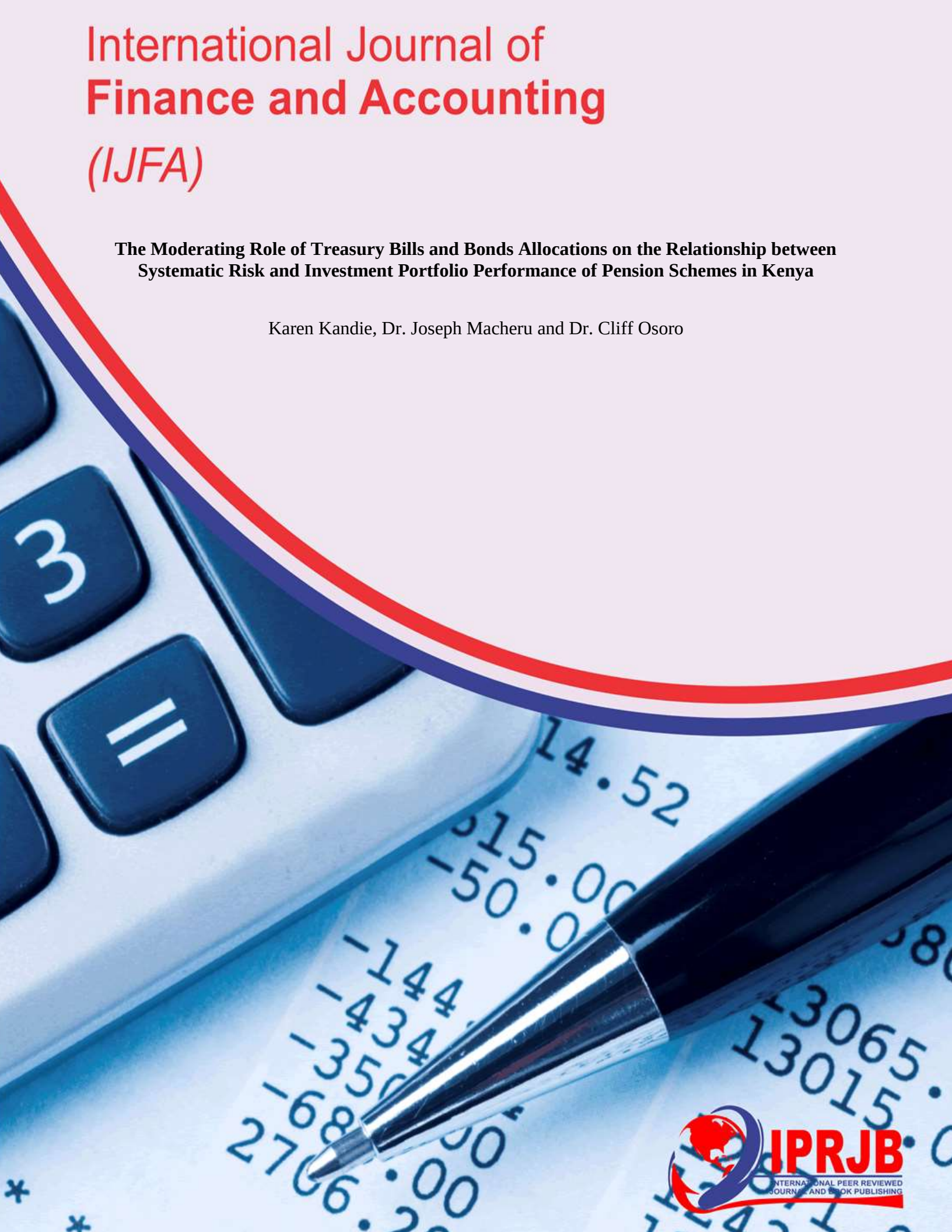
International Journal of
Finance and Accounting
(IJFA)

The Moderating Role of Treasury Bills and Bonds Allocations on the Relationship between Systematic Risk and Investment Portfolio Performance of Pension Schemes in Kenya

Karen Kandie, Dr. Joseph Macheru and Dr. Cliff Osoro



International Journal of Finance and Accounting
ISSN 2518-4113 (online)
Vol.8 Issue 2, No.4. pp. 71 - 84, 2023

www.iprjb.org

The Moderating Role of Treasury Bills and Bonds Allocations on the Relationship between Systematic Risk and Investment Portfolio Performance of Pension Schemes in Kenya

