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Retirement Benefits Authority

Safeguarding your retirement benefits.

The Determinants of Pension Growth in Kenya

Authored by: *Directorate of Research, Strategy and Planning Staff.*

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ABSTRACT

Pension funds serve as the primary source of income for most retirees in Kenya and significantly contribute to the country's GDP, accounting for 13%. Understanding the factors driving the growth of the pension industry is crucial. This study investigates the determinants of the growth of pension funds in Kenya aiming to identify and quantify the effect of these factors. It specifically seeks to understand the relationship between the different factors and how shocks to each factor affect pension fund value.

The paper investigated the effect of key scheme characteristics - total contributions, total membership, and investment incomes alongside general macroeconomic factors such as interest rates, interest rates and inflation, which affect all forms of investment in an economy. The paper took a quantitative approach utilizing both Regression and Vector Autoregressive Models to analyse quarterly data collected by the Retirement Benefits Authority between 2016 and 2023.

The findings of the survey revealed that interest rates and inflation significantly negatively influence fund value. Notably, exchange rates have a significant positive effect on fund value. On the scheme-specific side, total contributions, total membership, and investment income all have a positive impact on fund value, although their impacts vary in significance. The study also showed the utility of predictive models in forecasting the effects of shocks on different factors to fund value.

Based on the results, policy recommendations include, employing investment strategies that are conscious of the prevailing macroeconomic conditions,

encouraging higher contribution rates through offering incentives, and adopting diversified investment strategies to maximize fund growth.

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1.0 INTRODUCTION

1.0 Background

Most retirees depend on pension funds as their only source of income. This fact underlines the critical role that pension schemes play in the lives of retirees. By providing benefits to retirees, pension schemes end up affecting the savings and consumption decisions of firms and individuals (Yego et al., 2023). Pension funds also play an important role in the capital markets of most countries. By participating in capital markets, they end up stimulating their growth while at the same time substituting the role played by banks. In addition, according to Bijlsma et al., (2018), pension funds also contribute to deeper and more efficient capital markets by increasing funds available for private investment and improving efficiency and economic growth by enhancing the allocation of capital.

Over the years, the contributory pension model has spread globally from Bismarck's Germany. As most schemes in earlier years were unfunded, bigger numbers of workers retiring started straining the sustainability of these schemes. This led to the establishment and growth in popularity of defined contribution (DC) schemes. These types of schemes are however susceptible to various economic and fiscal pressures that affect their performance and growth. An ageing population and increasing life expectancy have increased the need for more robust pension schemes. While developed countries can meet this challenge by increasing pension funding, developing countries are still grappling with challenges related to coverage, adequacy and funding.

In Africa, the pension landscape is very diverse perhaps reflecting the continent's different economic and cultural contexts. However, a recurring problem in most African countries has been how to incorporate the informal sector, which employs a significant portion of the workforce, into the pension equation. In addition, economic fragility, political instability and lack of financial infrastructure have provided more challenges to the pension industry development in Africa. Due to these challenges, there is a growing recognition of the importance of pensions in ensuring social protection and economic stability, prompting reforms and innovations in several African countries.

Kenya, like most of its African counterparts, has undertaken many reforms to improve coverage and ensure good performance of the pension industry. Currently, the membership coverage is 26% of the working population indicating that one in four workers is a member of the retirement benefits scheme. As of June 2023, the value of retirement benefits assets under management stood at Ksh. 1.704 trillion which represented an 8.09% growth from the previous value of Ksh. 1.576 trillion reported in December 2022. Most of these assets are invested in government securities accounting for 47.79% of the total assets. In addition, there are 1028 registered retirement benefits schemes, covering a total of 7,467,537 members. Total contributions as of December 2022 amounted to Ksh 143.16 billion, representing a 5.65% growth compared to 2021. However, investment income earned in 2022 was Ksh 44.37 billion, indicating a significant drop from the 2021 figure of Ksh 153.43 billion, primarily due to unrealized losses (Retirement Benefits Authority, 2023).

1.2 The Concept of Growth

The growth of a pension fund refers to the increase in its size, value, and assets over time. This growth is crucial for the fund's ability to meet its obligations to retirees and beneficiaries. Several factors contribute to the growth of a pension fund.

1.2.1 Total Contributions

A retirement benefits scheme serves as a savings platform where individuals contribute regularly during their working years. These contributions are invested to generate returns. Upon retirement, members access their total contributions along with accrued net returns. Consistent contributions allow the fund to benefit from the compounding effect. The 2013 NSSF Act aims to improve retirement benefits by expanding coverage, allowing tier II contributions, and enhancing governance practices within the retirement sector.

Over the past decade, Kenya's pension funds have experienced remarkable growth. In 2009, total contributions were Ksh 33.659 billion, but by December 2022, they surged to Ksh 143.161 billion. This growth is attributed to the harmonization of the retirement benefits sector by the Retirement Benefits Authority and increased awareness of retirement planning. However, challenges arise from unremitted contributions, which currently stand at Ksh 45.764 billion as of

2022 (Retirement Benefits Authority, 2022). These unremitted contributions hinder pension fund growth by limiting investments, delaying compound interest, and eroding trust. Addressing this issue requires robust enforcement and collaboration among stakeholders to ensure consistent contributions to retirement benefits schemes.

1.2.2 Investment Income

Pension funds worldwide operate within a framework where contributed funds form a collective pool strategically invested across various asset classes. These investments aim to generate income for retirement benefits members' schemes. Upon retirement, members gain access to both their total contributions and the net returns accrued during their tenure in the scheme. Interest payments received from fixed-income securities, such as government bonds, significantly contribute to the fund's value over time. Similarly, dividends earned from equities (stocks) distributed by publicly traded companies enhance the fund's capital, fostering sustained growth.

As of December 2022, in Kenya, the total value of assets under the government securities class reached Ksh 745.1 billion. Guaranteed Funds followed closely at Ksh 308.7 billion, with immovable property and quoted equity at Ksh 241.7 billion and Ksh 213.83 billion, respectively. The investment income distribution for government securities stood at Ksh 85.79 billion, while guaranteed funds accounted for Ksh 22.75 billion. However, investment income declined in 2022 by 71.08%, dropping to Ksh 44.37 billion from Ksh 153.4 billion in 2021 (Retirement Benefits Authority, 2022). This decline is primarily attributed to higher interest rates leading to lower bond valuations. As Kenya's pension industry evolves, prudent investment strategies and effective risk management will continue to drive positive outcomes for members and the broader economy.

1.2.3 Total Membership

Kenya's retirement benefits sector operates within a dynamic framework where contributing members, new entrants, leavers, inactive members, and pensioners collectively shape the trajectory of pension funds. A higher influx of contributors at the start of a period leads to increased fund inflows. As new employees join the workforce, they become potential contributors to pension funds. Their

participation expands the membership base, injecting fresh capital into the system. Members who exit the workforce due to retirement or job changes impact pension funds. Managing the outflow of funds while maintaining a healthy balance is crucial for long-term viability and retirees' financial security.

According to the Retirement Benefits Authority (2023), the substantial membership base covered by pension schemes in 2022 was 7,467,537, which significantly influences the trajectory of pension funds in Kenya. Representing a coverage ratio of 26% of the working population**,** this membership base indicates that one in four workers is a member of a retirement benefits scheme. However, a critical challenge lies in the low coverage of the informal sector, where a significant portion of the workforce operates. Many informal workers lack access to formal pension schemes, resulting in underrepresentation. As new members enroll (385,075 in 2022, up from 352,768 in 2021), their contributions inject fresh capital into the system.

1.2.4 Interest Rates

Interest rates play a pivotal role in shaping the growth trajectory of pension funds in Kenya. The influence of interest rates on pension fund returns is profound. When higher interest rates, government bonds yield less returns. Conversely, during periods of low rates, the returns are usually high. Given that pension funds allocate a significant portion of their assets to government securities, they remain acutely sensitive to fluctuations in interest rates. Moreover, pension funds bear the responsibility of meeting future obligations to retirees, with these commitments calculated using discount rates tied to prevailing interest rates.

In 2022, pension fund investments yielded a weighted average return of 1.7%, while inflation averaged 7.64%. These returns directly impact the interest paid to savers on their contributions annually, accounting for administrative and fund management expenses. The previous year (2021) saw an average pension fund return of 11.6%, compared to an inflation average of 6.1% (Retirement Benefits Authority, 2023). The decline in returns was primarily due to declining equity performance at the Nairobi Securities Exchange (NSE), resulting in a loss of Sh600 billion in investor wealth. Equities investments by pension funds stood at a negative 14%, underperforming the benchmark NSE 20 share index, which dropped 11.9%. While fixed income returns remained relatively stable at 8%,

offshore assets experienced a significant decline with a return of -19.8% compared to the previous year's 18.5%. Diversification strategies included allocating an average of 21.8% to equities, 76.5% to fixed income, and 1.53% to offshore investments among the surveyed funds, emphasizing the importance of balancing risk and long-term stability.

1.2.5 Inflation

Pension fund growth faces significant challenges due to inflation, which manifests as a persistent increase in overall prices. As inflation rises, the purchasing power of money gradually erodes, impacting the real value of pension contributions. To safeguard retirees' benefits, pension funds must generate returns that outpace inflation. When inflation is high, there may be a shift away from fixed-income securities toward assets that offer better protection against inflation, such as equities or real estate. Additionally, pension funds have a crucial obligation to meet future promises made to retirees—their anticipated retirement benefits. Inflation affects the present value of these future payments, making it more expensive to fulfill these liabilities. Regulatory bodies closely monitor investment choices and risk management practices, ensuring adherence to guidelines while navigating inflation risks during 2023, inflation significantly impacted the growth of pension funds. Despite the challenging economic environment, pension schemes recorded a weighted average return of 1.4 percent, which was lower than the 1.7 percent return in 2022. Meanwhile, Kenya faced an average inflation rate of 7.7 percent, causing the average saver to lose value in real terms (Central Bank of Kenya, 2024). This marked the second consecutive year where pensions failed to outpace inflation. The decline in returns was attributed to an underperforming equities market and fair value losses on bond holdings due to rising yields. Asset allocation strategies shifted, with a decrease in equities allocation and an increase in fixed income and offshore investments.

1.2.6 Exchange Rate

Foreign exchange rates impact the valuation of pension fund assets denominated in foreign currencies. When the local currency depreciates, the value of foreign assets (such as offshore investments) increases in terms of the local currency. Conversely, a strengthening local currency reduces the value of these assets. Pension funds often diversify their portfolios by investing in global markets to

enhance returns and manage risk. Exchange rate movements introduce volatility. A favourable exchange rate can boost returns, while an unfavourable rate may erode gains. If these obligations are denominated in a different currency than the fund's assets, currency mismatches arise. Exchange rate fluctuations impact the cost of meeting liabilities. A depreciating local currency increases the burden.

1.2.7 Fund Value

Fund Value which is the net assets of a Retirement Benefits Scheme is calculated by summing the Assets under Management plus fixed Assets plus Current Assets less Current Liabilities. The fund value serves as a comprehensive measure of a pension fund's financial health, encompassing contributions from members and investment income. A higher fund value signifies robust financial strength. Member contributions directly impact this value, ensuring consistent funding. Pension funds strategically invest in diverse instruments—equities, fixed income, and real estate—to enhance returns. Investment income, including dividends, interest, and capital gains, bolsters the fund's value. Positive returns amplify the fund's capacity to provide meaningful benefits to retirees.

As of June 2023, the value of retirement benefits assets under management stood at Ksh. 1.704 trillion which represented an 8.09% growth from the previous value of Ksh. 1.576 trillion reported in December 2022. Most of these assets are invested in government securities accounting for 47.79% of the total assets (Retirement Benefits Authority, 2023). This growth was driven by a combination of factors including investment returns, contributions from members and employers, and new membership enrolment.

