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OPTIMAL PORTFOLIO CONSTRUCTION MAXIMIZING INVESTOR UTILITY: A STUDY OF BBRI AND WIKA STOCKS

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Abstract

This study examines optimal portfolio construction within the context of the Indonesian capital market, focusing on an investor utility approach—specifically regarding BBRI and WIKA stocks. In an investment environment characterized by the risk-return trade-off, a utility-based approach is essential for explicitly capturing investor risk preferences. Consequently, this study aims to determine the optimal portfolio composition that maximizes investor utility, accounting for a specific level of risk aversion. The study employs a mean-variance theoretical framework extended by a quadratic utility function, with investor preferences represented by a risk aversion coefficient of 2.5. Stock return data are used to calculate expected returns and portfolio risk, as well as to determine optimal weights through a utility optimization process. The analysis reveals that the optimal portfolio is dominated by BBRI stock, comprising 98.28% of the portfolio, while WIKA stock accounts for only 1.72%. This combination yields an expected return of 0.43% and a risk level of 7.81%. The maximum utility value obtained is -0.0034. Although this utility value is negative, it remains theoretically valid; the utility function used is relative in nature and heavily influenced by the magnitude of risk and the investor's level of risk aversion during the optimization process. These findings indicate that, under certain conditions, a portfolio dominated by low-risk assets is preferred by investors with high risk aversion, even if it results in an absolute negative utility value. Thus, the study underscores the importance of considering investor risk preferences in investment decision-making and demonstrates that a utility value need not be positive to reflect an optimal investment decision.

Keywords: *optimal portfolio, utility, mean-variance, risk aversion, BBRI, WIKA*

JEL Classification: *G11, G12, G17.*

INTRODUCTION

Portfolio theory was first introduced in 1952 by Harry Markowitz as part of Modern Portfolio Theory (MPT), it is a financial framework that emphasizes the nature of investments. The theory posits that investors should not allocate all their funds to a single type of investment but should instead diversify across various assets, creating a portfolio, to reduce risk without compromising expected returns. In essence, this is a strategy that should be adopted. An investment portfolio is a crucial strategy for managing assets to achieve long-term financial goals. By constructing a portfolio, investors can mitigate risk while enhancing the potential for optimal returns. This strategy is relevant not only for financial institutions but also for individuals seeking to secure and grow their assets in a measured manner (Lesmana & Maulana, 2025).

Constructing an investment portfolio offers several benefits, one of which is risk diversification. By spreading investments across various assets with low or even negative correlations, individual risk can be minimized. This allows the underperformance of one asset to be offset by the performance of others. Diversification also helps mitigate inherent, or non-systematic risk, which affects only specific assets or entities, such as business failures or operational losses; through diversification, such risks can be entirely eliminated. Furthermore, return optimization can be achieved by selecting an asset mix that yields the best return for a given level of risk, or the lowest risk for a desired level of return (Ganefi et al., 2024).

An efficient portfolio is characterized by the inability to increase returns without increasing risk, or to reduce risk without lowering returns. When constructing a portfolio, the total risk involved comprises two types: systematic risk and unsystematic risk. Systematic risk, such as inflation, interest rate fluctuations, or a global economic crisis, cannot be eliminated through diversification because it affects all assets in the market. Conversely, unsystematic risk, which is specific to a particular company or industry, can be reduced or even eliminated through diversification.

Diversification can reduce portfolio total risk. This is because assets with low correlation within a portfolio balance each other out; losses in one asset can be offset by gains in another. The more assets held in a portfolio, the lower the individual risk exposure, leaving only unavoidable systematic risk. Holding a single stock exposes an investor to both company-specific risk and market risk. However, adding stocks from different sectors and industries can reduce overall portfolio volatility, as price movements across assets are not always perfectly correlated (Wiharno et al., 2023).

Ultimately, diversification is key to achieving optimal returns with lower risk. Holding a single stock exposes an investor to a combination of company-specific risk and market risk. However, adding stocks from various sectors and industries can reduce overall portfolio volatility, as the price movement of one asset is not always perfectly correlated with that of another. Portfolio theory asserts that diversification is key to achieving optimal returns with lower risk.

