

The Effect of Asset Allocation Strategy on Pension Funds Investment Returns: The Moderating Role of Interest Rates

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Abstract

This study is motivated by the instability of pension fund investment returns in Indonesia despite the continuous growth of assets under management. Fluctuations in Return on Investment (ROI) during the 2020–2024 period indicate that asset growth is not necessarily followed by consistent performance, highlighting the need to examine the determinants of pension fund returns. This study aims to analyze the effect of asset allocation strategies comprising time deposits, government securities, equities, and corporate bonds on pension fund ROI, as well as to investigate the moderating role of interest rates. This research employs a quantitative explanatory approach using panel data regression analysis. The sample consists of 35 pension funds registered with the Financial Services Authority (OJK) observed over five years (2020–2024), resulting in 175 observations. The Random Effect Model (REM) is selected as the best estimation model, and Moderated Regression Analysis (MRA) is applied to test the interaction effects. The results show that only corporate bonds have a significant positive effect on ROI, while time deposits, government securities, and equities do not significantly influence returns. However, interest rates significantly moderate the relationship between all asset allocation components and ROI. In conclusion, pension fund investment performance is not solely determined by asset allocation but is also influenced by macroeconomic conditions, particularly interest rates, suggesting the need for adaptive and dynamic investment strategies.

Keywords: Asset Allocation; Pension Funds; Return on Investment; Interest Rates; Panel Data Regression.

INTRODUCTION

Pension funds are institutional investors that play a strategic role in the financial system by mobilizing and managing long-term capital to meet future pension benefit obligations. The OECD emphasizes that pension funds invest over long horizons with the primary objective of ensuring the sustainability of retirement benefits for participants, making investment performance a key determinant of funding stability. In Indonesia, Otoritas Jasa Keuangan/OJK positions pension funds as an important component of the national financial system that supports stability and public welfare through prudent and sustainable asset management. However, growth in assets under management is not necessarily accompanied by stable investment returns. Industry data show that pension fund assets and investment values increased during 2020–2024, while Return on Investment (ROI) fluctuated across periods. This volatility is reflected in the decline of ROI from 9.00% in 2020 to 6.13% in 2021 and 5.58% in 2022, followed by an increase to 6.83% in 2023 before falling again to 5.86% in 2024 (Figure 1). This pattern indicates that pension fund investment performance remains unstable, highlighting the need to further examine its underlying determinants.

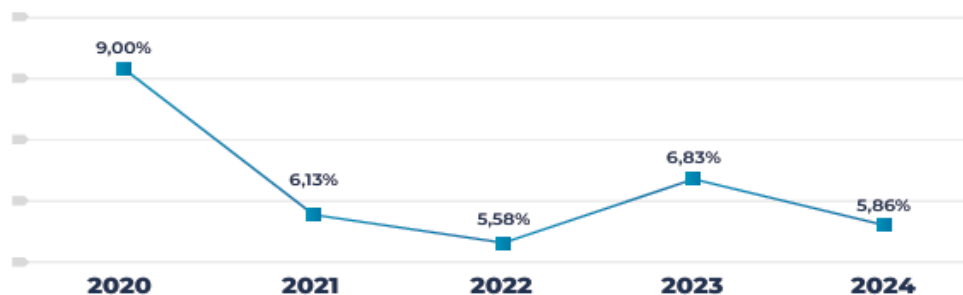


Figure 1. Return on Investment (ROI) of Pension Funds in Indonesia, 2020–2024
Source: OJK Report 2026

From a theoretical perspective, variations in pension fund ROI are closely linked to asset allocation strategy, as portfolio decisions determine risk exposure and long-term return potential (Bodie, Kane, & Marcus, 2021). In Indonesia, pension fund investment policies are implemented within a regulatory framework, particularly OJK Regulation No. 27/2023, which guides investment placement across specific instruments under the prudential principle. In practice, pension fund portfolios remain dominated by low to medium risk instruments, particularly government securities and time deposits. This structure reflects a conservative investment strategy aimed at preserving portfolio stability, yet it may not necessarily be effective in generating sustainable returns. Prior empirical studies also report mixed evidence regarding the contribution of major asset classes to pension fund performance (Fortuin, 2022; Triyana & Muharam, 2024; Kenga et al., 2024). Massawe & Sanga (2022) find that deposits and government debt securities can significantly enhance returns, whereas Linus et al. (2025) show that defensive instruments do not always contribute meaningfully to long-term performance.