1.3 Statement of the Problem

The financial performance of pension schemes in Kenya is very critical, both to the economy and pension scheme members. Pension schemes are an important contributor to the economic wellness of the country. In addition, pension schemes should be able to adequately meet the financial obligations of their members. This underlines the need for extensive research on factors that may contribute to the growth of the sector.

Several studies have been conducted on the topic including research by Onyango (2020), and (Gathimba, 2017). However, it is important to note that several key

changes have occurred in the industry since these studies were published including the enactment of new NSSF rates, which has greatly improved contributions. The studies also do not explain the combined effect of the various variables on the financial performance of pension funds. This study will therefore aim at addressing the existing research gaps and attain the following research objective.

1.4 Research objective.

1.4.1 General Objective

The main objective of the study is to analyse the determinants of the growth of pension funds in Kenya.

1.4.2 Specific Objective

i. To quantify and analyse the impact of total contributions on the growth of pension funds in Kenya.
ii. To assess and measure the influence of investment income on the growth trajectory of pension funds in Kenya.
iii. To evaluate and examine how total membership impacts the growth of pension funds in Kenya.
iv. To determine and analyse the effect of exchange rate fluctuations on the growth of pension funds in Kenya.
v. To establish and quantify the influence of interest rates on the growth of pension funds in Kenya.
vi. To investigate and assess the impact of inflation on the growth of pension funds in Kenya.
vii. Identify the sensitivity of fund value to changes in investment returns, investment income, inflation, interest rates, exchange rates, total membership, total contribution
viii. Forecast the future impact on investment returns, investment income, inflation, interest rates, exchange rates, total membership, and total contributions.

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of theories, past studies, and other relevant material related to the analysis of determinants of the growth of pension funds in Kenya.

2.2 Theoretical Review

This section examines the theoretical foundation of the study. The anchor theories for the study were the Modern Portfolio Theory (Markowitz, 1952), The Life Cycle Theory (1950), and the Efficient Market Hypothesis (EMH 1960s). The life-cycle theory of pension fund growth advises investors to adjust their asset allocation according to their changing risk appetite as they grow older. Younger investors are encouraged to invest more in riskier assets such as stocks, while older investors are advised to invest more in less risky assets such as bonds. Modern Portfolio Theory posits that risk and return are correlated positively and an investor can therefore build an efficient frontier of optimal portfolios. The theory is hinged to this study as it applies to the investment of pension funds. Investment managers seek to build diversified portfolios that minimize total risk and maximize returns.

2.2.1 The Life Cycle Theory

The life-cycle hypothesis of consumption and saving, proposed by economists Franco Modigliani and his student Richard Brumberg in the early 1950s, is the basis of the life-cycle theory of pension funds growth. The hypothesis suggests that individuals plan their spending over their entire lives, considering their future income, and try to maintain a consistent level of consumption over time (Ando & Modigliani, 1963).

The life-cycle theory objects to the earlier classical Keynesian Model, which asserted that people tend to increase their spending with an increase in income. Instead, the theory proposed that throughout their lives, people tend to make rational decisions on their consumption and savings by considering their unique circumstances and future goals (Szenberg & Ramrattan, 2008).

The life-cycle theory of pension fund growth advises investors to adjust their asset allocation according to their changing risk appetite as they grow older. Younger investors are encouraged to invest more in riskier assets such as stocks, while older investors are advised to invest more in less risky assets such as bonds. This is

because younger investors have more time to recover from any losses, while older investors have less time to recover and need to protect their capital.

The theory also accounts for the replacement ratio, which is the ratio of the pension benefit to the pre-retirement income. The higher the replacement ratio, the more cautious the asset allocation should be. The life-cycle theory of pension fund growth has been adopted by many pension funds around the world to devise optimal asset allocation strategies for their members.

However, the theory also has some drawbacks. Critics argue that the theory ignores the effect of family size on the consumption and saving patterns of individual lives. It predicts that as a nation's incomes increase, a savings surplus will occur, and aggregate demand and economic output will decline. This is because people would save more for higher future consumption, but this would lower the current consumption and investment.

2.2.2 Modern Portfolio Theory (MPT)

According to Markowitz (1952), the theory posits that risk and return are correlated positively and an investor can therefore build an efficient frontier of optimal portfolios. These portfolios offer the highest return for each given risk level. The theory lays the foundation for the mathematical design of the theory of diversification. The goal is to select a portfolio that has collectively a lower total risk than any of the assets, taken in isolation.

The management of pension assets is very important since it directly affects the quality-of-life retirees get to enjoy at the end of their working life. Therefore, it is crucial to manage risk while making investment decisions effectively. The aim for pension fund managers is to minimize risk while maximizing the returns to their members. Modern portfolio theory provided a solution to this problem by introducing the mean-variance model, which has been widely used in various investment portfolios (Obed, 2018).

The model subscribes to some assumptions, some related to how investors behave. The first assumption is that investors believe that for each investment alternative, the expected returns are normally distributed over the period they will hold the asset. Investors therefore estimate fund risk based on the variability of the projected returns. They maximize expected utility, and their decisions are driven

largely by the return they expect, and the risk faced. There is thus an assumption that investors determine asset allocation under a single-period perspective. It is further assumed that investors choose higher returns when confronted with a choice between higher and lower returns (investors are rational). It is also assumed that investors choose lower risk when faced with a choice between higher and lower risk, for the same level of expected returns (Nyaga, 2014). This implies that an investor would decline a portfolio if there were an alternative one offering higher return for lower risk. The theory also assumes high market efficiency where market prices reflect all available information.

The theory has limitations, including focusing on total risk instead of systematic risk when measuring fund or portfolio risk. The relevant investment risk is the non-diversifiable risk but not the total risk. The second criticism is related to the assumption about the existence of a probability distribution of investment returns. In practice, returns may not follow the normal probability distribution or indeed any symmetric distribution (Ahmed, 2018). This theory is hinged to this study as it applies to the investment of pension funds. Investment managers seek to build diversified portfolios that minimize total risk and maximize returns. Pension schemes also report returns on a single-period basis usually annually, thus the theory is applicable as the pension fund members evaluate the annual return earned by the fund. Finally, the theory's assumption of the rational investor applies to pension fund members as they prefer a higher return to a lower return.

2.2.3 Efficient Market Hypothesis (EMH)

The efficient market hypothesis is a hypothesis that states that asset prices in the market reflect all available information. It further argues that the returns that investors receive from their investments should be in harmony with the level of risk that they take (Leković, 2018). The hypothesis advocates that due to the assets incorporating all relevant information, investors cannot consistently achieve returns above the average market research. The hypothesis can be classified into weak, semi-strong, and strong forms of EMH.

The weak form of EMH assumes that asset prices reflect all historical market data and thus one cannot use such data to predict future price movements. Therefore, any technical analysis that claims to rely on historical data to predict future market trends is useless. The semi-strong form of EMH argues that asset prices adjust

rapidly to any public information that is released. This includes information such as earnings and dividends announcements and any macroeconomic information released to the public. This means that it is not possible to consistently predict overvalued or undervalued assets by relying on available public information. Lastly, Strong Forms of EMH states that no one in the market holds a monopoly of information, therefore, asset prices reflect all information from private and public sources. This means that even with insider information, it is impossible to consistently outperform the average market returns.

EMH can be applied in the pension industry in the strategies that fund managers choose. Since it is impossible to consistently beat the market, it is wise for managers to choose passive trading strategies that aim at matching market returns. However, even if EMH assumes information efficiency, it is important to still consider macroeconomic factors such as interest rates, inflation rates, and exchange rates when making investment decisions. Whereas the theory provides a framework for understanding market efficiency, it is still important to combine it with practical considerations such as the effects of macroeconomic factors on fund performance.

2.3 Empirical Literature

2.3.1 International Studies

Ajibade et al., (2018), conducted a study to compare fund characteristics and financial performance in Nigeria. The characteristics chosen were the age of the fund, expenditure, contribution density, and idle contributions. The study indicated that the value of the fund as of the end of 2017 stood at N7.5 trillion. It also noted the vital role that pension funds play in the Nigerian economy. Using secondary data collected by 11 pension administrators and the National Pension Commission between 2010 – 2016, the study utilized multiple regression analysis to analyse the data. The study concluded that age, contribution density, and idle contributions had a significant effect on financial performance. However, expenditure did not have any impact on financial performance. As per the results, pension schemes perform better the older they get, the smaller the funds they manage and they have adequate idle contributions.

Zubair (2016), conducted a study examining the impact of pension fund investments on Nigeria's capital market performance, with a focus on how pension

industry reforms contribute to ensuring income security in old age and fostering financial market development. The research revealed a 1.75% growth in pension scheme membership in the first quarter of 2016, with total monthly contributions amounting to N3.55 trillion. Employing a time series analysis covering the period from 2009Q3 to 2016Q1, the study utilized the Autoregressive Integrated Moving Average (ARIMA) regression technique. Results indicated a significant positive relationship between pension fund investments and capital market performance following the 2004 industry reform, particularly in enhancing market depth and liquidity (measured by market capitalization and value traded). Additionally, the study underscored the impact of macroeconomic indicators such as interest rates, inflation, and GDP per capita on capital market performance in conjunction with pension investments. The findings emphasise the importance of stable monetary policies in achieving the objectives of pension industry reforms and ensuring adequate resources for retirees' financial security in Nigeria.

Ofori-Abebrese et al. (2017), explored macroeconomic factors' effects on Ghana's pension benefits, focusing on the Social Security and National Insurance Trust. Employing the Auto-regressive Distributed Lag Model, they investigated the influence of key economic indicators over both short and long-term periods. The findings suggest that inflation adversely affects pension benefits, while the impact of monetary policy rate increases, and currency depreciation is transient. The study underscores the significance of the 2008 National Pension Reform and concludes that long-term stabilization of pension benefits is less likely to be achieved through monetary policy rate reduction or currency appreciation due to their minimal impact. Instead, controlling inflation is recommended as the most effective strategy for ensuring retirees' long-term financial security.

Ogonda and Okiakpe (2022), conducted a study exploring the indirect influence of pension funds on economic growth in Nigeria via the financial system. Utilizing the Autoregressive Distributive Lag (ARDL) model, the research discovered that pension fund contributions effectively stimulate growth by investing in portfolios yielding short-term returns. This suggests that pension fund contributions alone, without a reliable financial system, do not significantly impact economic growth. The policy implication derived from this study suggests that Pension Fund Administrators (PFAs) should allocate investments towards portfolios with short-term returns. Consequently, a substantial portion of funds invested in federal

government securities should be diversified into other portfolios offering short-term returns.

Aniqa Arslan et al. (2020) conducted a study aimed at identifying the factors influencing the financial sustainability and growth of Turkish pension funds. The research sought to examine how firm-level characteristics such as size, age, contribution levels, earnings before interest and taxes (EBIT), board competency, board size, operational risk, administrative expenses, and effective tax rates relate to the sustainability of pension funds. Utilizing a dynamic panel data model, the study analysed data from fifteen pension companies spanning the period from 2005 to 2017. The findings indicate that factors including financial sustainability, firm size, firm age, contributions, income, and board competency exhibit significant and positive impacts on the financial sustainability of pension funds.

Yan & Foong (2020), investigated the role that fees, fund segregation, and management companies play in influencing investment performance in select Asian Countries of Hong Kong, Malaysia, Thailand, South Korea, and Singapore. The study used a sample of 931 pension schemes, where they obtained 6 years' worth of monthly data. Net and Gross returns were used to evaluate the impact of the various variables on the investment performance of the funds. Findings showed that most private schemes in Asian countries already had poor performance, even before consideration of fee payments. However, management fees also play a role in lowering the performance of the pension funds. Pension schemes that had higher management fees generally reported lower investment returns than their counterparts. This contrasts with the findings by Ajibade et al., (2018), which found that in Nigeria, management fees did not have a significant impact on pension fund investment performance.