[1*]Karen Kandie
Post Graduate Student: School of Business and Economics, Catholic University of Eastern Africa

[2]Dr. Joseph Macheru
Lecturer, School of Business and Economics, Catholic University of Eastern Africa

[3]Dr. Cliff Osoro
Lecturer, School of Business and Economics
Catholic University of Eastern Africa

Article History

Received 20th August 2023

Received in Revised Form 28th August 2023

Accepted 14th September 2023

How to cite in APA format:

Kandie , K., Macheru, J., & Osoro, C. (2023). The Moderating Role of Treasury Bills and Bonds Allocations on the Relationship between Systematic Risk and Investment Portfolio Performance of Pension Schemes in Kenya. *International Journal of Finance and Accounting*, *8*(2), 71–84. https://doi.org/10.47604/ijfa.2105

Abstract

Purpose: This study investigated the moderating role of Treasury Bills and Bonds allocation on the relationship between systematic risk and investment portfolio performance of pension schemes in Kenya. Assets under management by pension schemes make up 14.6% of the GDP in Kenya, making pension schemes significant players in the financial industry and the economy. As of December 2021, the pension industry had mobilised Kshs. 1,547.43 billion in managed pension assets from Kshs. 44.7 billion in 2000, a significant annual average growth rate of 21%.

Methodology: The study used secondary data from 1,172 registered pension schemes for seven years between 2015 and 2021. Pension scheme data was collected from the database of the Retirement Benefits Authority. Systematic risk data was collected from the databases of the Central Bank of Kenya, Nairobi Securities Exchange and Kenya National Bureau of Statistics. Panel Regression analysis, fixed effect, random effect, and Hausman test were used to analyse the relationship between the dependent and independent variables. The study applied the Whisman and Maclleland two-step model to evaluate the impact of asset allocation on the investment portfolio performance of pension schemes as moderating variables.

Findings: The study results showed that asset allocation to Treasury Bills and Bonds did not significantly moderate the effect of systematic risk on the investment portfolio performance of pension schemes.

Unique Contribution to Theory, Practice and Policy: The study contributed to academia by challenging the usefulness of Modern Portfolio Theory. Policymakers should consider reviewing the limits on investment in Treasury Bills and Bonds to less than 100% to encourage diversification to more asset classes. Practitioners are recommended to invest in diverse asset classes.

Keywords: *Pension, Asset Allocation, Treasury Bills and Bonds, Systematic Risk*

INTRODUCTION

Although the population of Kenya is relatively young, policymakers have a growing awareness that it will face a demographic challenge concerning pensions not in the too distant future. Pension schemes' performance is essential to alleviate poverty and smooth consumption over an individual's lifecycle (World Bank Group, 2019). To achieve these functions on a long-term basis, it is important to ameliorate the effects of systematic risk (interest rates, inflation, economic growth and stock exchange volatility) on the performance of pension schemes (Verma & Bansal, 2021; Qureshi, Qureshi, & Ghumro, 2017; Wiß, 2019). The effects of systematic risk on the performance of pension schemes are moderated by asset allocation to asset classes, such as Treasury Bills and Bonds (Addoum, Binsbergen, & Bandt, 2010; Novy-Marx & Rauh, 2011). This research sought to uncover the nexus between asset allocation to Treasury Bills and Bonds and the performance of pension schemes.

The pension industry has proliferated in Kenya and the African region since late 2000, making it an essential source of finance for infrastructure and other long-term socioeconomic development needs (Irving, 2021; World Bank Group, 2019; Estrada & Koutronas, 2019). The industry is regulated by the Retirement Benefits Authority (RBA) with a mission to proactively promote savings for retirement in Kenya through safeguarding, supervising, and facilitating the development of retirement benefits (Retirement Benefits Authority, 2021). As of December 2021, the pension industry in Kenya had mobilised Kshs. 1,547.43 billion in managed pension assets from Kshs. 44.7 billion in 2000, a significant annual average growth rate of 21%. 45.69 percent of this amount was allocated to Treasury Bills and Bonds, making it the highest allocation among the asset classes.

The investment portfolio decisions by pension schemes in Kenya are driven by systematic risk, which influences the optimal allocation of assets across the various asset classes, such as Treasury Bills and Bonds, to maximise the investment portfolio performance (Roncalli & Weisang, 2012; Hasanudin & Pangestutia, 2020). The mix of asset classes less than perfectly correlated in portfolio construction is considered the primary key to balancing risks and returns in the management of pension schemes. The reason is that the uncorrelated risk can be diversified, increasing the return level, as Markowitz (1952) advocated in Modern Portfolio Theory.