For riskier assets, Andonov & Rauh (2022) identify equities as a primary driver of returns, while Defau and De Moor (2021) suggest that their contribution may weaken due to market volatility. Moreover, Boyante et al. (2022) show that credit risk is a key factor underlying the negative effect of corporate bonds, whereas Akwimbi et al. (2024) report that corporate bonds may positively affect performance when supported by diversification and effective investment strategies. These inconsistencies indicate a clear research gap concerning the impact of asset allocation components on pension fund ROI.

Beyond internal portfolio decisions, macroeconomic dynamics, particularly interest rates, may influence the effectiveness of asset allocation strategies (Jensen, 2022). During 2020–2024, Indonesia experienced shifts in the interest rate regime, ranging from monetary easing during the COVID-19 period to subsequent tightening in the post-pandemic phase (Bank Indonesia, 2024). The literature suggests that interest rate environments affect the performance of financial instruments and may induce search-for-yield behavior, where institutional investors reallocate from low-risk assets toward higher-risk assets to sustain returns (Hermans et al., 2023; Ioannidou et al., 2022; Zheng, 2025).

Nevertheless, most prior studies treat interest rates as a control variable or as a partial external factor, rather than empirically testing their role as a moderator that strengthens or weakens the relationship between asset allocation and ROI. Accordingly, this study aims to examine the effect of asset allocation strategy (deposits, government securities, equities, and corporate bonds) on pension fund ROI in Indonesia and to test the moderating role of interest rates over the 2020–2024 period. The findings are expected

to contribute empirically to the literature on institutional investment and provide practical implications for pension fund managers and regulators in formulating adaptive and sustainable investment strategies.

RESEARCH METHOD

This study employs an explanatory quantitative research design, which aims to examine causal relationships among variables through empirical hypothesis testing. A research design functions as a blueprint that guides the overall research process from data selection and variable measurement to the analytical techniques applied so that the findings are valid, reliable, and aligned with the research objectives (Sekaran & Bougie, 2019). Accordingly, this study utilizes numerical data derived from pension fund investment reports and macroeconomic indicators, and applies inferential statistical methods for analysis (Reilly, Brown, & Leeds, 2019).

The dataset consists of a balanced panel, combining cross-sectional observations across pension funds and time-series observations across years. Panel data are used because they enhance analytical power, accommodate unobserved heterogeneity across units, and generate more informative estimates compared to purely cross-sectional or time-series data (Gujarati & Porter, 2020). The unit of analysis is pension fund institutions registered and supervised by Otoritas Jasa Keuangan (OJK), observed annually over the period 2020–2024. The variables include the proportion of asset allocation in time deposits, government securities, equities, and corporate bonds; investment performance measured by Return on Investment (ROI); and the Bank Indonesia policy rate (BI 7-Day Reverse Repo Rate/BI7DRR) as the moderating variable.

This study relies on quantitative secondary data that are historical, objective, and measurable. Investment allocation and ROI data are obtained from the annual financial statements of pension funds, while interest rate data are collected from official publications of Bank Indonesia, particularly the BI7DRR series available in the Indonesian Economic and Financial Statistics and the annual monetary policy reports. Data were collected using a documentation method, involving source identification, collection of relevant documents for the 2020–2024 period, verification of data completeness and consistency, and construction of the final dataset in panel format.

The population comprises all pension funds registered and supervised by OJK in 2024. The sample was selected using purposive sampling based on the following criteria: (1) pension funds remained active and were registered as members of the Asosiasi Dana Pensiun Indonesia (ADPI) during 2020–2024; (2) pension funds were not under suspension, liquidation, or program termination during the study period; (3) pension funds published complete and consistent annual financial statements; and (4) pension funds provided complete data on investment allocation proportions in deposits, government securities, equities, and corporate bonds for 2020–2024. Based on these criteria, the final sample consists of 35 pension funds observed over five years, resulting in 175 observations.

