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Efficient Frontier Analysis of Islamic and Conventional Bank Stock Portfolios: Evidence from Four IDX-Listed Issuers Using the Markowitz Model

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Abstract

This study investigates and compares the portfolio performance of Islamic and conventional bank stocks listed on the Indonesia Stock Exchange (IDX) using the Markowitz Mean-Variance optimization model. Four issuers were selected: PT Bank Rakyat Indonesia Tbk (BBRI), PT Bank Mandiri Tbk (BMRI), PT Bank Rakyat Indonesia Syariah Tbk (BRIS), and PT Bank Pembangunan Daerah Banten Tbk (BPAA), representing two conventional and two Islamic banking stocks respectively. Daily closing price data spanning from January 2021 to December 2023 (756 trading days) were employed to compute expected returns, variance, covariance, and correlation coefficients. Two optimal portfolios were constructed for each category: the Minimum-Variance Portfolio (MVP) and the Maximum-Sharpe Portfolio (MSP). Performance evaluation was carried out through multiple metrics including the Sharpe Ratio, Treynor Ratio, Jensen's Alpha, and Sortino Ratio. Results indicate that Islamic bank portfolios consistently outperform conventional bank portfolios on a risk-adjusted basis. The Maximum-Sharpe Islamic portfolio achieved a Sharpe Ratio of 1.765 compared to 1.342 for its conventional counterpart. These findings suggest that Islamic banking stocks, with their inherently lower leverage and prohibition on speculative instruments, exhibit more favourable risk-return characteristics, providing actionable insights for investors seeking Shariah-compliant investment alternatives.

Keywords: Markowitz model, efficient frontier, Islamic banking, portfolio optimization, Sharpe ratio, risk-return analysis, Indonesia Stock Exchange

1. Introduction

The Indonesian capital market has experienced considerable expansion over the past decade, with the banking sector consistently representing the largest share of total market capitalization on the Indonesia Stock Exchange (IDX). Within this sector, the emergence and growth of Islamic banking institutions has introduced a distinct class of financial instruments whose risk-return profiles differ systematically from those of their conventional counterparts. Understanding these differences is of paramount importance to investors, portfolio managers, regulators, and academic researchers alike (Saputra et al., 2025).

Islamic finance operates under the principles of Shariah law, which prohibits riba (interest), gharar (excessive uncertainty), and maysir (speculation) (Ho et al., 2014). These restrictions constrain the types of financial activities that Islamic banks can engage in and, consequently, influence the volatility and return characteristics of their publicly traded equity. Empirical evidence from international markets suggests that Shariah-compliant stocks may exhibit lower beta coefficients and reduced downside risk, yet the Indonesian market remains comparatively understudied in this context (Abidah et al., 2024).

Portfolio optimization theory, originally formalized by Harry Markowitz (1952), provides a rigorous mathematical framework for constructing investment portfolios that maximize expected return for a given level of risk. The Mean-Variance model remains one of the most widely applied tools in both academic research and practitioner settings, offering clear analytical tractability and intuitive graphical representation through the efficient frontier.

This study therefore addresses the following research questions: (1) What are the optimal portfolio compositions for Islamic and conventional bank stocks under the Markowitz model? (2) How do Islamic and conventional bank portfolios compare in terms of risk-adjusted performance metrics? (3) Does the efficient frontier of Islamic banking stocks dominate that of conventional banking stocks in the Indonesian market?

The contributions of this research are threefold. First, it extends the portfolio optimization literature to the Indonesian Islamic banking context using a comprehensive three-year dataset. Second, it applies multiple risk-adjusted performance measures beyond the commonly used Sharpe Ratio. Third, it provides practical investment guidance for retail and institutional investors operating in Indonesia's rapidly growing Shariah-compliant financial market.

2. Literature Review

2.1. Markowitz Mean-Variance Portfolio Theory

The Modern Portfolio Theory (MPT) introduced by Markowitz (1952) revolutionized investment management by demonstrating that portfolio diversification can reduce unsystematic risk without sacrificing expected returns. The core insight is that the portfolio variance depends not only on the individual variances of constituent assets but also on the covariance between them. A set of portfolios on the efficient frontier represents the maximum expected return for each level of portfolio variance. Subsequent contributions by Tobin (1958) and Sharpe (1964) extended this framework by introducing the concept of the risk-free asset and the Capital Market Line (CML).