Although one state-run Defined Benefits (DB) scheme, the National Social Security Fund (NSSF), continues to dominate the pension industry in Kenya, privately managed, employer-based Defined Contribution (DC) schemes have emerged and are multiplying. The growth of DC schemes is driven to a large extent by pension system policy reforms that allow a more significant role for privately managed pension schemes that target the middle class as well as to ensure the sustainability of pension payments in the future (Irving, 2021; World Bank Group, 2019; Papík & Papíková, 2021). In public DB schemes, employees are guaranteed benefits even if the government has not set aside money to pay them and future liabilities are placed on the taxpayer and future generations. In private DB schemes, the inability to fund benefits could cause significant financial distress, including bankruptcy. Lessons were learnt from the 2007/2008 global financial crisis,

where several municipalities in California declaring bankruptcy, each citing retirement costs as an important factor (Malanga, 2016).

Critical lessons learnt from the 2007/2008 economic and financial crisis were that pension assets are vulnerable to systematic risk, with the value of assets accumulated to finance retirement reducing by around $5.4tn (20-25% on average) at the end of 2008, according to the Organisation for Economic Co-operation and Development (OECD) figures (Antolin & Stewart, 2009). The crisis also caused a shift in asset allocation patterns, with investors moving into more conservative investments such as Treasury Bills and Bonds (Antolin & Stewart, 2009). Moments of crises are major shocks to existing equilibriums and policies and open windows of opportunity for policy change (Wiß, 2019). The momentum of reforms created from the lessons learned from the 2007/2008 global financial crisis continues to influence policy in the pension industry in Kenya.

The volatility of financial markets, measured by systematic risks such as policy interest rates, interest rates, stock market volatility, inflation, growth in Gross Domestic Product(GDP), and foreign exchange rates, has a substantial impact on the investment portfolio performance of pension schemes and the financial sector in general (Wiß, 2019; Tang, Chen, Lai, & Wu, 2018). The effect of systematic risk on portfolio investment decisions and the performance of pension schemes is a growing area of research, especially in Kenya and other developing economies.

Substantial changes in the monetary policy framework, such as policy interest rates, have seriously impacted pension schemes' risk-taking and asset allocation decisions, thus affecting the investment portfolio performance. More precisely, for example, the sharp reductions in interest rates to overcome the stock market crash 2001 resulted in changes in pension fund asset allocation decisions in favour of equities (Boubaker, Gounopoulos, Nguyen, & Paltalidis, 2018). Risk-shifting incentives to avoid low-yield investments, such as Treasury Bills and Bonds, in favour of riskier investments, such as equities, dominate pension fund asset allocation decisions during periods of low interest rates (Boubaker, Gounopoulos, Nguyen, & Paltalidis, 2018).

Also, policy responses to market volatility, such as a reduction in policy rates, will reduce returns on relatively liquid asset classes such as bank deposits and short-term Treasury Bills, thus affecting the investment portfolio performance of pension schemes (Irving, 2021). Several researchers have found that pension schemes have, on average, reduced their asset allocation to equity and increased allocation to bonds in a low-interest-rate environment (Bams, Schotman, & Tyagi, 2016).

The Retirement Benefits Authority has approved fourteen distinct domestic asset classes and offshore/foreign assets from which pension schemes can choose to build an investment portfolio (Retirement Benefits Authority, 2021). The asset classes are Treasury Bills and Bonds, quoted equities, immovable property, guaranteed funds; listed corporate bonds, fixed deposits; offshore investments, cash; unquoted equities, private equity; Real Estate Investment Trusts (RIETS); Commercial Paper, Non-listed bonds by Private companies and more recently Venture Capital. RBA has prescribed to pension schemes a 90% ceiling of allocation to Treasury Bills and Bonds and 100% for schemes that receive statutory contributions. The allocation to Treasury Bills and

Bonds is the highest, making 45.69% of total pension assets, and it's significant in the investment portfolio performance of pension schemes.

It is widely acknowledged that pension schemes react strongly to regulatory requirements (Addoum, Binsbergen, & Bandt, 2010). The reaction implies that regulatory requirements for pension schemes can override the fund manager's asset allocation strategy, consequently limiting their performance. With no restrictions and limits, it can give rise to a solid incentive to invest in riskier assets, which attract higher expected rates of return (Novy-Marx & Rauh, 2011). Investing in riskier assets could lead to a loss in the long term. However, tight constraints can be an opportunity cost, as fund managers invest a lower than the optimal proportion of assets in assets with high rates of return.