Table 1. Variable Operationalization

Variable	Measurement Indicator	Measurement Scale
X1	$\frac{\text{Time Deposits Investment}}{\text{Total Investment Assets}} \times 100\%$	Ratio

X2	$\frac{\text{Government Securities Investment}}{\text{Total Investment Assets}} \times 100\%$	Ratio
X3	$\frac{\text{Equities Investment}}{\text{Total Investment Assets}} \times 100\%$	Ratio
X4	$\frac{\text{Corporate Bonds Investment}}{\text{Total Investment Assets}} \times 100\%$	Ratio
Y	$\frac{\text{Net Investment Income}}{\text{Total Investment Assets}} \times 100\%$	Ratio
M	"Annual average BI 7-Day Reverse Repo Rate (BI7DRR)"	Ratio

Source: Processed by the authors

Data Analysis Technique

Data analysis was conducted using EViews software. EViews was selected due to its strong capability in processing panel data, estimating Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM), and providing standard model selection tests, namely the Chow test, Hausman test, and Lagrange Multiplier (LM) test. In addition, EViews supports classical assumption testing, coefficient significance testing, and the estimation of moderation models required in this study.

Descriptive Statistical Analysis

Descriptive statistics were used to summarize the characteristics of the dataset by reporting the mean, median, minimum, maximum, and standard deviation (Sekaran & Bougie, 2019). In this study, descriptive statistics provide an overview of pension funds' asset allocation structure, Return on Investment, and interest rate dynamics during the 2020–2024 period.

Panel Regression Estimation and Model Selection

This study considered three estimation approaches: CEM, FEM, and REM. The best model was selected using the following procedures:

1. Chow test to compare CEM and FEM
2. Hausman test to compare FEM and REM
3. Lagrange Multiplier (LM) test to compare CEM and REM

All decisions were made using a 5% significance level (Gujarati & Porter, 2020).

Classical Assumption Tests

Classical assumption tests were performed to ensure that the regression model satisfies the basic requirements so that coefficient estimates can be interpreted validly (Gujarati & Porter, 2020). The tests include:

1. Normality test (Jarque–Bera),
2. Autocorrelation test (Durbin–Watson or Breusch–Godfrey LM Test),
3. Heteroskedasticity test (Breusch–Pagan–Godfrey), and
4. Multicollinearity test (Variance Inflation Factor/VIF).

Hypothesis Testing

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Hypothesis testing was conducted after determining the most appropriate panel regression model. The procedures include:

1. t-test to assess the partial effects of each independent variable and interaction term,
2. F-test to evaluate the overall (simultaneous) significance of the model, and
3. Coefficient of determination (R^2 and Adjusted R^2) to assess the explanatory power of the model in explaining variations in Return on Investment.

Statistical significance was determined using p-values < 0.05 . In the moderation analysis, the interaction coefficients were interpreted as follows:

1. positive and significant coefficient \rightarrow the moderator strengthens the relationship,
2. negative and significant coefficient \rightarrow the moderator weakens the relationship,
3. insignificant coefficient \rightarrow no moderating effect is present.

Research Model

Baseline Panel Regression Model

The baseline panel regression model is employed to examine the direct effect of asset allocation strategy on pension fund return investment. This model estimates whether changes in the proportion of investment allocated to each portfolio instrument (time deposits, government bonds, equities, and corporate bonds) significantly affect return investment, assuming that the relationship occurs directly without incorporating macroeconomic conditions as a moderating factor.

The baseline model is specified as follows:

$$ROI_{it} = a + b_1X1_{it} + b_2X2_{it} + b_3X3_{it} + b_4X4_{it} + e_{it}$$

a = constant term

b_1, b_2, b_3, b_4 = coefficients representing the direct effects of each investment instrument

$X1_{it}$ = proportion of investment in time deposits

$X2_{it}$ = proportion of investment in government bonds

$X3_{it}$ = proportion of investment in equities

$X4_{it}$ = proportion of investment in corporate bonds

e_{it} = error term

In this model, coefficients b_1 to b_4 indicate the direction and magnitude of the direct relationship between each asset allocation component and pension fund return investment. A positive coefficient implies that an increase in the proportion of the respective instrument tends to increase return investment, while a negative coefficient indicates the opposite.