2.3.2 Local Studies

Omollo et al. (2021) conducted a study that aimed to investigate the financial structure and growth of pension funds in Kenya, using data from 2009 to 2018. The study used descriptive statistics, correlation analysis, and regression analysis to examine the relationship between pension fund assets, liabilities, income, and expenses. The study discovered that pension fund assets and income have increased considerably over the years, while liabilities and expenses have stayed relatively low. It further reported that pension funds are growing rapidly and are

a reliable source of investment funds for the domestic financial markets. As a result of their active participation in the financial markets, the study further noticed that investment income is the main factor of pension fund growth, followed by contributions and transfers.

Onyango (2020) carried out a study on factors affecting the financial performance of pension schemes in Kenya. The study considered factors such as risk management, membership age, members' contribution, and size of the firm to determine their effect on the financial performance of the pension schemes. The study findings indicated that the financial performance of pension schemes in Kenya was strongly correlated with risk management, member contributions, and the size of the firm. However, the study did not find a significant correlation between the scheme's financial performance and the age of scheme members. Using these findings, pension schemes should take advantage of the growing amounts of contributions and put in place adequate risk management measures to ensure they post attractive returns to their members.

While attempting to identify the effect of fund characteristics on the financial performance of pension schemes in Kenya, Waweru (2021) analysed the effect of portfolio mix, liquidity, fund size, and operational expenses on schemes' financial performance. The research employed a sample of 93 pension schemes out of the then-registered 1340 schemes. Analysis of the data revealed that portfolio mix, and fund size had a positive correlation with the financial performance of the schemes. This agrees with the findings by Onyango (2020) who also found that portfolio mix was also positively correlated with pension funds' financial performance. The study did not find any correlation between liquidity, and operating costs with financial performance. The results indicate an R^2 of 0.333, which means that the selected variables could only explain 33.3% of the noted variations in performance. This means that over 66% of the variation can be explained by factors that were out of the scope of the research. This fact calls for the need to research while considering additional variables.

Kipruto (2019) investigated the relationship between the density of the contributions and the financial performance of pension schemes in Kenya. The study used panel data from 49 pension schemes for the period 2009-2018 and applied multiple regression analysis. The study also discovered that expenditure

and idle contributions had a negative and significant relationship with the financial performance of pension schemes, while fund governance had a positive and significant relationship.

Akwimbi (2018) sought to evaluate the impact of corporate governance, investment strategy, inflation rate, interest rate, exchange rate, and GDP growth rate on the performance of pension funds in Kenya. Using annual data from 1997 to 2018, a linear regression model was used to evaluate the effect of the variables on the performance of the pension funds. The results showed that the factors had a significant impact on financial performance. However, their level of significance varies, with the exchange and interest rates having the highest impact on performance. The study findings suggested that different factor risks, both systematic and non-systematic, needed to be taken into consideration when making investment decisions.

Gathimba (2017), examined how pension fund assets in Kenya are affected by the growth in the equity market, interest rates, and inflation. The study applied descriptive statistics to analyse the distribution and regression analysis to explore the relationship between the growth of pension fund assets and growth in the equity market, interest rates, and inflation. The study used multiple regression analysis to assess the impact of Equity Growth, Interest Rates, and Inflation on the growth of Pension Funds' Assets in Kenya. The study reported an adjusted R-squared value of 0.889, indicating that there is an 88.9% probability that changes in interest rate cause changes in Pension Fund Assets in Kenya. The study further established that equity growth had a positive impact on pension schemes' assets. With equity markets growing by one unit, pension fund assets grew by 4.362 units. The same results were observed with interest rates, whereby an increase in interest rates coincided with growth in pension fund assets. The data implies that inflation movements do not hinder the growth of pension fund assets. The study shows that when inflation reached the highest levels, the growth in pension fund assets was also the highest. Interest rate volatility was however found to impact pension fund assets negatively.

Wanyeki (2019) delved into the influence of macroeconomic elements on the National Social Security Fund's (NSSF) financial outcomes in Kenya. Utilizing an economic model and statistical tests such as the Johansen cointegration test,

Granger causality test, and Vector Autoregressive model, the study fitted a regression model to the data. The analysis indicated that the Gross Domestic Product (GDP), exchange rates, and inflation rates significantly and positively impacted NSSF's financial health. While interest rates also contributed positively, their effect was minor relative to other factors. The research further uncovered a cointegrating relationship among these variables, suggesting that, over time, interest rates and inflation rates might negatively impact NSSF's financial performance, with their significance diminishing in the long-term forecast.

Wanjiku (2014) conducted a study on how portfolio returns of the pension industry in Kenya are influenced by macroeconomic variables. The study found that the selected macroeconomic variables had a strong impact on pension funds' industry return, with exchange rates being the most influential and interest rates being the least influential. The study calculated an R2 of 0.533, which demonstrates a positive and strong correlation between the selected variables and industry returns. The study results showed that exchange rates, inflation rates, and interest rates are macroeconomic factors that have a negative relationship with pension funds' returns, while GDP growth has a positive relationship. Thus, the study supports and confirms the researcher's hypothesis that the performance of the pension fund industry is affected by key macroeconomic factors such as GDP growth, inflation, exchange rate, and interest rates.

2.4 Research Gaps

While a wealth of knowledge exists on the topic, there still exists a comprehensive research gap on the effect of the various variables on pension fund growth. Most of the available research was conducted using data collected before 2020. Recent changes to the retirement benefits sector including the introduction of new NSSF rates could have an impact on the validity of these findings. Therefore, it is important to conduct research using more up-to-date data.

There is also a scarcity of studies that combine all the dependent variables under investigation. Although studies such as that by Omollo et al., (2021) sought to investigate the factors behind the growth of pension funds in Kenya, they did not include all the variables that this study seeks to include. There are no studies that combine the effect of various macroeconomic variables with other pension scheme characteristics in investigating the effect of these variables on the growth of the

industry. The study seeks to bridge this gap by using the independent variables, investment income, inflation, interest rates, exchange rates, total membership, and total contributions.

2.5 Conceptual Framework

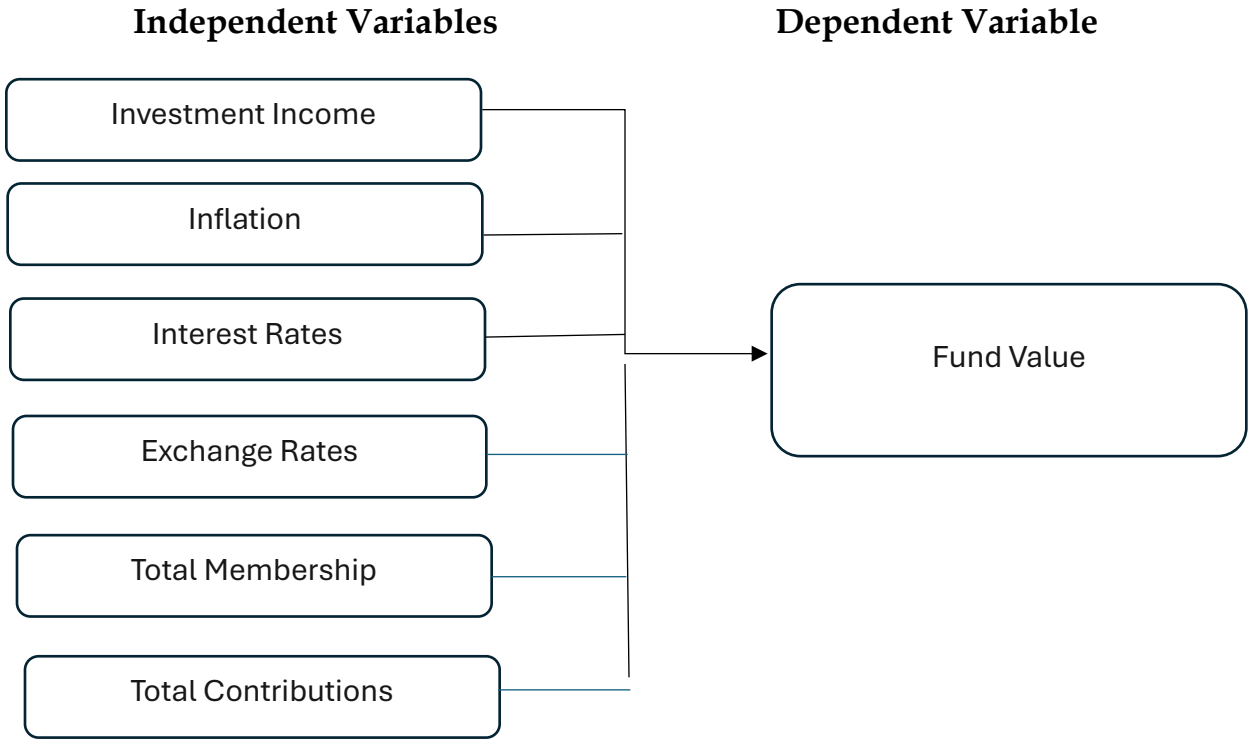

Table 1: Conceptual Framework

3.0 RESEARCH METHODOLOGY

This chapter describes the methods, techniques and procedures used to arrive at the conclusions. It provides an of the research design, data collection, variables, data analysis techniques, data analysis techniques, model specifications and validation and reliability.

3.1 Research Design

This paper integrated both regression analysis and Vector Autoregression (VAR) modelling to achieve it objectives. The research incorporated these methodologies to leverage on their respective strengths in understanding and unravelling the relationship between the various variables.

3.2 Data Collection

The study utilized secondary data with the sources indicated in Table 1.

Table 2: Data Sources

Variable	**Source**
Fund Value	RBA Database
Inflation	Central Bank of Kenya Website
Interest Rates	Central Bank of Kenya Website
Exchange Rates	Central Bank of Kenya Website
Total Contributions	RBA Database
Total Membership	RBA Database
Investment Income	RBA Database

3.3 Data Processing and Analysis Using Regression Analysis

3.3.1 Defining the Regression Model

A multiple Linear regression model was specified as shown in Equation 1 to represent the relationship between the dependent variable and the 6 independent variables.

$$FV = \beta_0 + \beta_1 INF + \beta_2 IR + \beta_3 EXR + \beta_4 TC + \beta_5 TM + \beta_6 II + \epsilon$$

Equation 1: Linear regression Equation sample

Where:

- *FV*: Fund value (dependent variable)
- *INF*: Inflation
- *IR*: Interest rates
- *EXR*: Exchange rate
- *TC*: Total contributions
- *TM*: Total membership
- *II*: Investment income
- β_0: Intercept term
- β_1, β_2, β_3, β_4, β_5, β_6: Coefficients for the respective independent variables
- ϵ: Error term

3.3.2 Diagnostic Tests

Diagnostic tests were performed to determine the validity of the model. This study conducted normality, autocorrelation, heteroscedasticity, and multicollinearity tests.

i. Normality tests

The normality test assesses whether the residuals (errors) of the regression model are normally distributed. This assumption is crucial for conducting valid hypothesis tests and constructing confidence intervals for the regression coefficients. The Shapiro-Wilk test was used to test for normality.

ii. Autocorrelation

The autocorrelation test examines whether the residuals are independent across observations. In time series data, this is particularly important because autocorrelation can lead to inefficient estimates and invalidate statistical tests. This study utilized the Durbin Watson (DW) to test for autocorrelation across observations.

iii. Heteroscedasticity

The heteroscedasticity test checks whether the variance of the residuals is constant across all levels of the independent variables. Heteroscedasticity can

lead to inefficient estimates and biased standard errors, which affect hypothesis testing. Heteroscedasticity was tested using the Breusch-Pagan test.

iv. Multicollinearity

The multicollinearity test evaluates whether there are high correlations among the independent variables. Multicollinearity can inflate the variances of the regression coefficients, making them unstable and difficult to interpret. Multicollinearity assessment was conducted using Variance Inflation Factor (VIF) and Tolerance (TOL) values for the predictors in this paper's regression model.