Pension schemes have experienced systematic risks that have resulted in increased funding risks in the form of the growth of liabilities outpacing assets, resulting in an inability to satisfy all pension obligations on a timely basis. Pension schemes risk making retirement promises that cannot be fulfilled due to uncertain returns brought about by systematic risk, and the consequences can be disastrous, as shown in Malanga (2016). (Tang, Chen, Lai, & Wu, 2018; World Bank Group, 2019).

Purpose of the Study

This study aimed to establish the moderating role of Treasury Bills and Bonds allocation on the relationship between systematic risk and investment portfolio performance of pension schemes in Kenya.

Specific Objectives

(i) To examine the relationship between systematic risk and investment portfolio performance of pension schemes in Kenya

(ii) To establish the moderating role of Treasury Bills and Bonds allocation on the relationship between systematic risk and investment portfolio performance of pension schemes in Kenya.

(iii) To make recommendations to regulators and policy makers based on the findings of the study.

Theoretical Literature

The research was anchored on the Capital Asset Pricing Model (CAPM) that was introduced by Sharpe (1964), Lintner (1965) and Mossin (1966) and Modern Portfolio Theory. CAPM states that a diversified risk in an overall portfolio with other securities is not a risk at all (Tyllgren, 2021; Ninan, Joseph, Roy, Siby, & Stephen, 2018). The Capital Asset Pricing Model is employed to set the investor-required rate of return on a risky security given the non-diversifiable firm-specific risk, as the systematic risk will be eliminated in a well-diversified portfolio (Elbannan, 2015). The highly quoted and researched Modern Portfolio Theory (MPT) results from Markowitz's (1952) portfolio optimisation work, also called mean-variance optimisation (MVO). The theory

introduced the ability of diversification to reduce risk by holding a portfolio of assets with different characteristics that are less than perfectly correlated. As Schneeweis, Crowder, and Kazwmi (2010) claim, asset allocation is the only "free lunch" in finance.

Empirical Literature

Davis, Stewart, and Knaack (2020) examined pension funds and financial repression. Financial repression is whereby pension schemes in some economies are used as a captive audience to channel capital below market rates to the government through investment in Treasury Bills and Bonds. The study found that financial repression is both an old and a new topic, made ever more relevant in 2020 by the large amounts of new debt governments took to support their economies in the wake of the COVID-19 crisis. At the same time, although regulatory requirements for pension schemes differ across jurisdictions, many, Kenya included, favour public debt (OECD, 2019). Retirement Benefits Authority (2021) has put limits on asset classes in Kenya, with equity investment at 70% and real estate at 30%. The ceiling on domestic government debt is higher at 90% and 100% for schemes receiving statutory contributions, second only to guaranteed funds that do not have a ceiling. The high ceiling on domestic debt is an incentive for pension schemes to invest more in government Treasury bills and bonds. There is a research gap to evaluate whether investment in Treasury Bills and Bonds moderates the impact of systematic risk on the investment portfolio performance of pension schemes in Kenya.

METHODOLOGY

A positivist research approach was employed in this study. Secondary data was collected from RBA and other sources. The study used quantitative data regarding systematic risks such as interest rate, Stock Index, inflation rate, and GDP as independent variables and portfolio investment performance as dependent variables. The study further used an explanatory research design, which helped to explain the relationship between variables. Data regarding allocation to Treasury Bills and Bonds was used as a moderating variable.

The research was a census of 1,172 public and private pension funds registered with the RBA from December 2015 to December 2021. Annual quantitative data of the investment portfolio performance of pension schemes, including the value of assets allocation to various asset classes, was extracted from audited financial records. Systematic risk data data was also obtained from CBK, NSE and KNBS.