Moderation Model (Moderated Regression Analysis)

To examine whether interest rates influence the strength of the relationship between asset allocation strategy and pension fund return investment, this study applies Moderated Regression Analysis (MRA). This approach is conducted by incorporating interaction terms between each investment instrument and the moderating variable, namely the interest rate.

The moderation model is specified as follows:

$$ROI_{it} = \alpha + b_1X1_{it} + b_2X2_{it} + b_3X3_{it} + b_4X4_{it} + b_5(X1_{it} \times M_t) + b_6(X2_{it} \times M_t) + b_7(X3_{it} \times M_t) + b_8(X4_{it} \times M_t) + \varepsilon_{it}$$

M_t = interest rate (BI 7-Day Reverse Repo Rate) in year t

$X1_{it} \times M_t$ = interaction between time deposits and interest rate

$X2_{it} \times M_t$ = interaction between government bonds and interest rate

$X3_{it} \times M_t$ = interaction between equities and interest rate

$X4_{it} \times M_t$ = interaction between corporate bonds and interest rate

b_5, b_6, b_7, b_8 = moderation coefficients

The interaction coefficients b_5 to b_8 are used to determine whether interest rates strengthen or weaken the effect of each asset allocation component on pension fund return investment. A statistically significant positive interaction coefficient indicates a strengthening effect, while a statistically significant negative coefficient indicates a weakening effect.

RESULTS AND DISCUSSION

The object of this study is pension fund institutions in Indonesia that are registered and supervised by the Financial Services Authority (Otoritas Jasa Keuangan/OJK). The study population consists of 191 pension funds recorded in the OJK Pension Fund Statistics for the 2020–2024 period. The sample was determined using purposive sampling based on the following criteria: (1) pension funds were active during 2020–2024; (2) pension funds were not under suspension, liquidation, or program termination status; (3) pension funds published complete and consistent annual financial statements; and (4) pension funds provided data on the proportion of investments allocated to time deposits, Indonesian Government Securities, equities, and corporate bonds throughout the observation period. Based on this selection process, 35 pension funds were obtained as the research sample, forming a balanced panel dataset for 2020–2024 with a total of 175 observations. This study examines the effect of asset allocation strategy across four major investment instruments on Return on Investment (ROI) and tests the role of Bank Indonesia’s policy interest rate (BI 7-Day Reverse Repo Rate/BI7DRR) as a moderating variable that may strengthen or weaken the relationship between asset allocation and ROI.

Data Analysis

Descriptive Statistics

Table 2 presents the descriptive statistics for all research variables. The average pension fund return on investment (ROI) is 0.065137, or approximately 6.51%. The asset allocation structure of pension fund portfolios is generally dominated by Indonesian Government Securities (mean = 30.78%), followed by time deposits (mean = 23.53%) and corporate bonds (mean = 23.38%). Meanwhile, equity investment has the smallest proportion (mean = 4.36%), indicating that pension funds in Indonesia tend to adopt a conservative investment strategy.

Table 2. Descriptive Statistics of Research Variables (n = 175)

Variable	Mean	Median	Min	Max	Std. Dev.
ROI (Y)	0.065137	0.064993	0.011937	0.171827	0.017840

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Time Deposits (X1)	0.235348	0.126133	0.002531	0.800719	0.230817
Government Securities (X2)	0.307758	0.290761	0.005654	0.607369	0.114418
Equities (X3)	0.043613	0.025942	0.000283	0.216085	0.045260
Corporate Bonds (X4)	0.233841	0.202977	0.001234	0.731683	0.177802
Interest Rate (M)	0.047490	0.043076	0.035208	0.061041	0.010258

Source: Processed from EViews output (2026).

Panel Data Regression Model Selection

Panel data regression model selection was conducted to determine the most appropriate estimator among the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). The selection procedure employed the Chow test, Hausman test, and Lagrange Multiplier (LM) test. The results indicate that the Random Effect Model (REM) is the most suitable model for this study.

