = $total_{a}ssets_{s}d$)

$random_{s}hareholder_{e}quity$ <- rnorm(5, mean = $shareholder_{e}quity_{m}ean$, sd = $shareholder_{e}quity_{s}d$)

Calculate ROA and ROE

roa <- sum($random_{n}et_{i}ncome$) / sum($random_{t}otal_{a}ssets$)

roe <- sum($random_{n}et_{i}ncome$) / sum($random_{s}hareholder_{e}quity$)

Store the results

$roa_{v}alues$[i] <- roa

$roe_{v}alues$[i] <- roe

Visualize the distributions of ROA and ROE

par(mfrow=c(1,2)) # Create a 1x2 grid for plots

hist($roa_{v}alues$, breaks = 30, main = ”ROA Monte Carlo Simulation”, xlab = ”ROA”)

hist($roe_{v}alues$, breaks = 30, main = ”ROE Monte Carlo Simulation”, xlab = ”ROE”)

Create a data frame with the provided data

data <- data.frame(Year = c(2018, 2019, 2020, 2021, 2022), RiskFreeRate = c(0.126, 0.125, 0.11975, 0.13168, 0.14326))

Market risk premium

MRP <- 0.1486 # 14.86# Betas for the asset

Betas <- c(0.9, 1.0, 1.2)

Initialize a matrix to store the expected returns for different betas

$expected_{r}eturns_{m}atrix$ <- matrix(nrow = length(Betas), ncol = length(data$Year))

Calculate the expected returns using CAPM for each beta

for (i in 1:length(Betas))

expected_returns_matrix[*i*], <- data$RiskFreeRate + Betas[i] * MRP

Create a data frame with the years and expected returns for different betas

data_with_betas <- data.frame(Year = rep(data$Year, length(Betas)), ExpectedReturn = as.vector($expected_{r}eturns_{m}atrix$), Beta = rep(Betas, each = length(data$Year)))

# Visualize the expected returns using ggplot2
# Load the ggplot2 library
library(ggplot2)

# Create a bar chart
ggplot($data_with_betas$, aes(x = as.factor(Year), y = ExpectedReturn, fill = as.factor(Beta))) + $geom_bar$(stat = ”identity”, position = ”dodge”) + labs(title = ”Expected Returns for Your Asset (CAPM)”, x = ”Year”, y = ”Expected Return”, fill = ”Beta”) + scale_fill_brewer(palette = ”Set1”) + theme_minimal()

# Create a data frame with the provided data
data <- data.frame(Year = c(2018, 2019, 2020, 2021, 2022)
, RiskFreeRate = c(0.126, 0.125, 0.11975, 0.13168, 0.14326))

# Market risk premium
MRP <- 0.1486 # 14.86
# Beta for the asset
Beta <- 1.5
# Calculate the expected returns using CAPM
$expected_returns$ <- data$RiskFreeRate + Beta * MRP

Create a data frame with the years and expected returns
data$ExpectedReturn <- $expected_returns$

# Visualize the expected returns using ggplot2
# Load the ggplot2 library
library(ggplot2)

Create a bar chart

ggplot(data, aes(x = as.factor(Year), y = ExpectedReturn, fill = as.factor(Year))) + $geom_{b}ar$(stat = ”identity”) + labs(title = ”Expected Returns for Your Asset (CAPM)”, x = ”Year”, y = ”Expected Return”) + $scale_{f}ill_{b}rewer$(palette = ”Set1”) + $theme_{m}inimal$()

Appendix B

data

- https://www.cicinsurancegroup.com/wp-content/uploads/2022/02/CIC-Life-Assurance-Report-2018.pdf
- https://cicinsurancegroup.com/wp-content/uploads/2022/02/CIC-Life-Assurance-Report-2019-20-8-2020.pdf
- https://cicinsurancegroup.com/wp-content/uploads/2022/02/CIC-Life-Assurance-2020-22-06-2021.pdf
- https://cic.co.ke/wp-content/uploads/2022/06/CIC-Life-Assurance-Annual-Report-Financial-*Statements*$_2$021.pdf
- https://cic.co.ke/wp-content/uploads/2023/06/CIC-LIFE-Annual-Report-2022.pdf