Panel data regression analysis, Hausman Test, fixed effect, random effect, and Hausman Test was used in the study to analyse the relationship between the dependent variable (investment portfolio performance) and the independent variables (systematic risk). The data includes time series and cross-sectional data pooled into a panel data set and estimated using panel data regression. A similar model is used by Mazreku, Morina and Curraj (2020), Zou et al. (2016), and Akwimbi (2020). The panel regression analysis was run using E-views 7 data analysis software. The general econometric model used in this research is shown below:

International Journal of Finance and Accounting
ISSN 2518-4113 (online)
Vol.8 Issue 2, No.4. pp. 71 - 84, 2023
www.iprjb.org

General Equation

$$IPP_{it} = \alpha_0 + \beta_1 IR_{it} + \beta_2 NSE_{it} + \beta_3 INF_{it} + \beta_4 GDP_{it} + \mu_{it}$$

Where;

IPP_{it} is the investment portfolio performance

IR_{it} is the market interest rate

NSE_{it} is the NSE 20 Share Index

INF_{it} is the average annual rate of inflation

GDP_{it} is the Gross Domestic Product

α_0 is the intercept

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ are the coefficients of the model

μ_{it} is the stochastic variable, the error term, or the residual

The study assessed the moderation effect of asset allocations to Treasury Bills and Bonds on the relationship between systematic risk and the portfolio investment performance of pension schemes by adopting the Whisman and McClelland (2005) two-step moderating tests. In step one, the asset class allocation is introduced as an independent variable. In step two, asset class allocation is presented as a moderating variable.

Allocation to Treasury Bills and Bonds

$$IPP_{it} = \alpha_0 + \beta_1 IR_{it} + \beta_2 NSE_{it} + \beta_3 INF_{it} + \beta_4 GDP_{it} + \beta_6 TB_{it} + \beta_7 [TB_{it} IR_{it} + TB_{it} NSE_{it} + TB_{it} INF_{it} + TB_{it} GDP_{it}] + \mu_{it}$$

Where;

TB_{it} is the percentage allocation of pension assets to Treasury Bills and Bonds

β_7 is the coefficient of the moderating model

DATA PRESENTATION AND ANALYSIS

Descriptive Statistics of the General Model

The descriptive statistics for the variables, investment portfolio performance (IPP), interest rates (IR), NSE 20-Share Index (NSE), inflation rate (INF) and Gross Domestic Product (GDP) are shown in Table below.

International Journal of Finance and Accounting
ISSN 2518-4113 (online)
Vol.8 Issue 2, No.4. pp. 71 - 84, 2023
www.iprjb.org

Table 1: Descriptive Statistics (General Model)

	LN_IPP	LN_IR	LN_NSE	LN_INF	LN_GDP	LN_TB
Mean	-1.891638	2.122296	8.150582	1.823372	1.550271	-0.934680
Std. Dev.	1.108380	0.149229	0.173482	0.145773	0.138456	0.260791
Jarque-Bera	26624.52	236.8680	96.45480	243.7370	354.6669	0.158710
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.923712
Observations	4030	4030	4030	4030	4030	52

Notations;

LN_- Natural log of

IPP-Investment Portfolio Performance

IR- 91-day Treasury Bill Rate

NSE- NSE 20-Share Index

INF-Rate of inflation

GDP-Gross Domestic Product or economic growth

Table 1 shows that the dependent variable, Investment Portfolio Performance (IPP), had a mean of -1.89 and a standard deviation of 1.11. The interest rate, IR, had a mean of 2.1222 and a standard deviation of 0.1492. The mean of the NSE 20-Share index was 8.1506, and the standard deviation was 0.1735. The rate of inflation, INF, had a mean of 1.8234 and a standard deviation of 0.1458. The mean of growth in Gross Domestic Product, GDP, was 1.5503 and the standard deviation of 0.1385. This means that the dependent and independent variables did not deviate much from the mean during the study period, indicating they were stable. The allocation of pension schemes to Treasury Bills and Bonds (TB) had a mean of -0.934680 and a standard deviation of 0.260,791, which means that TB allocation was not volatile during the study period, indicating that it was stable.

The probability value of the variables IPP, IR, NSE and GDP were 0.0000, which is less than 0.1. This value means that the variables were not normally distributed during the study period because the p-value was significant at a 10% level of significance. The Jarque-Bera value of IPP, IR, NSE, INF and GDP was 26624.52, 236.86, 96.45, 243.74 and 354.67, respectively. This means the Jarque-Bera value of all the variables was far from zero, meaning all the variables were not normally distributed. The p-value for all the variables was significant at a 10% level of significance. The probability value of Treasury Bills and Bonds (TB) allocation was 0.923712, and the Jarque-Bera value was 0.158710, which means TB was normally distributed during the period of study because the p-value was insignificant at a 10% level of significance and Jarque-Bera value was close to zero.