The Indonesian capital market has undergone a significant transformation in recent years, marked by a substantial rise in the number of active investors and market capitalization. The Indonesia Stock Exchange (IDX), as the capital market operator, continues to demonstrate rapid

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growth, reflected in various investment product innovations and increased trading liquidity (Lesmana et al., 2024). This phenomenon indicates a paradigm shift in how Indonesians manage their finances, moving from a saving society to an investing society (Ariyanti & Pangestuty, 2023).

Indonesia's capital market is projected to experience significant growth through the end of 2024. Key indicators reflecting the state of the market include the number of investors: as of December 27, 2024, there were 14.8 million capital market participants, 6.4 million of whom were equity investors. Market capitalization reached IDR 12,264 trillion as of December 27, 2024. Regarding average daily trading value (ADTV), the market reached IDR 12.85 trillion in 2024, a 19.6% increase from IDR 10.75 trillion in 2023. The total value of EBUS (Equity-Based and Underlying Securities) traded via the Alternative Market Provider System (SPPA) reached IDR 1.04 trillion in 2024, up 51.9% from IDR 686 billion in 2023.

The total value of non-equity transactions (rights, warrants, structured warrants, single stock futures, collective investment agreements, and derivatives) reached IDR 4.38 trillion as of December 27, 2024. New derivative products on the Carbon Exchange recorded a total trading volume valued at IDR 19.73 billion as of December 27, 2024. Regarding Initial Public Offerings (IPOs), 41 companies listed on the Indonesia Stock Exchange (IDX), raising IDR 14.35 trillion and bringing the total number of listed companies to 943 as of December 27, 2024. The Jakarta Composite Index (JCI) reached an all-time high of 7,905 on September 19, 2024. The data above indicates positive growth in Indonesia's capital market, driven by the rise in the stock price index, investor numbers, daily trading volume, and market capitalization.

In the context of investment portfolio optimization, the selection of financial instruments is a decisive factor influencing the achievement of investment objectives. Bank Rakyat Indonesia (BRI), possessing the largest market capitalization in the national banking industry, and Wijaya Karya (WIKA), representing the infrastructure sector, offer promising prospects for diversification. Although these two companies operate in different sectors, they both demonstrate solid business fundamentals and a consistent growth track record (Rachmawati et al., 2023).

The portfolio optimization approach that incorporates investor utility functions is becoming increasingly relevant amidst the complexity and volatility of contemporary capital markets. Utility functions, which represent an investor's risk preferences and return expectations, serve as crucial parameters in constructing portfolios that align with investment objectives. A comprehensive understanding of utility functions enables the creation of portfolios that are not only theoretically optimal but also practically applicable to the investor's specific characteristics (Warren, 2019).

With a strategic focus on the MSME segment, BRI has demonstrated its resilience in navigating various economic cycles. The financial institution has not only maintained stable operational performance but also exhibited impressive adaptability by accelerating its digital transformation. The implementation of comprehensive financial technology has further solidified BRI's position as the bank with the widest market penetration in Indonesia, underpinned by sophisticated

digital infrastructure (Ibrahim et al., 2024).

As a key player in the national construction and infrastructure industry, WIKA presents attractive growth prospects aligned with the continuity of the government's infrastructure development programs. The company consistently demonstrates progress in developing construction technology capabilities and diversifying its project portfolio, contributing to long-term sustainable growth. Technological innovation and expansion into new business segments strengthen WIKA's competitive position within the national construction industry (Purnomo et al., 2024).

Integrating stocks from the banking and infrastructure sectors into a single portfolio represents the implementation of a diversification strategy aimed at optimizing the risk-return profile. The moderate return correlation between these two sectors offers superior diversification benefits for mitigating aggregate portfolio risk. Empirical analysis indicates that combining these two sectors can yield a more optimal efficient frontier compared to single-sector portfolios (Athaide, 2012).

The evolution of the Indonesian capital market, accompanied by the growing sophistication of retail investors, necessitates a more systematic approach to portfolio construction. A deep understanding of investment instrument characteristics, market dynamics, and investor preferences is a prerequisite for achieving sustainable portfolio optimization. Recent research demonstrates that portfolio optimization incorporating utility functions yields superior performance compared to traditional approaches (Kubo & Nakagawa, 2025).