3.4 Data Analysis Using Vector Autoregression (VAR) Modelling

3.4.1 Defining the Vector Autoregression (VAR) Model

In a VAR model, each variable is modelled as a linear combination of past values of itself and the past values of other variables in the system of equations. Let's say we need to predict the values of the time series Fund Value (FV) at time t. For instance, to predict the value of the time series Fund Value at time *t,* (FV_t), VAR will use the past values of both FV_t as well as the past values of the independent variables (INF, IR, EXR, TC, TM, II).

Given in Equation 2 is the system of equations for a VAR (2) Model with one dependent variable (FV) and six independent variables:

$$FV_t = \beta_0+\beta_{11}FV_{t-1}+\beta_{12}INF_{t-1}+\beta_{13}IR_{t-1}+\beta_{14}EXR_{t-1}+\beta_{15}TC_{t-1}+\beta_{16}TM_{t-1}+\beta_{17}II_{t-1}+\varepsilon_{FVt} \quad \text{(i)}$$

$$IN_{Ft}=\beta_0+\beta_{21}FV_{t-1}+\beta_{22}INF_{t-1}+\beta_{23}IR_{t-1}+\beta_{24}EXR_{t-1}+\beta_{25}TC_{t-1}+\beta_{26}TM_{t-1}+\beta_{27}II_{t-1}+\varepsilon_{INFt} \quad \text{(ii)}$$

$$IR_t=\beta_0+\beta_{31}FV_{t-1}+\beta_{32}INF_{t-1}+\beta_{33}IR_{t-1}+\beta_{34}EXR_{t-1}+\beta_{35}TC_{t-1}+\beta_{36}TM_{t-1}+\beta_{37}II_{t-1}+\varepsilon_{IRt} \quad \text{(iii)}$$

$$EXR_t=\beta_0+\beta_{41}FV_{t-1}+\beta_{42}INF_{t-1}+\beta_{43}IR_{t-1}+\beta_{44}EXR_{t-1}+\beta_{45}TC_{t-1}+\beta_{46}TM_{t-1}+\beta_{47}II_{t-1}+\varepsilon_{EXRt} \quad \text{(iv)}$$

$$TCt = \beta_0+\beta_{51}FV_{t-1}+\beta_{52}INF_{t-1}+\beta_{53}IR_{t-1}+\beta_{54}EXR_{t-1}+\beta_{55}TC_{t-1}+\beta_{56}TM_{t-1}+\beta_{57}II_{t-1}+\varepsilon_{TCt} \quad \text{(v)}$$

$$TM_t=\beta_0+\beta_{61}FV_{t-1}+\beta_{62}INF_{t-1}+\beta_{63}IR_{t-1}+\beta_{64}EXR_{t-1}+\beta_{65}TC_{t-1}+\beta_{66}TM_{t-1}+\beta_{67}II_{t-1}+\varepsilon_{TMt} \quad \text{(vi)}$$

$$II_t=\beta_0+\beta_{71}FV_{t-1}+\beta_{72}INF_{t-1}+\beta_{73}IR_{t-1}+\beta_{74}EXR_{t-1}+\beta_{75}TC_{t-1}+\beta_{76}TM_{t-1}+\beta_{77}II_{t-1}+\varepsilon_{IIt} \quad \text{(vii)}$$

Equation 2: System of equations for a VAR Model

3.4.2 Impulse Response Analysis (IRA)

Impulse response analysis is used to analyse the behaviour of variables when subjected to shocks in a VAR model. It helps to trace the effects of a one-time shock to one of the variables on the present and future values of the variables within the system. The impulse response function (IRF) measures the response of each variable in the system to a one-unit shock in one of the error terms, while holding all other shocks at zero. IRA was used in this paper to determine the effect that shocks on the independent variables have on Fund Value.

4.0 RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, we will present the results of our regression and time series analyses, specifically focusing on the factors that influence the Fund value. Our objective is to gain insights into the relationships between the Fund value and its predictors, encompassing interest rates, inflation, exchange rates, total contributions, total membership, and investment income. Initially, we will explore the regression analysis in-depth, outlining the methodology employed, key findings, and their implications. Subsequently, we will undertake an examination of the time series analysis, emphasizing trends, seasonal patterns, and the accuracy of forecasts. The ensuing discussion will integrate findings from both analytical methodologies, offering a comprehensive understanding of the data and valuable insights to support decision-making purposes.

4.2 Regression Analysis

The regression analysis aimed to identify the key predictors influencing the Fund variable and to quantify their impact. Using multiple linear regression, we assessed the significance of each independent variable, checked for multicollinearity, and validated the model through diagnostic tests.

4.2. 1 Model Specification and Estimation:

- **Model Formulation**: The regression model was specified as Fund Value=β0+β1Interest Rates+β2Inflation+β3Exchange Rates+β4Total Contributions+β5Total Membership+β6Investment Income+ϵ
- **Data Transformation**: Logarithms of the variables were used to meet the assumptions of linearity and normality.

- **Estimation Method**: Ordinary Least Squares (OLS) were used to estimate the parameters.

4.2.1 Summary Statistics

Table 3: Summary Statistics

	Fund Value	Inflation	Interest Rates	Exchange Rates	Total Contributions	Total Membership	Investment Income
mean	1,048,606,000,000	0.0637	0.0891	110.2656	24,056,870,000	668278	19,860,920,000
std	224,469,700,000	0.0164	0.0149	13.1037	5,995,348,000	98558	5,538,433,000
min	657,810,000,000	0.0399	0.0700	100.7055	14,360,660,000	424696	9,979,609,000
max	1,397,330,000,000	0.1080	0.1250	151.7673	40,032,550,000	810622	30,024,340,000
kurtosis	-1.0255	0.4425	-0.5076	3.3026	1.3699	-0.3334	-0.3590
skewness	-156476	0.9030	0.2320	1.9380	0.8884	-0.5586	0.2944

The summary statistics as indicated on Table 3, showed that inflation, interest rates, exchange rates, total contributions and investment income were positively skewed while fund value and total membership were negatively skewed.

4.2.2 Correlation Matrix

The correlation matrix highlights the relationships between variables. The relationships are shown on Table 4.

Table 4: Correlation Matrix

	Fund Value	Inflation	Interest Rates	Exchange Rates	Total Contributions	Total Membership	Investment Income
Fund Vale	1	0.098	-0.462	0.736	0.942	0.948	-0.074
Inflation	0.098	1	0.22	0.421	0.154	0.156	-0.161
Interest Rates	-0.462	0.22	1	0.146	-0.27	-0.438	-0.082
Exchange Rates	0.736	0.421	0.146	1	0.818	0.653	-0.225
Total Contributions	0.942	0.154	-0.27	0.818	1	0.896	-0.11
Total Membership	0.948	0.156	-0.438	0.653	0.896	1	-0.059
Investment Income	-0.074	-0.161	-0.082	-0.225	-0.11	-0.059	1

- There is a very strong positive correlation, indicating that higher total contributions are closely associated with higher fund values. This makes sense as more contributions directly increase the fund's value. (0.942)
- There is a very strong positive correlation, suggesting that an increase in membership significantly boosts the fund value. More members are likely to contribute more to the fund. A moderate negative correlation indicates that higher interest rates tend to be associated with lower fund values (-0.462).
- There is a strong positive correlation, suggesting that as exchange rates rise (potentially indicating a stronger domestic currency or favourable exchange conditions), the fund value increases. (0.736).
- There is a very weak positive correlation between fund value and inflation, suggesting that changes in inflation have a minimal direct linear impact on the fund value investment income is negatively correlated with investment (0.098).
- There is a very weak negative correlation, indicating that changes in investment income have a negligible direct impact on the fund value.

4.2.3 Model Fit and Adequacy

Table 5: Results of the Regression Analysis

Regression Statistics	
Multiple R	0.988299055
R Square	0.976735021
Adjusted R Square	0.971151427
Standard Error	0.038323677
Observations	32

As indicated in Table 5, the regression model explains 97.7% of the variability in Fund value, with an R-squared value of 0.977 and an adjusted R-squared value of 0.971 accounting for the number of predictors used.

Table 6: Results of the Anova

ANOVA					
	df	SS	MS	F	Significance F
Regression	6	1.54151751	0.256919585	174.9294225	3.59369E-19
Residual	25	0.036717606	0.001468704		
Total	31	1.578235116			

As further illustrated on Table 6, the model's highly significant F-statistic (174.9) and extremely low p-value (< 2.2e-16) indicate strong overall significance, and the low residual standard error (0.03832) confirms its accuracy in predicting Fund value.

4.2.4 Coefficients and Significance

The coefficients and their statistical significance in the regression model provide insights into the impact of each independent variable on the dependent variable (Fund value).

Table 7: Coefficients of the model and their significance

	Coefficients			
	Estimate	**Std. Error**	**t value**	**Pr(>|t|)**
Intercept	9.77798	1.10078	8.883	3.31e-09 ***
Inflation	-0.08951	0.03429	-2.61	0.015064 *
Interest Rates	-0.33222	0.06091	-5.455	1.15e-05 ***
Exchange Rates	0.76437	0.17056	4.481	0.000143 ***
Total Contributions	0.18692	0.09985	1.872	0.072931
Total Membership	0.62657	0.11421	5.486	1.07e-05 ***
Investment Income	0.01563	0.02457	0.636	0.530526

Following the above results, the regression model can be stated as shown in Equation 3 below: -

Fund Value = 9.77798 − 0.08951(Inflation) − 0.33222(Interest Rates) + 0.76437(Exchange Rates) + 0.18692(Total Contributions) + 0.62657(Total Membership) + 0.01563(Investment Income)

Equation 3: Regression equation Statement

i. **Intercept**

- **Estimate**: The intercept is 9.77798, which represents the expected log value of the Fund value when all independent variables are zero.
- **Significance**: With a p-value of 3.31e-09, the intercept is highly significant ($p < 0.001$). This strong significance indicates that the baseline level of the Fund value, independent of other variables, is reliably different from zero.

ii. **Inflation**

- **Estimate**: The coefficient for inflation is -0.08951, meaning that for a one-unit increase in inflation, the log value of the Fund decreases by 0.08951 units, holding other variables constant.
- **Significance**: The p-value is 0.015064, indicating that inflation is a significant predictor ($p < 0.05$), at the 5% significance level. This negative relationship suggests that higher inflation is associated with a decrease in the Fund value.

iii. Interest Rates

- **Estimate**: The coefficient for interest rates is -0.33222, meaning that for a one-unit increase in interest rates, the log value of the Fund decreases by 0.33222 units, holding other variables constant.
- **Significance**: The p-value is 1.15e-05, making interest rates highly significant ($p < 0.001$) at the 0.1% significance level. This strong negative relationship indicates that higher interest rates significantly reduce the Fund value.

iv. Exchange Rates

- **Estimate**: The coefficient for exchange rates is 0.76437, meaning that for a one-unit increase in exchange rates, the log value of the Fund increases by 0.76437 units, holding other variables constant.
- **Significance**: The p-value is 0.000143, indicating that exchange rates are highly significant ($p < 0.001$) at the 0.1% significance level. This positive relationship suggests that favourable exchange rate conditions significantly increase the Fund value.

v. Total Contributions

- **Estimate**: The coefficient for total contributions is 0.18692, meaning that for a one-unit increase in total contributions, the log value of the Fund increases by 0.18692 units, holding other variables constant.
- **Significance**: The p-value is 0.072931, suggesting that total contributions are marginally significant ($p < 0.001$) at the 10% level. This positive relationship indicates that higher total contributions likely

increase the Fund value, although the evidence is not as strong as for other variables.

vi. Total Membership

- **Estimate**: The coefficient for total membership is 0.62657, meaning that for a one-unit increase in total membership, the log value of the Fund increases by 0.62657 units, holding other variables constant.
- **Significance**: The p-value is 1.07e-05, making total membership highly significant ($p < 0.001$) at the 0.1% significance level. This positive relationship indicates that an increase in membership raises the Fund value.

vii. Investment Income

- **Estimate**: The coefficient for investment income is 0.01563, meaning that for a one-unit increase in investment income, the log value of the Fund increases by 0.01563 units, holding other variables constant.
- **Significance**: The p-value is 0.530526, indicating that investment income is not significant ($p > 0.001$). This suggests that changes in investment income do not have a statistically significant impact on the Fund value in this model.