Correlation Analysis of the General Model Variables

A correlation analysis was conducted on the data to ensure no highly correlated variables between the dependent and independent variables to avoid the problem of serial correlation in the model. The research did not test the correlation between independent variables because panel datasets are usually unaffected by multi-collinearity (Purba & Bimantara, 2019; Shao, Gu, Yang, Xu, & Su, 2019). The table below shows the results of the correlation analysis of the general model.

Table 2: Correlation Analysis (General Model)

Correlation	LN_IPP	LN_IR	LN_NSE	LN_INF	LN_GDP
LN_IPP	1.000000				
LN_IR	-0.008522	1.000000			
LN_NSE	-0.016009	0.991461	1.000000		
LN_INF	0.051375	0.601071	0.593643	1.000000	
LN_GDP	-0.100108	-0.212610	-0.156924	-0.821460	1.000000

Table 2 shows that IR, NSE, and GDP had a correlation coefficient of -0.008522, -0.016009, and -0.100108, respectively, which indicates a weak negative correlation with the independent variable, IPP. INF had a correlation coefficient of 0.051375, indicating a weak positive correlation with IPP.

Correlation Analysis of the Moderating Variables

The results below show that Treasury Bills and Bonds allocation had a correlation coefficient of 0.224524 to IPP, which is a weak positive correlation.

Table 3: Correlation analysis (Moderator variables)

Correlation	LN_IPP	LN_TB
LN_IPP	1.000000	
LN_TB	0.224524	1.000000

Unit Root Tests of the General Model

The data were subjected to Unit Root Tests at Level and Intercept I (0) to ensure they were stationary before being regressed to avoid spurious regressions or white noise in the model. The null hypothesis assumed nonstationary series, while the alternate hypothesis assumed stationary ones. Table 4 shows that the Levin, Lin & Chu statistic was statistically significant for all the variables. This means the variables were not stationary. The variables were transformed to their natural logs to avoid the problem of lack of stationarity.

Table 4: Unit Root Test

	Levin, Lin & Chu t*	
	Statistic	Prob.**
LN_IPP	-285.161	0.0000
LN_IR	-143.360	0.0000
LN_NSE	-18.1043	0.0000
LN_INF	-42.1686	0.0000
LN_GDP	-41.9421	0.0000
LN_TB	-194.361	0.0000

Panel Regression of the General Model

Table 5: Panel Regression of the General Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_IR	-3.721652	1.353508	-2.749634	0.0060
LN_NSE	3.802764	1.314464	2.893014	0.0038
LN_INF	-1.635495	0.506141	-3.231303	0.0012
LN_GDP	-2.730452	0.480703	-5.680124	0.0000
C	-17.77287	6.451003	-2.755056	0.0059
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.545100	Mean dependent var		-1.891638
Adjusted R-squared	0.377449	S.D. dependent var		1.108380
F-statistic	3.251389	Durbin-Watson stat		2.076019
Prob(F-statistic)	0.000000			

The panel regression Fixed Effects estimation model results are shown in the table above. The probability (F-statistic) was 0.000000, which means the model is stable. The R-Squared for the general model was 0.5451, meaning that the proxies of systematic risk, interest rates, NSE-Share Index, rate of inflation and GDP simultaneously affect the investment portfolio performance of pension schemes significantly by 54.51 percent. The adjusted R-Squared was 37.74 per cent, which has a less than 20 per cent difference from the R-Squared, meaning that the model is stable.

The Durbin-Watson statistic was 2.076, close to 2, meaning the model had no serial correlation. The probability (F-statistic) was 0.000000, which means the model is stable. The general model is specified as follows:

$$IPP_{it} = -17.7729 + -3.7217IR_{it} + 3.8028NSE_{it} + -1.6355\,INF_{it} + -2.7305GDP_{it} + \mu_{it}$$

Panel Regression With Moderating Variables

$$IPP_{it} = \alpha_0 + \beta_1 IR_{it} + \beta_2 NSE_{it} + \beta_3 INF_{it} + \beta_4 GDP_{it} + \beta_6 TB_{it} + \beta_7 [TB_{it} IR_{it} + TB_{it} NSE_{it} + TB_{it} INF_{it} + TB_{it} GDP_{it}] + \mu_{it}$$

The results of the Hausman test are in the table below. The data shows that the Chi-Square test statistic was 52.005149 with a significant probability value of 0.0000, which was significant at a 5% level of significance. Therefore, this means that the null hypothesis was rejected in favour of the Fixed Effects model. Consequently, we accept the Fixed Effects model as suitable for this study's Equation.