The ongoing digital transformation in the financial and infrastructure sectors is opening up new growth opportunities while simultaneously creating challenges regarding valuation and risk analysis. BRI and WIKA, representing their respective sectors, demonstrate a high degree of adaptability in the face of technological disruption. This adaptive capability is a significant factor in determining the long-term performance sustainability of both companies (Akbar & Faeni, 2025).

The objective of this study is to construct an optimal portfolio tailored to an investor's needs and preferences, specifically, a portfolio capable of delivering maximum returns at an acceptable level of risk. This concept relies on a utility function, which describes how each investor evaluates the trade-off between return and risk. An optimal portfolio is designed to balance potential gains with a risk level comfortable for the investor, thereby making investment decisions more strategic and aligned with long-term financial goals.

LITERATURE REVIEW

Portfolio theory is an approach to optimizing the combination of investment assets in order to maximize expected return for a given level of risk or to minimize risk for a given level of expected return. This concept was first developed by Harry Markowitz in his 1952 work, “Portfolio Selection.” The theory underscores the importance of diversification in reducing total portfolio risk through the combination of assets that are uncorrelated with one another (Markowitz, 1952).

The key components of portfolio theory are expected return, risk (standard deviation), and the correlation between assets. Markowitz demonstrated that

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portfolio risk can be minimized by selecting assets that exhibit low or negative correlations with each other. The portfolio efficiency graph, known as the Efficient Frontier, illustrates the optimal asset combinations for various levels of risk (Elton et al., 2014).

Portfolio return is the weighted average of the individual returns of each asset within the portfolio. This return represents the expected profit level for the entire portfolio based on the investment allocation across the respective assets. This concept helps investors understand the contribution of each asset to the portfolio's overall performance (Bodie, Kane, & Marcus, 2018). For instance, if an investor holds a portfolio comprising three assets with weights of 40%, 35%, and 25%, and respective returns of 10%, 12%, and 8%, this figure indicates the expected average return of the portfolio.

Portfolio risk reflects the volatility or uncertainty of the portfolio's return. This risk is calculated based on the weights and volatilities of the individual assets, as well as the correlations between them. This concept is significant because total portfolio risk can be reduced through diversification, specifically, by combining assets that exhibit low or negative correlations (Ross et al., 2019). If two assets have a low correlation, the total portfolio risk can be lower than the weighted average of the individual assets' risks.

Portfolio return and risk share a direct and significant relationship. In portfolio theory, investors must determine an asset combination that yields the optimal return for a given level of risk, or the minimum risk for a given level of return. This concept is embodied in the Efficient Frontier, which illustrates optimal portfolio combinations (Markowitz, 1952).

Diversification is a strategy used to reduce unsystematic risk by including a variety of assets in a portfolio. Effective diversification occurs when the assets within the portfolio have low correlations. Consequently, fluctuations in the return of one asset can be offset by other assets, thereby lowering the portfolio's overall risk without sacrificing expected returns (Elton et al., 2014).

In the context of investment, utility refers to the level of satisfaction an investor derives from the outcomes of their investment decisions. This concept underpins behavioral economic theory, wherein individual preferences regarding risk and return influence decision-making; utility reflects how an investor evaluates the trade-off between risk and return, thereby enabling investment decisions that are more personalized and quantifiable (Pratt & Zeckhauser, 1985).

In modern portfolio theory, utility is frequently expressed through a utility function that relates risk to expected return. This function aims to provide a metric that assists investors in selecting an optimal portfolio aligned with their preferences. Investors with a high degree of risk aversion tend to favor low-risk portfolios, even if they offer lower potential returns (Charness et al., 2021).

Utility can also be measured using a quantitative approach to mathematically reflect investor satisfaction. One frequently used method is the negative exponential function; this illustrates an inverse relationship between risk and utility, indicating that risk-averse investors experience a significant decline in utility when facing high market volatility (Kalra & Gupta, 2023).

Furthermore, changing market conditions, such as global economic uncertainty, can influence investor utility. Investor utility tends to rise when portfolios consist of defensive assets, such as bonds or gold, during periods of uncertainty. This demonstrates that utility preferences are not merely static but are also shaped by external factors (Kim et al., 2023).