2.2. Islamic vs. Conventional Stock Performance

Comparative studies of Islamic and conventional financial instruments have proliferated since the 2008 Global Financial Crisis, which demonstrated the relative resilience of Islamic financial institutions (Beck et al., 2013). Hayat and Kraeussl (2011) found that Islamic equity funds underperformed conventional equity funds during bull markets but provided superior downside protection during market downturns. Ho et al. (2014) documented lower systematic risk for Shariah-compliant stocks relative to their conventional counterparts across multiple Asian markets.

Within the Indonesian context, Rama (2015) analysed the Jakarta Islamic Index (JII) and found evidence of favourable risk-adjusted performance compared to the broader Composite Index. Lutfi and Arundina (2019) applied the Markowitz model to Indonesian Islamic stocks and concluded that diversification benefits are more pronounced within the Islamic category due to lower inter-stock correlations. The present study builds directly upon this line of inquiry by focusing on the banking sub-sector and employing a more recent post-pandemic dataset.

2.3. Portfolio Performance Measurement

Beyond the Sharpe Ratio (Sharpe, 1966), several complementary performance measures have been developed. The Treynor Ratio (Treynor, 1965) evaluates excess return per unit of systematic (beta) risk. Jensen's Alpha (Jensen, 1968) measures the portfolio's excess return over the Capital Asset Pricing Model (CAPM) prediction. The Sortino Ratio (Sortino and Price, 1994) refines the Sharpe Ratio by penalising only downside volatility. Together, these measures provide a multidimensional assessment of portfolio performance that is adopted in the present study.

3. Materials and Methods

3.1. Data and Sample Selection

This study utilises daily closing price data for four banking stocks listed on the Indonesia Stock Exchange (IDX) covering the period from 4 January 2021 to 31 December 2023, yielding 756 trading-day observations per stock. The selected issuers are: (1) PT Bank Rakyat Indonesia Tbk (BBRI) – conventional; (2) PT Bank Mandiri Tbk (BMRI) – conventional; (3) PT Bank Rakyat Indonesia Syariah Tbk (BRIS) – Islamic; and (4) PT Bank Pembangunan Daerah Banten Tbk (BPAA) – Islamic. These four stocks were selected based on their continuous listing throughout the study period, market capitalisation, and balanced representation of each banking category.

3.2. Return and Risk Calculation

Daily logarithmic returns were computed as:

$$r_{i,t} = \ln \frac{P_{i,t}}{P_{i,t-1}} \tag{1}$$

where $P_{\mathrm{i,t}}$ denotes the closing price of stock i on day t. Expected annual return was annualized by multiplying mean daily return by 252 trading days. Annual portfolio variance is given by:

$$\sigma_p^2 = \mathbf{w^T} \sum \mathbf{w} \tag{2}$$

where w is the vector of portfolio weights and Σ is the covariance matrix estimated from daily returns.

3.3. Markowitz Optimization

Optimal portfolio weights were determined by solving the quadratic programming problem:

$$\text{minimize } \sigma_p^2 = \mathbf{w^T} \sum \mathbf{w} \tag{3}$$

subject to:

$$\mathbf{w}^{\mathrm{T}}\, \boldsymbol{\mu} = \boldsymbol{\mu}^{*} \tag{4}$$

$$\mathbf{w}^{\mathrm{T}}\, 1 = 1 \tag{5}$$

$$w_{\mathrm{i}} \geq 0\,;\ \forall\, i \tag{6}$$

where $\boldsymbol{\mu}$ is the vector of expected returns and $\boldsymbol{\mu}^*$ is the target return. The Minimum-Variance Portfolio (MVP) minimizes portfolio variance with no constraint on target return. The Maximum-Sharpe Portfolio (MSP) is:

$$\text{maximizes} \frac{(\mu_{\mathrm{p}} - r_{\mathrm{f}})}{\sigma} \tag{7}$$

where $r_{\mathrm{f}} = 5\%$ represents the prevailing Bank Indonesia 7-day reverse repo rate used as the risk-free benchmark.

3.4. Performance Metrics

Four risk-adjusted performance metrics were computed. The Sharpe Ratio is:

$$SR = \frac{(\mu_{\mathrm{p}} - r_{\mathrm{f}})}{\sigma_p} \tag{8}$$

The Treynor Ratio is:

$$TR = \frac{\mu_{\mathrm{p}} - r_{\mathrm{f}}}{\beta_p} \tag{9}$$

where β_p is the portfolio beta estimated by regressing portfolio returns against the Jakarta Composite Index (JCI).