4.2.5 Diagnostic Tests

- **Normality**: The residuals are normally distributed as shown in Figure 1 and confirmed by the Shapiro-Wilk test (P-value = 0.3561).

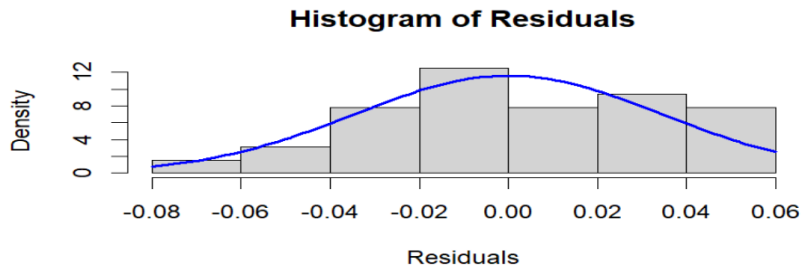

Figure 1: Histogram of the residuals

- **Autocorrelation**: The Durbin Watson (DW) test was used to test the presence of serial autocorrelation in the model. The DW measure obtained from the analysis was DW = 1.7697. Cooper and Schindler (2014) guide that a DW between 1.50 and 2.50 is tolerable hence the model is suitable for reliable regression results.
- **Heteroscedasticity:** Heteroscedasticity was tested using the Breusch-Pagan test. The assumption was that residuals have constant variance. The test yielded a test statistic (BP) of 6.5986 with 6 degrees of freedom, resulting in a p-value of 0. 3596 > 0.05. The regression model satisfies the assumption of constant variance of residuals. A residual versus fitted values plot did not reveal any discernible patterns that would indicate heteroscedasticity as shown in Figure 2.

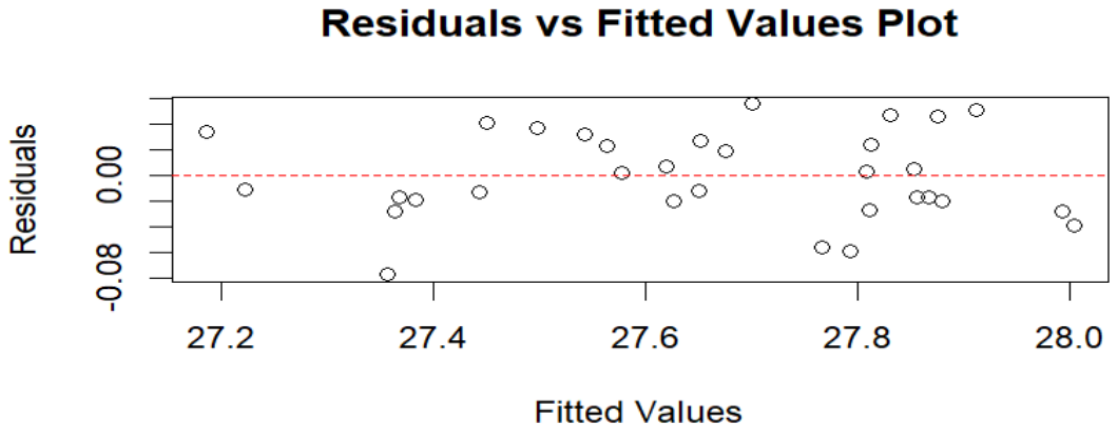

Figure 2: Residuals vs Fitted Values Plot

- **Implications:** Regression analysis identified significant predictors such as interest rates, exchange rates, total contributions, and total membership. These variables demonstrated varying degrees of influence on the Fund value, with membership and exchange rates showing particularly strong positive effects.
- **Predictive Power**: The regression model demonstrates strong predictive power, allowing for accurate estimation of the fund value based on significant predictors.
- **Policy Recommendations**: Policymakers should focus on managing inflation and interest rates, enhancing total contributions and membership to influence the fund effectively.

4.2.6 Multicollinearity

Multicollinearity assessment was conducted using Variance Inflation Factor (VIF) and Tolerance (TOL) values for the predictors in our regression model. Cooper and Schindler (2014) guide that VIF exceeding 10 would indicate the presence of multicollinearity that would be corrected by dropping one of the correlated variables. The results of the test are shown on Table 8.

Table 8: Results of the VIF Test

	Features	**VIF**
1	Fund Value	1.338603
2	Inflation	1.125012
3	Interest Rates	1.088142
4	Exchange Rates	1.154183
5	Total Contributions	1.087801
6	Total Membership	1.188647
7	Investment Income	1.128073

The VIF values are all below 2, which means that multicollinearity is not a concern in the model.

4.3 Time Series Analysis Using VAR Model

4.3.1 Plot of the Determinants

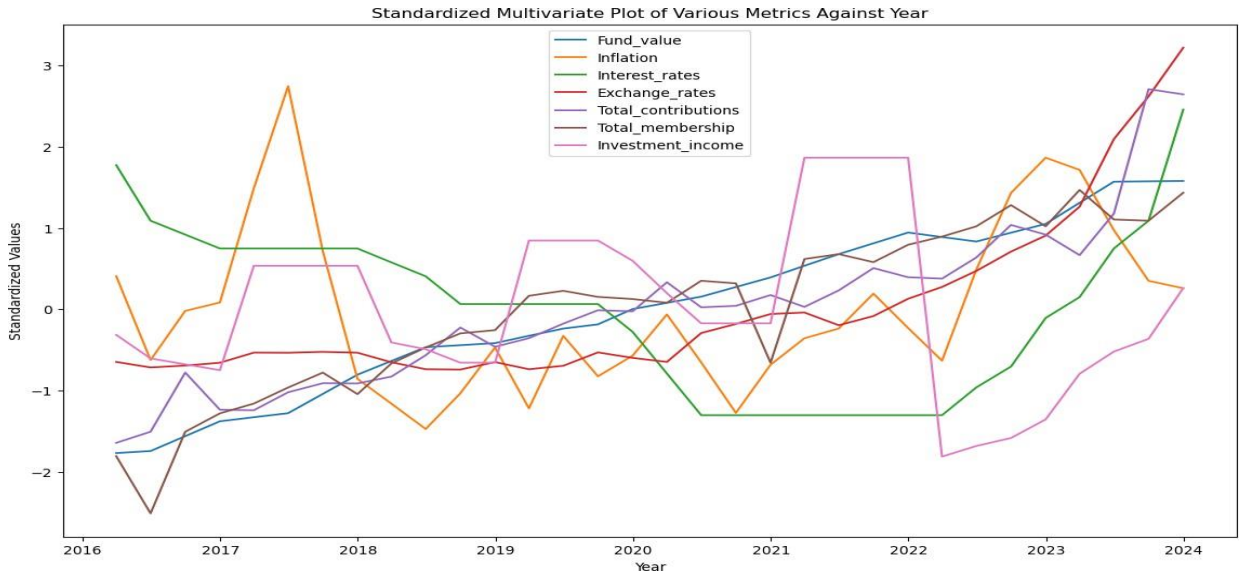

Figure 3: Time series plot of the variables

To assess stationarity among the time series model variables, quarterly data spanning from 2016 to 2023 was analysed, depicted in Figure 3. The variables examined include fund value, inflation, interest rates, exchange rates, total contributions, total membership, and investment income, each demonstrating nonstationary behaviour characterized by variability over time. Specifically, their mean, variance, and autocovariance exhibit notable fluctuations.

To achieve stationarity, all variables underwent first-order differencing, except for interest rates and exchange rates, which required second-order differencing. The decision to employ the Augmented Dickey-Fuller test was based on its recognized effectiveness in testing for stationarity among economic time series data.

4.3.2 Augmented Dickey-Fuller (ADF) Output

Table 9: Results of the Dickey Fuller test

		Critical value			
	ADF Test Stat	**0.01**	**0.05**	**0.1**	**P-value for Z(t)**
Fund Value	-4.4209	-3.7112	-2.9812	-2.6301	0.0003
Inflation	-4.361	-3.679	-2.968	-2.623	0.000
Interest Rates	-3.512	-3.700	-2.976	-2.628	0.008
Exchange Rates	-6.270	-3.689	-2.972	-2.625	0.000
Total Contribution	-5.665	-3.689	-2.972	-2.625	0.000
Total Membership	-6.550	-3.689	-2.972	-2.625	0.000
Investment Income	-4.835	-3.711	-2.981	-2.630	0.000

The Augmented Dickey-Fuller (ADF) test was employed to assess the stationarity of the variables—fund value, inflation, interest rates, exchange rates, total contributions, total membership, and investment income. The test statistics (-4.4209, -4.3607, -3.5120, -6.2702, -5.6653, -6.5500, -4.8354) for each variable exceeded the respective critical values at the 1% significance level as shown on Table 9, providing evidence to reject the null hypothesis of nonstationary. Correspondingly, the small p-values (0.0003 for fund value and inflation, 0.0077 for interest rates, and 0.0000 for exchange rates, total contributions, total membership, and investment income) further supported this rejection. These findings indicate that following differencing, the variables exhibit stable mean and variance characteristics essential for robust time series modelling and forecasting, affirming their stationarity.