Understanding the concept of utility enables portfolio managers to design investment strategies that are more adaptive and aligned with investor preferences. By maximizing utility, investors can achieve an optimal balance between the risk undertaken and the satisfaction derived from their investment outcomes.

METHODS

This study selects the shares of Bank Rakyat Indonesia (BRI) and Wijaya Karya (WIKA) as the sample for several reasons. First, these companies possess large market capitalizations, reflecting their significant roles within their respective sectors. Second, the stock price movements of BRI and WIKA exhibit patterns that are compelling to analyze in the context of portfolio diversification. Third, the combination of the financial and construction sectors is viewed as complementary in terms of risk and return, thereby enabling a more optimal diversification simulation.

This study employs a quantitative approach, utilizing historical stock data analysis to calculate portfolio return and risk. The analytical tool used is portfolio analysis based on the Markowitz model. Utility is defined as a function of expected return and risk. This utility value serves as a tool for ranking assets or portfolios. Investors select the portfolio with the highest utility. The utility function follows the Association of Investment Management and Research (AIMR) version (Bodie et al., 2018).

$$U = E(R_p) - \frac{1}{2}A\sigma_p^2$$

where A is the risk aversion coefficient, $E(R_p)$ is the expected portfolio return, and σ_p^2 is the variance of the portfolio return.

For a portfolio consisting of two stocks with expected returns $E(R_1)$ and $E(R_2)$, variance return σ_1^2 and σ_2^2, and covariance $Cov(R_1, R_2)$, the expected return and the variance of the portfolio return are defined as

$$E(R_p) = w_1 E(R_1) + w_2 E(R_2)$$

$$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1 w_2 Cov(R_1, R_2)$$

We seek the weight w that maximizes utility. To do this, we differentiate the utility function with respect to w and set the derivative equal to zero.

$$\frac{dU}{dw} = 0$$

$$w^* = \frac{E(R_1) - E(R_2) + A\left(\sigma_2^2 - Cov(R_1, R_2)\right)}{A\left(\sigma_1^2 + \sigma_2^2 - 2Cov(R_1, R_2)\right)}$$

RESULT AND DISCUSSIONS

Result

The research sample consists of the closing prices of BBRI and WIKA shares, obtained from https://id.investing.com for the five-year period from 2019 to 2024. These closing prices are used to calculate the returns for both stocks. The data for the two stocks are presented below:

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Table 1. BBRI Stock Closing Price

BBRI	2019	2020	2021	2022	2023	2024
January	3756	4351	4078	4070	4580	5700
February	3756	4088	4595	4550	4670	6125
March	4020	2946	4293	4660	4730	6050
April	4263	2663	3951	4870	5100	4940
May	4000	2878	4156	4630	5575	4340
June	4254	2956	3844	4150	5425	4600
July	4371	3083	3620	4360	5650	4670
August	4166	3424	3834	4340	5550	5150
September	4020	2966	3850	4490	5225	4950
October	4107	3278	4250	4650	4960	4800
November	3990	3990	4090	4980	5275	4250
December	4293	4068	4110	4940	5725	4080

Table 2. WIKA Stock Closing Price

WIKA	2019	2020	2021	2022	2023	2024
January	1610	1606	1529	879	586	162
February	1517	1593	1478	858	535	112
March	1835	709	1304	845	438	86
April	2056	807	1223	807	514	193
May	1929	922	1062	820	311	390
June	2065	1020	841	824	429	368
July	1988	1011	782	794	372	378
August	1878	1054	799	909	335	294
September	1636	930	1028	786	389	244
October	1682	1024	1058	773	326	-
November	1474	1376	986	790	321	-
December	1691	1687	939	680	204	-

BBRI demonstrated a higher level of stability compared to WIKA. As part of the banking sector, BBRI managed to maintain relatively consistent performance, despite experiencing a decline at the onset of the COVID-19 pandemic in 2020. In contrast, WIKA shares, belonging to the construction sector, exhibited greater volatility, primarily due to infrastructure projects being delayed during that period.