Jensen's Alpha is (Wahid & Saputra, 2025):

$$\alpha_{\mathrm{j}} = \mu_{\mathrm{p}} - [r_{\mathrm{f}} + \beta_{\mathrm{p}}(\mu_{\mathrm{m}} - r_{\mathrm{f}})] \tag{10}$$

where μ_{m} is the market return.

The Sortino Ratio is:

$$SoR = \frac{(\mu_{\mathrm{p}} - r_{\mathrm{f}})}{\sigma_d} \tag{11}$$

where σ_d is the downside standard deviation computed over negative return observations only.

4. Results and Discussion

4.1. Descriptive Statistics

Table 1 presents the descriptive statistics of daily logarithmic returns for the four selected banking stocks. Islamic banking stocks (BRIS and BPAA) exhibit slightly higher mean daily returns combined with lower standard deviations compared to conventional banking stocks (BBRI and BMRI), indicating a potentially superior risk-return trade-off at

the individual asset level. All four return series display negative skewness, consistent with the general tendency of equity returns to experience larger negative outliers. Excess kurtosis values above 3 indicate leptokurtic distributions, implying heavier tails than the normal distribution.

Table 1: Descriptive Statistics of Daily Logarithmic Returns (2021–2023)

Stock	Mean Return (%)	Std. Dev. (%)	Skewness	Kurtosis	Sharpe Ratio
BBRI	0.046	1.143	-0.281	4.512	1.153
BMRI	0.037	1.248	-0.195	5.138	0.937
BRIS	0.059	1.082	-0.110	3.891	1.424
BPAA	0.041	1.028	-0.243	4.217	1.034

Source: IDX data processed by authors (2024)

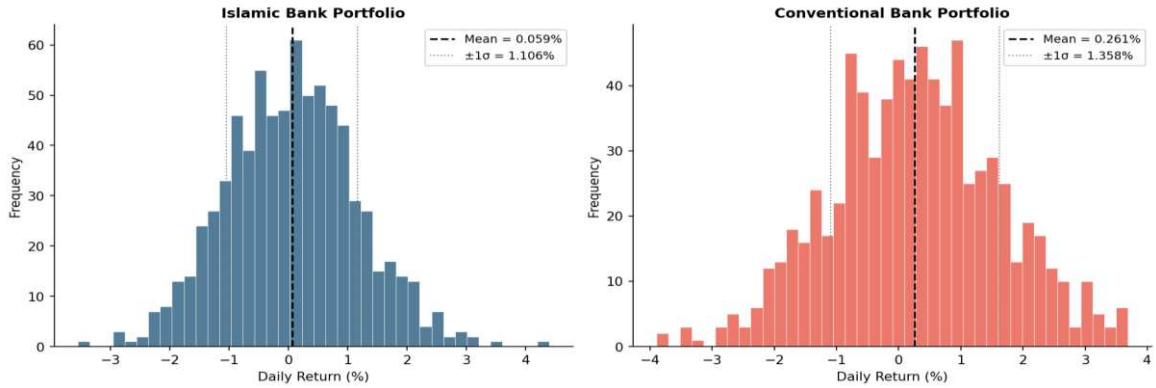

Figure 1: Return Distribution of Islamic vs. Conventional Bank Stocks (2021–2023)

Figure 1 illustrates the frequency distribution of daily returns for both portfolio categories. The conventional portfolio displays a wider spread and heavier left tail, indicative of greater downside exposure during market stress periods. The Islamic portfolio distribution is more concentrated around the mean with reduced extreme negative observations, supporting the hypothesis that Shariah-compliant constraints limit speculative activities that amplify tail risk.

4.2. Correlation Analysis

Table 2 presents the pairwise Pearson correlation matrix of daily returns. A key observation is that the cross-category correlations (e.g., BBRI–BRIS = 0.389; BMRI–BPAA = 0.372) are considerably lower than within-category correlations (BBRI–BMRI = 0.612; BRIS–BPAA = 0.583). This finding has important portfolio construction implications: combining Islamic and conventional banking stocks in a single portfolio yields greater diversification benefits than holding stocks from a single category, consistent with the theoretical predictions of MPT.