Table 3. Panel Data Regression Model Selection

Test	Prob.	Decision
Chow Test (CEM vs FEM)	0.0000	FEM is preferred
Hausman Test (FEM vs REM)	0.1790	REM is preferred
Lagrange Multiplier Test (CEM vs REM)	0.0000	REM is preferred

Source: Processed from EViews output (2026).

Based on the Chow test (Prob < 0.05), FEM is preferred over CEM. However, the Hausman test result (Prob > 0.05) indicates that REM is more appropriate than FEM. The LM test (Prob < 0.05) further supports the use of REM over CEM. Therefore, the Random Effect Model (REM) was adopted as the primary model for hypothesis testing.

Classical Assumption Tests

Normality Test

Table 4. Normality Test Results (Jarque–Bera)

Statistic	Value
Observations (n)	175
Skewness	2.867977
Kurtosis	25.48711
Jarque–Bera	3927.083
Probability	0.291311

Source: Processed from EViews output (2026).

Residual normality was assessed using the Jarque–Bera test based on standardized residuals. As shown in Table 4, the probability value is 0.291311, which exceeds the 5% significance level. This result suggests that the residuals do not show strong evidence of non-normality. In addition, given the panel structure and the relatively large sample size (n = 175), normality is not treated as a strict requirement for valid estimation. Therefore, the study places greater emphasis on heteroskedasticity, serial correlation, and multicollinearity diagnostics to ensure reliable statistical inference.

Autocorrelation Test

Table 5. Autocorrelation Test Results (Durbin–Watson)

Model	Durbin–Watson	Conclusion
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REM	1.662918	No autocorrelation
Moderation model	2.044082	No autocorrelation

Source: Processed from EViews output (2026).

The Durbin–Watson statistics for the REM (1.662918) and the moderation model (2.044082) are close to 2, indicating that the models are not affected by autocorrelation.

Heteroskedasticity Test

Table 6. Heteroskedasticity Test Results (ABSRES)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003075	0.010786	0.285094	0.776009
Time Deposits (X1)	0.019127	0.017059	1.121167	0.264207
Government Securities (X2)	0.002603	0.017193	0.151414	0.879875
Equities (X3)	0.003588	0.027696	0.129575	0.897094
Corporate Bonds (X4)	-0.013199	0.012580	-1.049197	0.295961
Interest Rate (M)	0.036601	0.067747	0.540259	0.589908

Conclusion: All Prob. values exceed 0.05, indicating no heteroskedasticity.

Source: Processed from EViews output (2026).

Multicollinearity Test (Random Effect Model)

Multicollinearity was assessed using a correlation matrix. The model is considered free from multicollinearity when correlations among independent variables are below 0.80.

Table 7. Multicollinearity Test Result

Variables	X1	X2	X3	X4	M
Time Deposits	1.000	0.423	0.121	0.480	0.081
Government Securities	0.423	1.000	0.087	0.072	0.282
Equities	0.121	0.087	1.000	0.124	0.017
Corporate Bonds	0.480	0.072	0.124	1.000	0.109
Interest Rate	0.081	0.282	0.017	0.109	1.000

Source: Processed from EViews output (2026)

All pairwise correlations among the independent variables are below 0.80, indicating that the regression model does not suffer from multicollinearity. Therefore, the model is appropriate for hypothesis testing.

Hypothesis Testing (Main Model: REM)

Table 8. Summary of REM Regression Results and Interest Rate Moderation Test
Panel A. Direct Effects (REM)

Hypothesis	Variable	Coefficient	Prob.	Decision
H1	Time Deposits (X1) → ROI	-0.015130	0.121845	Rejected
H2	Government Securities (X2) → ROI	-0.007497	0.637726	Rejected
H3	Equities (X3) → ROI	0.019403	0.555002	Rejected
H4	Corporate Bonds (X4) → ROI	0.028637	0.010132	Accepted

Source: Processed from EViews output (2026).