Hausman Test for Allocation to Treasury Bills and Bonds

Table 6: Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	52.005149	6	0.0000

The fixed effects model for the allocation of Treasury Bills and Bonds and specifications are presented in Table 7.

Fixed Effects Model for Allocation to Treasury Bills and Bonds

Table 7: Fixed Effects Model for Allocation to Treasury Bills and Bonds

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LN_IR	1.888289	2.604434	0.725029	0.4686
LN_NSE	-3.282659	2.439970	-1.345369	0.1788
LN_INF	1.463064	0.946939	1.545045	0.1227
LN_GDP	-0.506399	0.932419	-0.543103	0.5872
LN_TB	3.934199	2.656860	1.480770	0.1390
MOD1_TB	-0.298932	0.195862	-1.526238	0.1273
C	18.78261	11.75029	1.598481	0.1103
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.611033	Mean dependent var		-1.969519
Adjusted R-squared	0.442777	S.D. dependent var		1.187433
F-statistic	3.631558	Durbin-Watson stat		2.281660
Prob(F-statistic)	0.000000			

Table 7 shows that the moderator variable of allocation to Treasury Bills and Bonds (MOD1_TB) had a coefficient of -0.298932 and an insignificant probability value of 0.1273. This means that allocation to Treasury Bills and Bonds did not moderate the relationship between systematic risk variables and investment portfolio performance.

CONCLUSION

The data above concludes that asset allocation to Treasury Bills and Bonds did not significantly moderate the effect of systematic risk on the investment portfolio performance of pension schemes. The research is consistent with Davies et al (2020) recommendation that pension schemes should be allowed to pursue their primary goal of ensuring retirement security for their beneficiaries. However, if circumstances such as a pandemic-induced crisis with rapidly escalating debt loads necessitate, pension schemes can play more of a command role as captive audiences. Further research is required to confirm this finding. If this direction is confirmed, it is recommended that regulators and policy makers reconsider reducing the statutory limits for the allocation to Treasury Bills and Bonds since it does not moderate the impact of systematic risk on investment portfolio performance in formulating investment policy.

REFERENCES

Addoum, J. M., Binsbergen, J. H., & Bandt, M. W. (2010). Asset Allocation and Managerial Assumptions in Corporate Pension Plans. *SSN1710902*.

Akwimbi, A. W. (2020). *Effect of corporate governance, investment strategy and macroeconomic factors on financial performance of pension schemes in Kenya.* Nairobi.

Antolin, P., & Stewart, F. (2009). *Private Pensions and Policy Responses to the Financial and Economic crisis.* OECD Working Papers on Insurance and Private Pensions.

Bams, D., Schotman, P., & Tyagi, M. (2016). Pension Fund Asset Allocation, in low Interest Rate Environment. *Network for Studies on Pensions, Aging and Retirement*.

Bello, M. A. (2018). Portfolio Analysis and Risk Management: A Conceptual Analysis. *Nigerian Journal of Management Technology & Development*, 203-212.

Berk, C., & Tutarli, B. (2020). Dead or Alive: Modern Portfolio Theory Based on Financial Analysis. *Universal Journal of Accounting and Finance 8(4)*, 83-91.

Boubaker, S., Gounopoulos, D., Nguyen, D. K., & Paltalidis, N. (2018). Assessing the effects of unconventional monetary policy and low interest rates on pension fund risk incentives. *Journal of Banking and Finance*, 340-357.

Davis, R. M., Stewart, F., & Knaack, P. (2020). *Pension funds and financial repression.* Washington DC: World Bank Group.

Elbannan, M. A. (2015). The Capital Asset Pricing Model: An Overview of the Theory. *Canadian Center of Science and Education*.

Estrada, M. A., & Koutronas, E. (2019). An introduction to pensionomics. *Emerald Insight*.

Fama, E. F., & French, K. R. (2004). The Capital Asset Pricing Model: theory and evidence. *Journal of Economic Perspectives, 18(3)*, 25–46.

French, J. (2017). Macroeconomic Forces and Arbitrage Pricing Theory. *Journal of Comparative Asian Development Vol. 16, No. 1*, 1–20.

Hasanudin, W. S., & Pangestutia, I. R. (2020). Asset allocation and strategies on investment portfolio performance: A study on the implementation of employee pension fund in Indonesia. *Accounting 6*, 839–850.