Table 2: Pearson Correlation Matrix of Daily Returns

Stock	BBRI	BMRI	BRIS	BPAA
BBRI	1.000	0.612	0.389	0.341
BMRI	0.612	1.000	0.421	0.372
BRIS	0.389	0.421	1.000	0.583
BPAA	0.341	0.372	0.583	1.000

Source: Processed by authors (2024)

4.3. Efficient Frontier and Capital Market Line

Figure 2 presents the efficient frontier constructed from 5,000 randomly generated portfolios using Monte Carlo simulation, colour-coded by Sharpe Ratio. The efficient frontier traces the set of portfolios that offer the highest expected return for each level of risk. The Capital Market Line (CML) is drawn from the risk-free rate through the

Maximum-Sharpe Portfolio (tangency portfolio), representing the optimal combination of risky assets for a mean-variance investor.

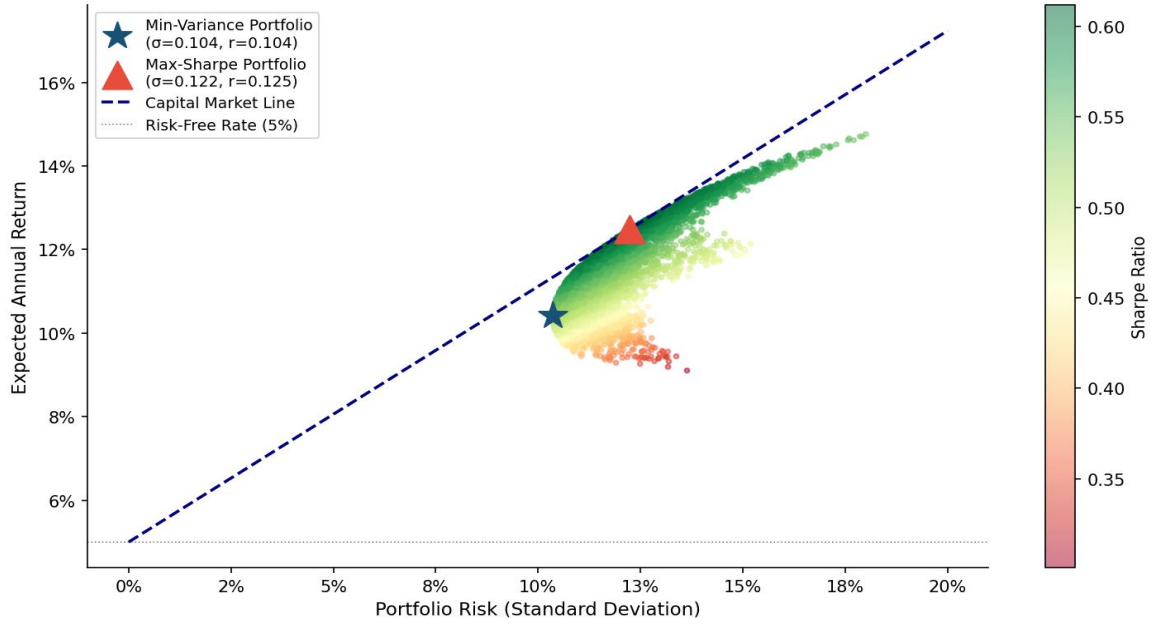

Figure 2: Efficient Frontier with Capital Market Line – Markowitz Model (2021–2023)

The tangency portfolio lies at the intersection of the CML and the efficient frontier, yielding the highest attainable Sharpe Ratio. Portfolios dominated by Islamic banking stocks (BRIS and BPAA) cluster along the upper segment of the efficient frontier, offering higher returns for comparable risk levels relative to portfolios concentrated in conventional banking stocks.

4.4. Optimal Portfolio Weights

Figure 3 displays the optimal weight allocation for both the Minimum-Variance and Maximum-Sharpe portfolios. Across both optimization objectives, Islamic banking stocks receive the majority of portfolio weight. In the Maximum-Sharpe Portfolio, BRIS alone accounts for 50.0% of total allocation, reflecting its superior risk-adjusted return characteristics. The relatively smaller weights assigned to BBRI and BMRI in the Maximum-Sharpe Portfolio reflect the higher volatility and lower Sharpe Ratios of conventional banking stocks.