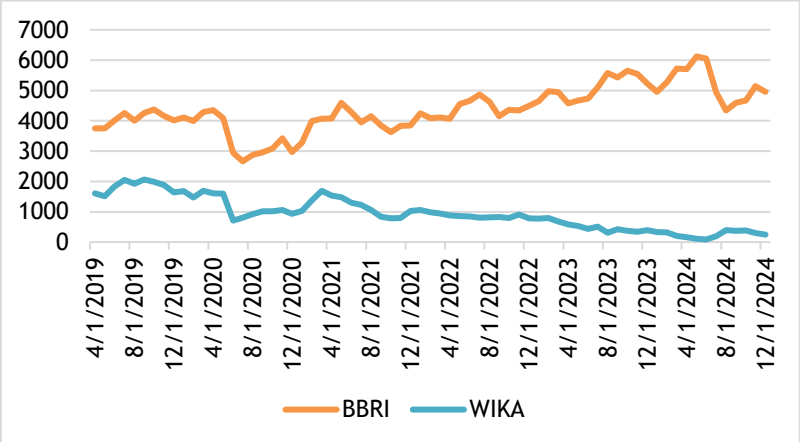

Figure 1. Return of BBRI and WIKA

In terms of average returns, BBRI demonstrated more consistent performance, yielding a higher number of positive returns compared to WIKA. During the pandemic, WIKA stock exhibited greater vulnerability, evidenced by a sharp drop in returns in March 2020 (-0.55493), whereas BBRI experienced only a moderate decline (-0.129412) during the same period. This indicates that the banking sector adapts more quickly to market pressures than the construction sector.

An efficient portfolio is an asset combination that maximizes the rate of return for a given level of risk or minimizes risk for a specific level of return (Harry Markowitz, 1952). Based on this theory, assets with stable returns and low volatility better meet the criteria for an efficient portfolio. In this context, BBRI stock aligns more closely with the characteristics of an efficient portfolio, while WIKA stock is better suited for investors with a high-risk tolerance who are aiming for portfolio diversification.

Table 3. Expected Return and Variance of BBRI and WIKA

Expected Return		Variance	
BBRI	**WIKA**	**BBRI**	**WIKA**
0.00436	-0.00111	0.00624	0.06572

BBRI stock outperforms WIKA stock; this is evident from BBRI's positive expected return, which signals potential profit for investors. Conversely, WIKA's negative expected return indicates a risk of loss, making it less attractive for an investment portfolio, particularly for risk-averse investors. Overall, BBRI stock offers a higher opportunity for efficient portfolio management compared to WIKA stock, given its prospects for positive returns and lower risk of loss. Naturally, this choice should still take into account other factors, such as risk tolerance and investment objectives. Variance indicates the extent to which data is dispersed around its mean. For BBRI, the recorded variance is 0.00624, indicating that value fluctuations for the company are relatively small and more consistent. In contrast, WIKA's variance stands at 0.06572, reflecting a significantly higher level of fluctuation and greater variability. Ultimately, BBRI demonstrates greater stability compared to WIKA, whose data tends to be less predictable.

Table 4. Covariance Between BBRI and WIKA

Covariance
BBRI dan WIKA
-0.00178

A negative covariance indicates that the return movements of the two stocks tend to move in opposite directions; thus, when the return on BBRI stock rises, the return on WIKA stock tends to fall, and vice versa. Theoretically, this condition reflects the potential for significant diversification benefits in portfolio construction. Within the framework of Markowitz portfolio theory, negative covariance is a desirable characteristic because it can reduce total portfolio risk without a proportional sacrifice in expected return.

Table 5. Asset Allocation (Weight) for BBRI dan WIKA

BBRI	WIKA
0.9828	0.0172

Portfolio optimization results indicate that the investment fund allocation is significantly dominated by BBRI stock, with a weight of 98.28%, whereas WIKA stock accounts for only 1.72%. These findings suggest that, within

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a utility-based optimization framework assuming a risk aversion coefficient of 2.5, BBRI stock exhibits far more optimal risk-return characteristics than WIKA stock.

The dominance of BBRI in the portfolio weighting can be attributed to a combination of relatively more stable expected returns and lower risk levels compared to WIKA. In the mean-variance model, assets with a higher risk-adjusted return ratio tend to receive a larger allocation within the optimal portfolio. Consequently, BBRI serves as the dominant asset in the portfolio construction, while WIKA acts as a complementary asset making a limited contribution.