4.3.3 Plot of Stationary Time Series

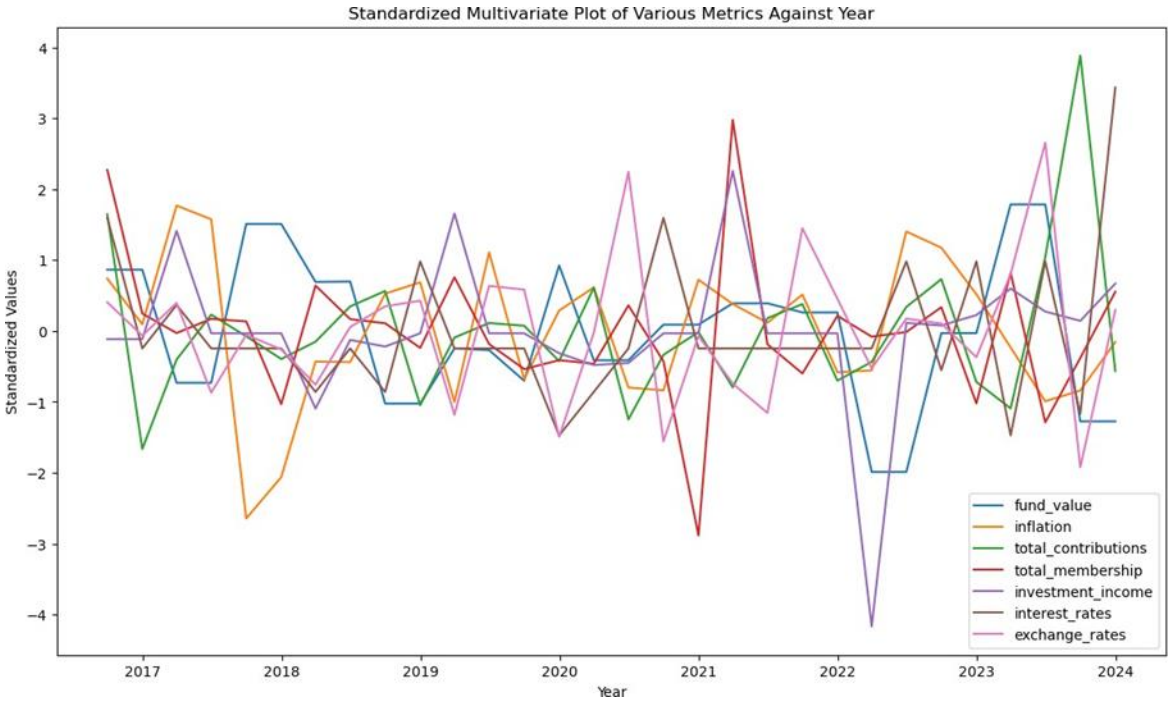

Figure 4: Differentiated Data time plot

After differencing, a plot of the variables was plotted to assess stationarity among the time series model variables, and quarterly data spanning from 2016 to 2023 was analysed, depicted in Figure 4. The variables examined include fund value, inflation, interest rates, exchange rates, total contributions, total membership, and investment income, each demonstrating stationary behaviour characterized by constant mean, variance and autocovariance over time.

4.3.4 Lag Order Selection Criteria

To determine the optimal lag, the paper used cross-validation using a range of potential lag values.

Cross-validation involves partitioning the data into training and validation sets multiple times to evaluate the model's performance. For each candidate lag length, the model is trained and validated.

The performance of each lag was evaluated using the Mean Squared Error (MSE). MSE measures the average of the squares of the errors measuring how the model's prediction measures up against the real values. The results of the model's evaluation are summarised in Table 10.

Table 10: Lag Order selection results

Lags	**MSE**
1	0.0084
2	0.0111
3	0.0134

From the table, the optimal lag length determined by cross-validation is 1. A lag value of 1 resulted in the lowest average MSE, indicating the best predictive performance among the tested lag values

4.3.5 Model fitting

Summary of Regression Results

Table 11: Summary of the VAR Model

```
  Summary of Regression Results
==================================
Model:                         VAR
Method:                        OLS
Date:           Wed, 17, Jul, 2024
Time:                      15:57:34
--------------------------------------------------------------------
No. of Equations:         7.00000    BIC:                   -12.7596
Nobs:                     29.0000    HQIC:                  -14.5730
Log likelihood:          -8.74589    FPE:                2.27252e-07
AIC:                     -15.3999    Det(Omega_mle):     4.12935e-08
--------------------------------------------------------------------
```

The output presents the results of a Vector Autoregression (VAR) model fitted using Ordinary Least Squares (OLS). The model includes 7 equations and was estimated using 29 observations as shown in Table 11. The information criteria

indicate a high level of model fit: the Akaike Information Criterion (AIC) is –15.3999, the Bayesian Information Criterion (BIC) is -12.7596, and the Hannan-Quinn Information Criterion (HQIC) is –14.5730. These values suggest that the model performs well in balancing goodness of fit with model complexity. The log-likelihood of –8.74589 and the Final Prediction Error (FPE) of 2.27252e-07 further support the adequacy of the model in capturing the relationships among the variables. The determinant of the asymptotic covariance matrix (Det(Omega_mle)) is 4.12935e-08, indicating that the model parameters are well-defined, and the estimated covariance matrix is well-conditioned.

4.3.6 Effects of the Independent Variables on Fund Value

i. Inflation on Fund Value

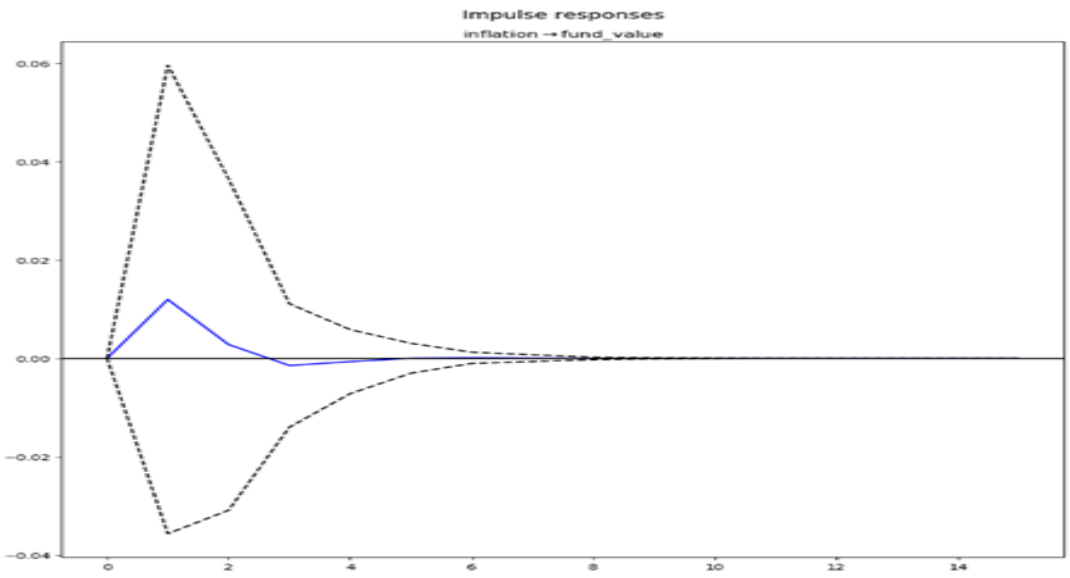

Figure 5: Impact of Inflation Shocks to Fund Value

Impulse Response Function (IRF) analysis of the fund value in response to a shock in inflation reveals several key dynamics over a 15-period horizon. As shown in Figure 5, initially, there is no immediate impact on the fund value. However, within the first two periods, the fund's value experiences a positive response, peaking at period 2, indicating a short-term increase due to the inflation shock.

This initial boost suggests that inflation may temporarily enhance the fund value, potentially due to short-term adjustments or market expectations. From periods 3 to 5, the response becomes negative, signifying that the ongoing effect of inflation turns detrimental to the fund value. This negative impact gradually diminishes, and by around period 8, the fund value's response returns to zero, demonstrating that the initial shock's effect neutralizes, allowing the fund value to stabilize back to its equilibrium level. The confidence intervals, depicted by dashed lines, indicate that these estimates are statistically reliable over the observed periods, lending credibility to the findings and suggesting robust conclusions about the transient nature of inflation shocks on fund value growth.

ii. Interest rates on Fund Value

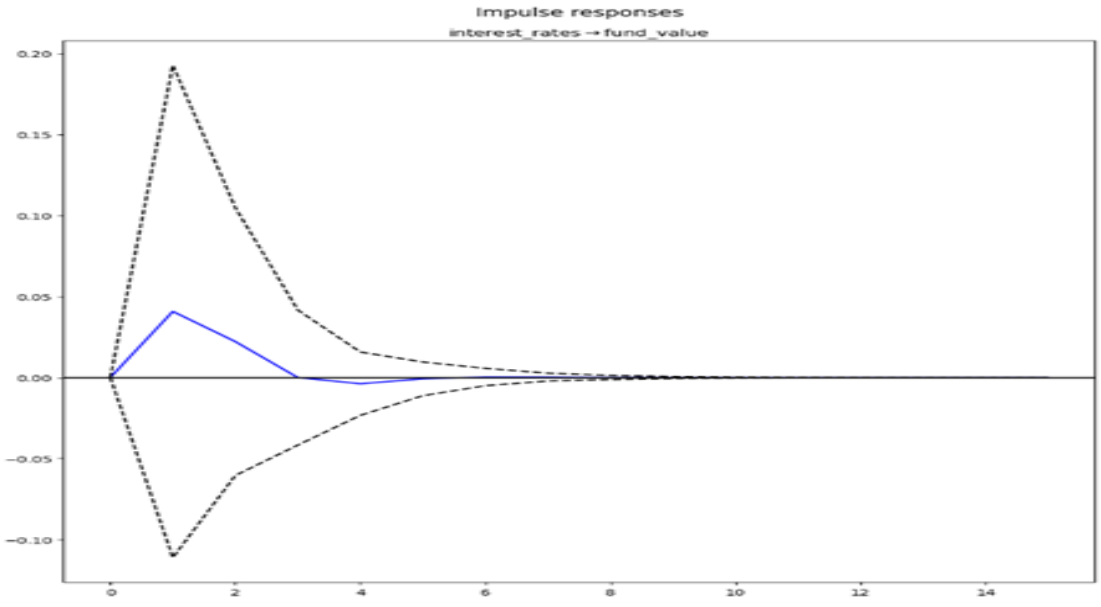

Figure 6: Impact of Interest Rates Shocks on Fund Value

The analysis of the fund value in response to an interest rate shock reveals several important dynamics over a 15-period horizon. Initially, there is no immediate impact on the fund value. However, within the first two periods, the fund experiences a positive response, peaking at period 2 as shown in Figure 7. This

suggests a short-term increase due to the interest rate shock. The initial boost indicates that interest rates may temporarily enhance the fund value, possibly due to short-term adjustments or market expectations. From periods 3 to 5, the response becomes negative, indicating that ongoing inflation negatively impacts the fund value. This negative effect gradually diminishes, and by around period 8, the fund value's response returns to zero. This demonstrates that the initial shock's effect neutralizes, allowing the fund value to stabilize back to its equilibrium level. The confidence intervals, represented by dashed lines, provide statistical reliability to these estimates over the observed periods, supporting robust conclusions about the transient nature of interest rate shocks on fund value growth.

iii. Exchange Rates on Fund Value

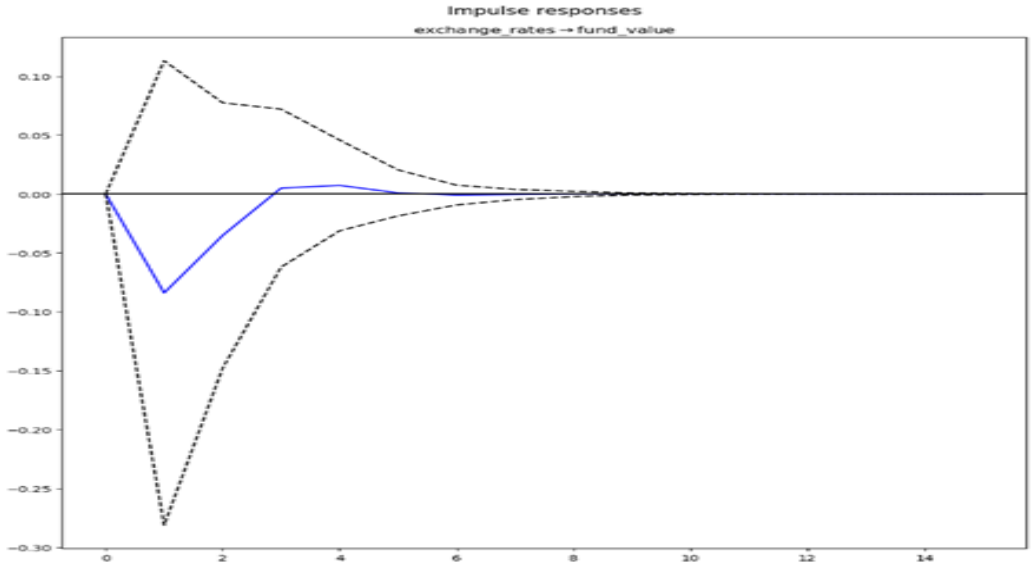

Figure 7: Impact of Exchange Rates Shocks on Fund Value

The Impulse Response Function (IRF) plot demonstrates that a shock to "exchange rates" initially causes a significant negative impact on "fund value," reaching its lowest point around the second period. Following this initial drop, the fund value begins to recover partially, with the response turning slightly positive around

periods 4 to 6, indicating a temporary improvement. However, this positive impact does not sustain, and the fund value returns to its equilibrium level by period 8, where it remains stable through to period 15. The dashed lines, representing the confidence intervals, suggest that these estimates are statistically reliable, highlighting that while exchange rate shocks can negatively affect fund value in the short term, the long-term impact neutralizes, allowing the fund value to stabilize.