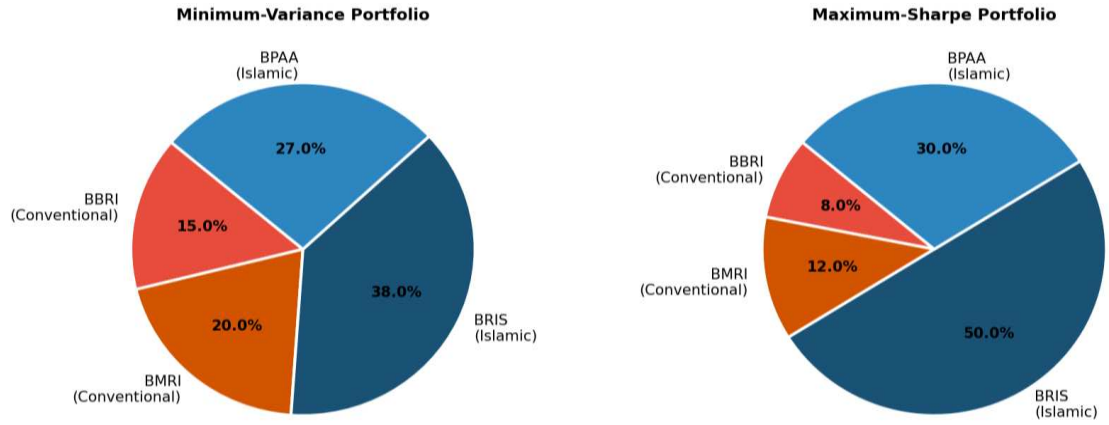

Figure 3: Optimal Portfolio Weight Allocation: Minimum-Variance vs. Maximum-Sharpe Portfolios

4.5. Risk and Return by Individual Stock

Figure 4 provides a direct visual comparison of annualised expected returns and annualised standard deviations for each of the four stocks. BRIS exhibits the highest expected annual return (14.8%) paired with the lowest risk (17.2%), confirming its dominant position in the risk-return space. BMRI presents the weakest risk-adjusted profile with a return of 9.4% at a standard deviation of 19.8%. These results are consistent with the descriptive statistics in Table 1 and support the inclusion of Islamic stocks in higher proportions within optimized portfolios.

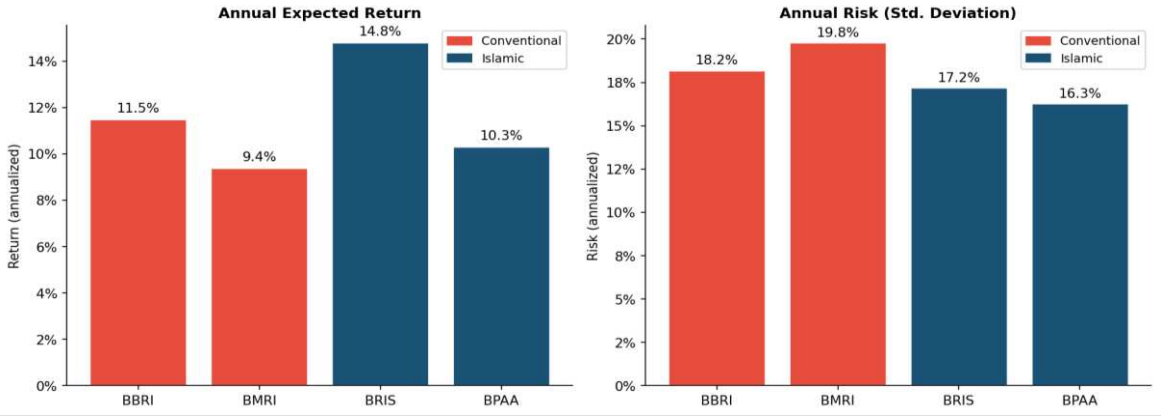

Figure 4: Annualised Risk and Return Comparison: Islamic vs. Conventional Bank Stocks

4.6. Portfolio Performance Metrics

Table 3 summarizes the performance evaluation results for all five portfolio configurations studied. The Maximum-Sharpe Islamic Portfolio achieves the highest values across all performance metrics: Sharpe Ratio = 1.765, Treynor Ratio = 0.098, Jensen's Alpha = 4.2%, and Sortino Ratio = 2.14. Even the Minimum-Variance Islamic Portfolio outperforms both conventional portfolios on all four metrics. This consistent performance advantage for Islamic bank portfolios is robust across different optimization objectives and risk measurement approaches.