Table 9. Panel B. Interest Rate Moderation (Interaction Effects)

Hypothesis	Interaction Variable	Coefficient	Prob.	Decision
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H5	X1×M (Time Deposits × Interest Rate)	0.214048	0.006331	Accepted
H6	X2×M (Government Securities × Interest Rate)	1.576352	0.012359	Accepted
H7	X3×M (Equities × Interest Rate)	4.685122	0.042136	Accepted
H8	X4×M (Corporate Bonds × Interest Rate)	0.348550	0.035918	Accepted

Source: Processed from EViews output (2026).

Summary of Findings

Overall, the results indicate that only corporate bonds have a statistically significant direct effect on pension fund ROI. In contrast, the interest rate significantly moderates the relationships between all asset allocation components (deposits, government securities, equities, and corporate bonds) and ROI.

The findings indicate that pension fund asset allocation strategies in Indonesia do not necessarily translate into higher investment returns directly. In the partial estimation, only corporate bonds show a positive and statistically significant effect on Return on Investment (ROI), while time deposits, government securities, and equities are not significant. This evidence strengthens the argument that defensive instruments such as deposits and government bonds primarily function as portfolio stabilizers rather than return-enhancing drivers. The insignificant effect of deposits is consistent with Linus et al. (2025), who report that allocating funds to highly liquid instruments does not significantly improve aggregate investment performance. This result is also supported by Hasa & Salva (2024), who emphasize that excessive cash holdings in pension funds may generate opportunity costs. In the Indonesian context, this finding aligns with Triyana & Muharam (2024), who conclude that deposits are not a major determinant of pension fund investment performance.

Regarding government securities, the results support Linus et al. (2025), who argue that government bonds mainly serve as safe assets with relatively moderate returns, thereby limiting their statistical contribution to ROI improvement. This is also consistent with Sun et al. (2023), who highlight that government bonds in pension fund portfolios are typically positioned as risk-control and stabilization instruments rather than as primary return-generating assets. Therefore, the dominance of government securities in Indonesian pension fund portfolios reflects a strong prudential preference, but it may constrain the potential for sustained return enhancement.

For equities, the estimated coefficient is positive but not statistically significant. This finding differs from Andonov & Rauh (2022), who emphasize that risky assets, including equities, represent the main source of long-term pension fund returns. However, the result is consistent with Triyana & Muharam (2024), who find that equities do not significantly explain pension fund returns in Indonesia. The divergence from parts of the global literature can be attributed to the relatively small equity allocation during the observation period, which limits its contribution to ROI variation. This explanation is consistent with Defau & De Moor (2021), who argue that increasing allocations to risky assets does not always produce stable returns due to market volatility and constraints in diversification strategies.

In contrast, corporate bonds emerge as the most consistent return-enhancing instrument. This result supports Triyana & Muharam (2024), who document a positive effect of corporate bonds on pension fund investment performance in Indonesia. The finding also aligns with Akwimbi et al. (2024), who show that corporate bonds can improve pension fund performance when supported by diversification and effective investment strategies. At the same time, the result provides a different perspective from Boyante et al. (2022), who report that corporate bonds may negatively affect pension fund performance due to credit risk exposure and market limitations. Overall, the evidence suggests that in the Indonesian context, corporate bonds tend to offer more competitive yields than deposits and government securities, enabling higher returns, although their effectiveness remains dependent on rigorous credit risk management.

CONCLUSION

This study concludes that pension fund asset allocation strategies in Indonesia during 2020–2024 do not automatically improve Return on Investment (ROI). In the partial estimation, only corporate bonds exhibit a positive and statistically significant effect on ROI, while time deposits, government securities, and equities do not show significant direct effects. These findings suggest that the dominance of defensive instruments in pension fund portfolios primarily supports stability, rather than serving as a key driver of return enhancement. In addition, the study confirms that interest rates play a significant moderating role. All interaction terms between interest rates and investment instruments (deposits, government securities, equities, and corporate bonds) are statistically significant, indicating that the effectiveness of asset allocation strategies is conditional on the prevailing interest rate regime. Practically, pension fund managers should adopt more adaptive allocation strategies in response to interest rate changes and optimize productive instruments such as corporate bonds, while maintaining prudential principles and robust risk management. Future research is recommended to incorporate additional macroeconomic variables and extend the observation period to provide a more comprehensive explanation of pension fund investment performance dynamics.

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