iv. Total Contributions on Fund Value

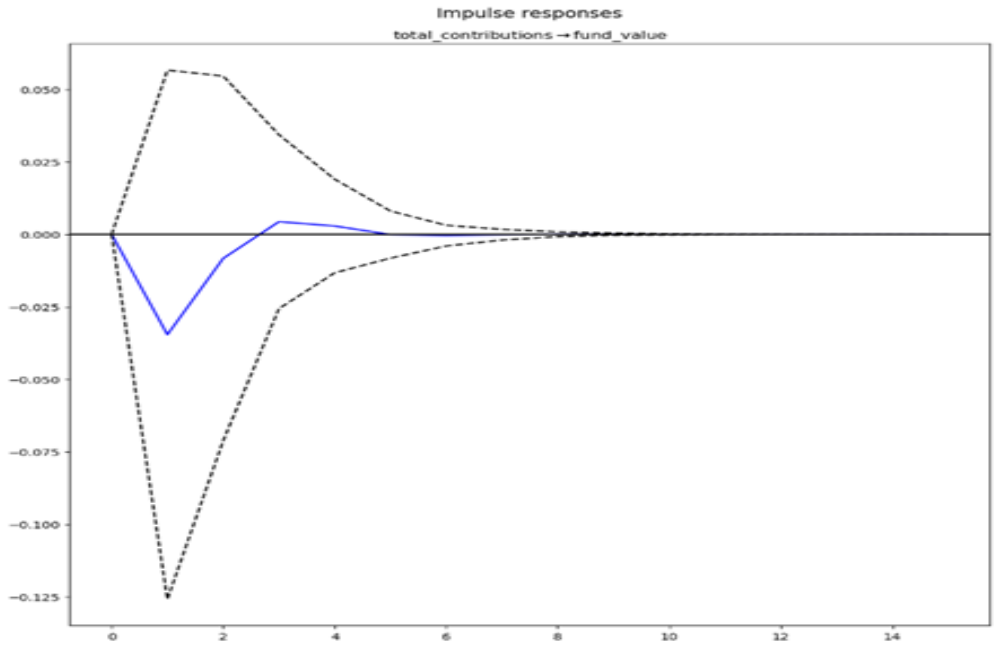

Figure 8: Impact of Total Contribution Shocks on Fund Value

The Impulse Response Function (IRF) plot on Figure 8 indicates that a shock to "total contributions" initially results in a significant negative impact on "fund value," with the lowest point occurring around the second period. Following this initial decline, the fund value begins to recover, moving towards zero and briefly turning slightly positive between periods 4 and 6. This suggests a short-term improvement, possibly due to adaptive measures or adjustments within the fund. However, this positive response is short-lived, and the fund value gradually

returns to equilibrium, stabilizing by around period 8 and remaining close to zero thereafter. The confidence intervals, represented by dashed lines, show that the estimates are statistically reliable, implying that while total contributions shocks negatively affect fund value in the short term, the long-term impact neutralizes, allowing the fund value to stabilize.

v. Total Membership to Fund Value

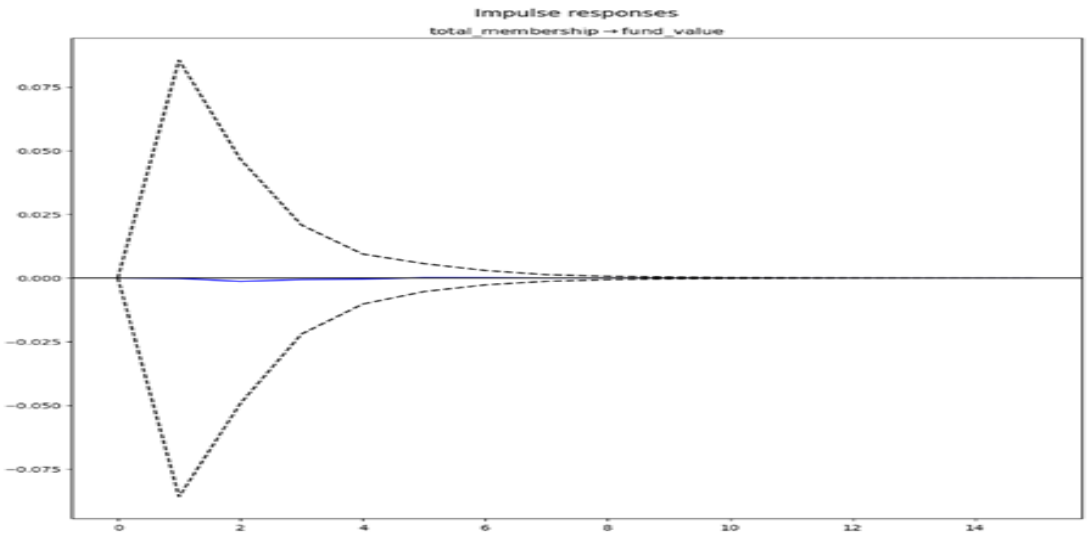

Figure 9: Impact of Total Membership Shocks on Fund Value

The impulse response analysis output shows how the growth of fund value responds to shocks in total membership over fifteen periods. The graph indicates an initial positive response in fund value to a shock in total membership, peaking sharply within the first period. This is followed by a quick reversal into negative territory, reaching a trough in the second period. The subsequent oscillations gradually dampen, with the response converging towards zero after several periods. The confidence intervals, represented by the dashed lines, widen initially but narrow over time, indicating decreasing uncertainty in the fund value's response as the effect of the initial shock dissipates.

vi. Investment Income to Fund Value

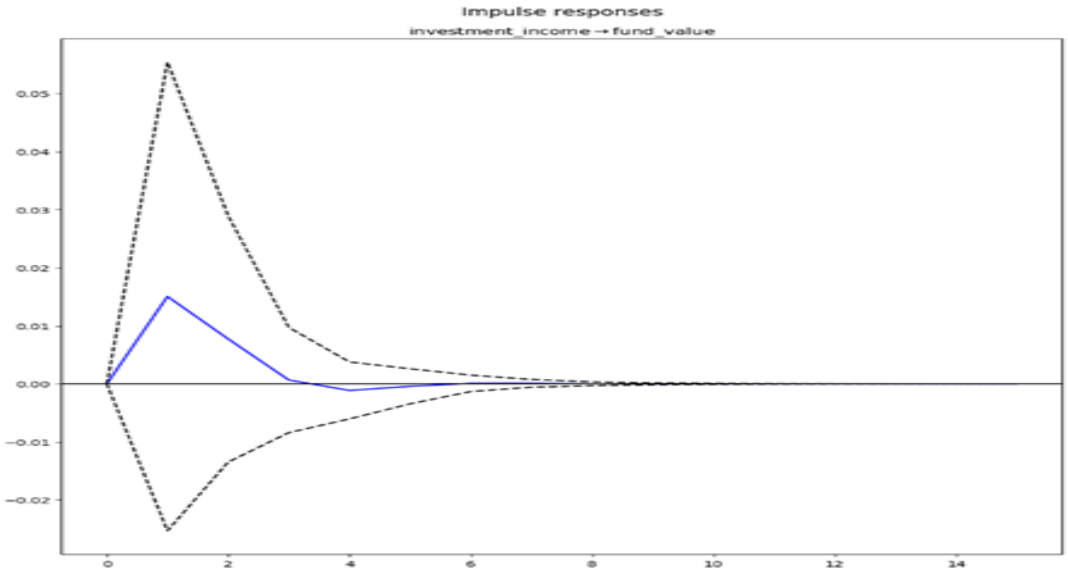

Figure 10: Impact of Investment Income Shocks on Fund Value

The impulse response analysis output illustrates how the growth of fund value responds to shocks in investment income over fifteen periods. Figure 10, shows an immediate and sharp positive response in fund value to a shock in investment income, peaking within the first period. This is followed by a quick decline, briefly dipping below zero in the third period. Subsequent fluctuations gradually diminish, with the response stabilizing close to zero after a few periods. The dashed lines, representing confidence intervals, are initially wide but narrow over time, indicating decreasing uncertainty in the response of fund value as the effect of the initial shock waves.

4.3.7 Forecast-error Variance Decomposition

The forecast-error variance decomposition (FEVD) data reveals the sources of variance in fund value over time.

Figure 11: Forecast-error Variance Decomposition

Period	Fund Value	Inflation	Total Contributions	Total Membership	Investment Income	Interest Rates	Exchange Rates
0	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
1	0.911745	0.016612	0.010801	0.002834	0.033881	0.005052	0.019075
2	0.896939	0.017938	0.011001	0.003138	0.042415	0.006515	0.022055
3	0.896844	0.017957	0.011235	0.003136	0.042295	0.006491	0.022042
4	0.896341	0.018005	0.011312	0.003167	0.042478	0.00653	0.022167
5	0.896319	0.018005	0.011312	0.003167	0.042497	0.006532	0.022168
6	0.896314	0.018005	0.011314	0.003167	0.042498	0.006532	0.02217
7	0.896312	0.018006	0.011314	0.003167	0.042499	0.006533	0.02217
8	0.896312	0.018006	0.011314	0.003167	0.042499	0.006533	0.02217
9	0.896312	0.018006	0.011314	0.003167	0.042499	0.006533	0.02217
10	0.896312	0.018006	0.011314	0.003167	0.042499	0.006533	0.02217
11	0.896312	0.018006	0.011314	0.003167	0.042499	0.006533	0.02217
12	0.896312	0.018006	0.011314	0.003167	0.042499	0.006533	0.02217
13	0.896312	0.018006	0.011314	0.003167	0.042499	0.006533	0.02217
14	0.896312	0.018006	0.011314	0.003167	0.042499	0.006533	0.02217

Initially, at period 0, the fund value's variance is entirely explained by its own shocks (100%). By period 1, 91.17% of the variance is still due to the fund value's own shocks, while the rest is attributed to other factors: inflation (1.66%), total contributions (1.08%), total membership (0.28%), investment income (3.39%), interest rates (0.51%), and exchange rates (1.91%). From period 2 onwards, the contribution of the fund value's own shocks slightly decreases, stabilizing at around 89.63%. Other factors continue to have a stable influence: inflation (1.80%), total contributions (1.13%), total membership (0.32%), investment income (4.25%), interest rates (0.65%), and exchange rates (2.22%). Thus, while the fund value's

own shocks remain the predominant factor, investment income, inflation, and exchange rates also play significant roles in explaining its variance over time.

5.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Findings

The objective of this study was to analyse the determinants of the growth of pension funds in Kenya. Secondary data were collected from the Retirement Benefits Authority and the Central Bank of Kenya. Multiple regression and time series analysis were used for data analysis. According to the correlation matrix, inflation, exchange rates, total contributions, and total membership had a positive relationship with fund value, while interest rates and investment income had a negative relationship. The study found that exchange rates, total contributions, total membership, and investment income positively affected the growth of fund value, whereas inflation and investment income had a negative effect.