Table 6. Expected Return Portfolio, Portfolio Risk, and Utility

Expected Return	Standard Deviation	Utility
0.00426	0.0781	-0.00337

The analysis results indicate that the constructed optimal portfolio yields an expected return of 0.42%, with a risk level, measured by standard deviation, of 7.81%. This expected return represents the return anticipated by investors for each observation period, while the standard deviation reflects the level of volatility or return uncertainty involved. Within the mean-variance theory framework, the combination of these two measures illustrates the risk-return trade-off that serves as the basis for investment decision-making.

A standard deviation value that is relatively high compared to the expected return indicates that the portfolio carries a significant level of risk relative to its potential return. This suggests that portfolio return fluctuations tend to be substantial, requiring investors to consider their risk tolerance before allocating funds. Nevertheless, within the context of utility-based optimization, this combination of return and risk reflects an optimal point aligned with the investor's preferences, as represented by the applied risk aversion coefficient.

An interesting finding in our optimization is that while the optimal portfolio weight w strictly satisfies the first-order conditions for utility maximization, the resulting maximum utility value U^* remains negative. In mean-variance framework, this does not indicate a mathematical error; rather, it reflects a severely constrained or highly volatile market regime. Because utility functions are ordinal constructs used to rank choices, a negative peak value demonstrates that under current asset allocations, the risk-adjusted penalty structurally exceeds the expected returns. The model successfully identifies the optimal allocation by choosing the portfolio that minimizes the investor's net disutility.

Discussion

The research results indicate that the resulting optimal portfolio is dominated by BBRI stock, with a proportion of 98.28%, while WIKA accounts for only 1.72%; this portfolio is characterized by a relatively low expected return, fairly high risk, and a negative maximum utility value. These findings directly address the research objective of determining a portfolio composition that maximizes investor utility. Within a utility-based mean-variance framework, optimality is determined by the balance between return and risk according to investor preferences, rather than by the magnitude of the return alone (Lin et al., 2023).

The dominant weighting of BBRI indicates that the stock possesses superior risk-return characteristics compared to

WIKA. This aligns with findings that mean-variance models tend to yield concentrated portfolios when there are significant differences between assets (Cesarone et al., 2023). Nevertheless, WIKA remains relevant in the context of diversification, particularly due to its negative covariance, which contributes to reducing portfolio risk.

A negative maximum utility value does not contradict theory, as utility is relative. This value reflects that the risk penalty outweighs the expected return, particularly for investors with high risk aversion (Boido & Fasano, 2023). Thus, the portfolio remains optimal because it yields the highest utility compared to other alternatives.

Overall, the findings of this study are consistent with literature indicating that investor risk preferences and data characteristics significantly influence portfolio optimization outcomes (Lassance, 2022). For future research, it is recommended to expand the number of assets and employ a robust approach to achieve greater portfolio diversification and stability.

CONCLUSION

Based on the analysis, this study concludes that the optimal portfolio maximizing investor utility regarding BBRI and WIKA stocks results in a composition heavily dominated by BBRI (98.28%), with WIKA accounting for only 1.72%. This portfolio yields an expected return of 0.0042 and a risk level (standard deviation) of 0.0781. The maximum utility value obtained is negative (-0.00337); however, this remains theoretically consistent, as the utility function is relative and reflects the balance between return and risk based on the investor's level of risk aversion. These findings demonstrate that within a utility-based optimization framework, investment decisions are driven more by risk preferences and asset characteristics than by return alone. Furthermore, the negative covariance between the two stocks provides diversification benefits, despite the relatively small contribution of the second asset.

This study has several limitations, including the restriction of assets to only two stocks and the use of the classic mean-variance model, which is sensitive to parameter estimation. Therefore, future research is encouraged to expand the number of assets in the portfolio to allow for a more comprehensive analysis of diversification effects. Additionally, employing alternative approaches, such as robust optimization, or incorporating other risk factors (e.g., skewness and kurtosis) could enhance the stability of the results. For practitioners, these findings underscore the importance of considering risk preferences in investment decision-making and focusing not merely on the magnitude of returns, but also on achieving an optimal balance between return and risk.

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