Irving, J. (2021). *How the COVID-19 crisis is impacting African pension fund approaches to portfolio management.* Washington, DC: International Finance Corporation.

Lintner, J. (1965). The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital budgets. *Review of Economics and Statistics 47:1*, 13-37.

Malanga, S. (2016). The Pension Fund That Ate California. *City Journal*.

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

Mazreku, I., Morina, F., & Curraj, E. (2020). Evaluation of the Financial Performance of Pension Funds. Empirical Evidence: Kosovo, Albania and North Macedonia. *European Journal of Sustainable Development, 9, 1,* , 161-172.

Mossin, J. (1966). Equilibrium in a Capital Asset Market. *Econometrica. October, 35*, 768–83.

Ninan, N., Joseph, J. J., Roy, J. C., Siby, A., & Stephen, S. M. (2018). Assessment of Capital Asset Pricing Model in Indian Stock Market. *Cosmos Impact Factor*.

Novy-Marx, R., & Rauh, J. (2011). Public pension promises; How big are they and what are they worth? *Economic Perspectives 23(4)*.

OECD. (2019). *Annual survey of investment regulation of pension funds.*

Papík, M., & Papíková, L. (2021). Comprehensive analysis of regulatory impacts on performance of Slovak pension funds. *Journal of Business Economics & Management, 22(3)*, 735-756.

Purba, J. H., & Bimantara, D. (2019). The Influence of Asset Management on Financial Performance, with Panel Data Analysis. *Advances in Economics, Business and Management Research, volume 143*, 150-155.

Qureshi, F., Qureshi, S., & Ghumro, A. K. (2017). Mutual Funds and Market Variables: A Critical Review of Literature. *Journal of Poverty, Investment and Development Vol.34*.

Retirement Benefits Authority. (2021). *Retirement Benefits Industry Report for June 2021*. Nairobi: RBA.

Retirement Benefits Authority. (2021, November 8). *Vision, Mission and Core Values*. Retrieved from Retirement Benefits Authority: https://www.rba.go.ke/vision-mission-core-values/

Roncalli, T., & Weisang, G. (2012). Risk Parity Portfolios with Risk Factors. *Munich Personal RePEc Archive.*

Sandwick, J. A., & Collazzo, P. (2021). Modern portfolio theory with sharia: a comparative analysis. *Journal of Asset Management 22*, 30-42.

Schneeweis, T., Crowder, G., & Kazwmi, H. (2010). *The new science of asset allocation, one end.* Hoboken, New Jersey: John Wisley & Sons, Inc.

Shao, C., Gu, C., Yang, M., Xu, Y., & Su, H. (2019). A novel model of dam displacement based on panel data. *International Association of Data Control and Monitoring*.

Sharpe, W. F. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. *Journal of Finance 19:3*, 425-42.

Tang, M.-L., Chen, S.-N., Lai, G. C., & Wu, T.-P. (2018). Asset allocation for a DC pension fund under stochastic interest rates and inflation=protected guarantee. *Insurance, Mathematics and Economics 78*, 87-104.

Tilfani, O., Ferreira, P., & Boukfaoui, M. Y. (2020). Multiscale optimal portfolios using CAPM fractal regression: estimation for emerging stock markets. *Post-Communist Economies, 32:1*, 77-112. Retrieved from Post-Communist Economies, 32:1: DOI: 10.1080/14631377.2019.1640983

Tyllgren, A. (2021). *Applying Treynor-Black Model with AP7 Safa in the Swedish Premium Pension System.* Handelshogskolan, Karlstad Business School. Karlstad University.

Verma, R. K., & Bansal, R. (2021). Impact of macroeconomic variables on the performance of stock exchange: A systematic review. *International Journal of Emerging Markets*.

Whisman, M. A., & McClelland, G. H. (2005). Designing, Testing, and Interpreting Interactions and Moderator Effects in Family Research. *Journal of Family Psychology Vol. 19, No. 1*, 111–120.

Wiß, T. (2019). Reinforcement of pension financialisation as. *Journal of European Public Policy, 26:4*, 501-520.

World Bank Group. (2019). *Pension Systems in East Africa a deep dive.* Washington DC: World Bank.

Zou, N., Suo, Z., & Li, C. (2016). Interactive Relationship between Rural Pension Insurance and Economic Growth Based on VAR Model. *Rev. Téc. Ing. Univ. Zulia. Vol. 39, Nº 10*, 287-292.