As per the results of the analysis, 97.7% of variations on fund value can be explained by the stated variables.

5.1.1 Influence of Macro-economic Variables

- Inflation – The study revealed that inflation negatively impacts fund value. As inflation increases, the real value of the pension fund decreases.
- Interest rates – Contrary to expectations, it was noted that interest rates have a negative impact on fund value. This can be explained by the previously used valuation method where financial assets in debt investments are valued using the fair value method, reflecting their current market worth based on prevailing market conditions. Volatility in interest rates has a direct impact on the value of government securities, with an increase in interest rates leading to a drop in the valuation of held government securities.

- Exchange rates – Exchange rates have a significantly positive impact on fund value, meaning that, pension schemes should be encouraged to increase their off-shore investment for optimum fund growth.

5.1.2 Scheme-Specific Characteristics

- Total Contributions – The results showed that although total contributions had a positive impact on fund growth, their impact was insignificant.
- Total Membership – An increase in membership contributed positively to fund value. Schemes can therefore look to increase fund value by incorporating strategies that increase the total membership.
- Investment Income – Investment income was found to be insignificant in determining fund value. This can be explained by its dependence on macroeconomic factors since the amount that schemes announce as earnings each year is heavily influenced by the prevailing macroeconomic conditions.

The study also employed Vector Autoregression (VAR) modelling to analyse the time series data. The analysis showed that shocks to interest rates, exchange rates, total contributions, and total membership significantly and positively affected fund value over time. The VAR model demonstrated good predictive power, accurately forecasting fund value based on past values of the independent variables.

5.2 Conclusion

In conclusion, the study identifies interest rates, exchange rates, total contributions, and total membership as key determinants of pension fund growth in Kenya. Effective management of these factors is crucial for enhancing the performance and sustainability of pension funds. Policymakers should focus on strategies that are conscious of prevailing interest rates and exchange rates while

also implementing policies aimed at increasing total contributions and membership to drive substantial growth in pension funds.

The study also emphasizes the utility of predictive models in pension fund analysis. Both regression and VAR models have proven to be effective tools for forecasting pension fund values, aiding in informed decision-making and policy formulation. By incorporating these models, stakeholders can better understand the dynamics of pension fund growth and develop strategies that promote financial stability and growth in the sector.

5.3 Policy Recommendations

From the results of the study, the following are policy recommendations:

i. Policymakers should develop strategies to encourage higher contribution rates by offering incentives to both employers and employees, such as tax benefits or government matching contributions.
ii. Pension funds should implement diversified investment strategies, including investments across various asset classes and geographies, to maximize returns and mitigate risks.
iii. Pension schemes should be encouraged to invest in offshore assets, as these have shown a bigger positive impact on fund value.
iv. Pension funds should adjust benefits and investment strategies to protect against inflation.
v. The government should continuously monitor interest rates, and pension funds should remain adaptable to adjust their investment strategies in response to interest rate changes to optimize returns.

5.4 Limitations of the Study

One major limitation of the study was the availability of quarterly data. The analysis was confined to data from 2016 to 2023, which may not capture long-term trends and cyclical patterns affecting the growth of pension funds. Secondary data were collected from the schemes' quarterly reports submitted to the Retirement

Benefits Authority. The study was also constrained by the precision of the secondary data. Although the data were verifiable as they originated from scheme publications, they could still be prone to inaccuracies.

Furthermore, the study did not include some potentially influential variables, such as government policies, fund regulations, and economic shocks, due to data constraints. Model selection was another limitation; while regression and VAR models are robust, they have inherent limitations and assumptions that may not fully capture complex economic dynamics. Additionally, data availability regarding investment income was a challenge, as most schemes report their investment income annually, making quarterly data less accessible.

5.5 Areas for Further Research

The study recommends conducting longitudinal studies to capture long-term trends and the impact of economic cycles on pension growth. Additionally, it suggests incorporating more variables, such as government policies, economic shocks, and demographic factors, to provide a more comprehensive analysis. Comparative studies across different countries should be performed to identify best practices and factors that drive pension growth in diverse economic contexts. Utilizing advanced econometric and machine learning models is recommended to improve the accuracy and robustness of pension fund growth predictions. Furthermore, the study highlights the importance of investigating the impact of technological advancements on pension fund management and growth, particularly in the context of digital financial services and fintech innovations.

REFERENCES

Actserv. (2023). *Pension Schemes Investment Performance Survey.* Nairobi: Actserv-africa. Retrieved from https://actserv.co.ke/wp-content/uploads/insights/investment/quarterly/ACTSERV%20Pension%20Schemes%20Investment%20Performance%20Survey%2031st%20December%202022.pdf

Ahmed, S. O. (2018). *Effect of Portfolio Diversification on Equity Returns of Individual Investors Listed at Nairobi Securities Exchange.* Nairobi: University of Nairobi - School of Business.

Ajibade, A. T., Jayeoba, O. O., & Aghahowa, E. O. (2018). Pension Fund Characteristics and Financial Performance in Nigeria. *International Journal of Research and Innovation in Social Science (IJRISS), II*(XII), 540 - 547.

Akwimbi, W. (2018). *Effect of Corporate Governance, Investment Strategy and Macroeconomic Factors on Financial Performance of Pension Schemes in Kenya.* Nairobi: University of Nairobi - School of Business.

Ando, A., & Modigliani, F. (1963). The "Life Cycle" Hypothesis of Saving: Aggregate Implications and Tests. *American Economic Association, 53*(1), 55 - 84. Retrieved from http://www.jstor.org/stable/1817129

Antolin, P., Schich, S., & Yermo, J. (2011). The Economic Impact of Protracted Low Interest Rates on Pension Funds and Insurance Companies. *OECD Journal: Financial Market Trends, 2011*(1), 237 - 258. doi:10.1787/fmt-2011-5kg55qw0m56l ·Source: RePEc

Bijlsma, M., Bonekamp, J., Ewijk, C. v., & Haaijen, F. (2018). Funded Pensions and Economic Growth. *De Economist, 166*(3), 337-362. doi:10.1007/s10645-018-9325-z

Central Bank of Kenya. (2024, 03 03). *Inflation Rates*. Retrieved from Central Bank of Kenya: https://www.centralbank.go.ke/inflation-rates/

Gathimba, J. (2017). *Factors Affecting the Growth of Pension Fund Assets in Kenya.* Nairobi: United States International University - Africa.

Kipruto, S. P. (2019). *The Effect of Fund Characteristics on Financial Performance of Pension Schemes in Kenya.* Nairobi: University of Nairobi.

Leković, M. (2018). Evidence for and Against the Validity of Efficient Market Hypothesis. *Economic Themes, 56*(3), 369 - 387. doi:10.2478/ethemes-2018-0022

Madukwe, O. D., & Okeke, D. C. (2022). Effect of Inflation on Pension Fund Investment in Federal Government Securities in Nigeria. *World Journal of Advanced Research and Reviews, 14*(03), 074 - 085. doi:10.30574/wjarr.2022.14.3.0471

Markowitz, H. (1952). Portfolio Selection. *The Journal of Finance,, 7*(1), 77 -91. Retrieved from jstor.org/sici?sici=0022 1082%28195203%297%3A1%3C77%3APS%3E2.0.CO%3B2-1

Nyaga, B. K. (2014). *The Effect of Enterprise Risk Management on Financial Performance of Pension Fund Management Firms in Kenya.* Nairobi: University of Nairobi - School of Business.

Obed. (2018). *Strategic Asset Allocation of Pension Funds; An Application of Markowitz Portfolio Theory.* Nairobi: Universtity of Nairobi - School of Mathematics. Retrieved from http://erepository.uonbi.ac.ke/bitstream/handle/11295/104635/Menjeri_Strategic%20Asset%20Allocation%20of%20Pension%20Funds%3B%20An%20Application%20of%20Markowitz%20Portfolio%20Theory.pdf?sequence=1&isAllowed=y#page=19&zoom=100,140,98

OECD. (2023). *Pension Markets in Focus 2023.* Paris: OECD Publishing. Retrieved from https://doi.org/10.1787/28970baf-en

Ofori-Abebrese, G., Pickson, R., & Abubakari, S. (2017). Assessing the impact of macroeconomic variables on pension benefits in Ghana: A case of Social Security and National Insurance Trust'. *South African Journal of Economic and Management Sciences, 20*(1), 1703.

Ogonda, G., & Okiakpe, K. (2022). Pension Fund Investment and Economic Development in Nigeria. *23*(1), 1 - 4.

Omollo, H., Olweny, T., Oluoch, O., & Wamatanda, J. (2021). *Financial Structure and Growth of Pension Funds in Kenya.* Nairobi: Jomo Kenyatta University of Agriculture and Technology.

Onyango, O. J. (2020). *Factors Affecting Financial Performance of Pension Schemes in Kenya.* Nairobi: KCA University - School of Business.

Retirement Benefits Authority. (2022). *Statistical Digest 2021.* Nairobi: Retirement Benefits Authority - Research, Strategy and Planning Directorate. Retrieved from https://www.rba.go.ke/download/statistical-digest-2021-pdf/?wpdmdl=4973&refresh=65dc8208512aa1708950024

Retirement Benefits Authority. (2023). *Industry Brief - June 2023.* Nairobi: Retirement Benefits Authority - Research, Strategy and Planning Directorate. Retrieved from https://www.rba.go.ke/download/industry-brief-june-2023/?wpdmdl=5184&refresh=65dc4baec0e861708936110

Retirement Benefits Authority. (2023). *Statistical Digest 2022.* Nairobi: Retirement Benefits Authority - Research, Strategy and Planning Department.

Rosenberg, D. (2024, 02 26). *Compounding interest and investment returns: The incremental approach to building wealth*. Retrieved from Britannica Money: https://www.britannica.com/money/what-is-compounding

Szenberg, M., & Ramrattan, L. (2008). Modigliani and Keynesian Economics. In *Franco Modigliani: A Mind That Never Rests* (pp. 15 - 44). London: Palgrave Macmillan UK. doi:10.1057/9780230582439_2

Wanjiku, E. (2014). *The Effect of Macroeconomic Variables on Portfolio Returns of the Pension Industry in Kenya.* Nairobi: University of Nairobi - School of Business.

Wanyeki, M. J. (2019). *Effect of Macroeconomic Factors on Financial Performance of National Social Security Fund in Kenya.* Nairobi: KCA University.

Waweru, W. (2021). *Effect of Fund Characteristics on Financial Performance of Pension Schemes in Kenya.* Nairobi: Nairobi University - Faculty of Business and Management Sciences.

World Bank Group. (2023, April 23). *Pensions & Aging*. Retrieved from World Bank Group Website: https://www.worldbank.org/en/topic/pensions#:~:text=Social%20pensions%20cover%20close%20to%2035%25%20of%20the,America%20and%20the%20Caribbean%2C%20and%20South%20Asia%20regions.

Yan, L. W., & Foong, W. M. (2020). Investment Performance of Private Pension Funds in Selected Asian Countries: The Role of Fees and Management Companies. *Advances in Economics, Business and Management Research*, 164 - 171.

Yego, N. K., Kasozi, J., & Nkurunziza, J. (2023). Optimizing Pension Participation in Kenya through Predictive Modeling: A Comparative Analysis of Tree-Based Machine Learning Algorithms and Logistic Regression Classifier. *Risks, 11*(4), 77. Retrieved from doi.org/10.3390/risks1104007

Zubair, A. (2016). Effects of Pension Funds' Investments on Capital Market Performance in Nigeria. *International Journal of Management Economics and Business, 2*(3), 1 - 17.