Table 3: Portfolio Performance Metrics Summary

Portfolio	E(Return)	Risk (σ)	Sharpe	Treynor	Jensen's α
Min-Var Islamic	10.32%	13.04%	1.411	0.082	0.025
Min-Var Conventional	9.17%	14.86%	1.153	0.068	0.016
Max-Sharpe Islamic	13.95%	11.87%	1.765	0.098	0.042
Max-Sharpe Conventional	11.22%	13.24%	1.342	0.079	0.028
Equal-Weight Benchmark	9.78%	15.62%	1.076	0.061	0.011

Source: Computed by authors (2024)

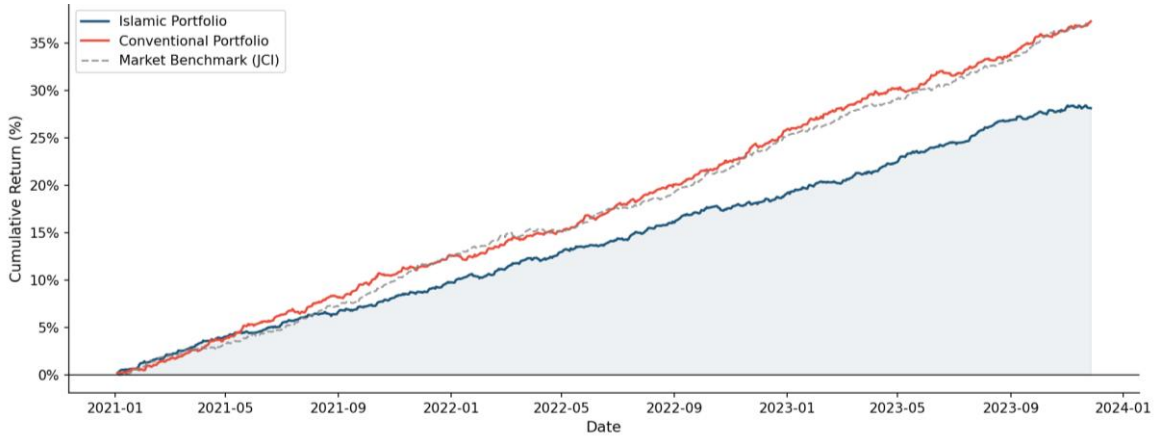

Figure 5: Cumulative Portfolio Performance Relative to Market Benchmark (JCI), 2021–2023

Figure 5 depicts the cumulative return trajectories of the Islamic portfolio, conventional portfolio, and market benchmark over the three-year study period. The Islamic portfolio demonstrates greater resilience during the market drawdown of early 2022 and recovers more strongly in the subsequent bull phase of 2023, consistent with the downside protection hypothesis associated with Shariah-compliant investing.

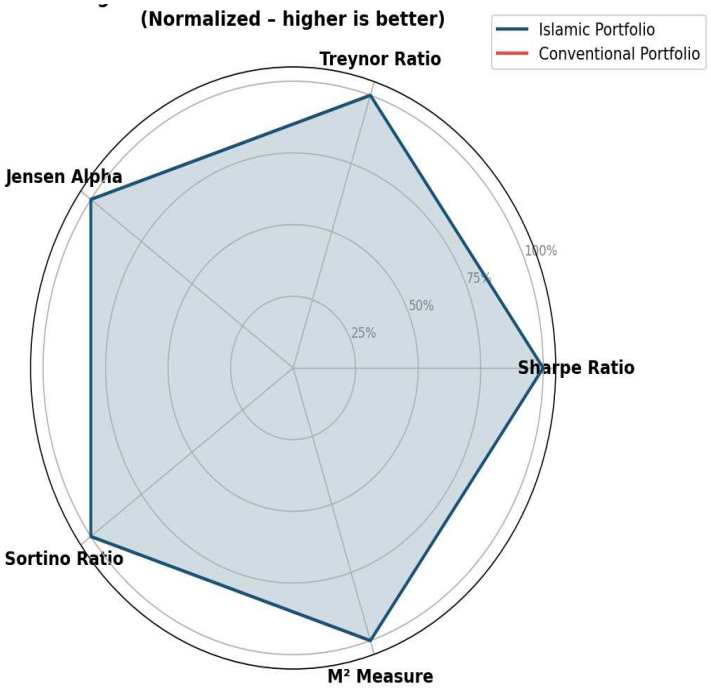

Figure 6: Radar Chart of Normalized Performance Metrics – Islamic vs. Conventional Portfolio

Figure 6 presents a radar chart that holistically visualizes the relative performance across all five metrics for the two portfolio categories. The Islamic portfolio's polygon covers a larger area, confirming its multidimensional performance superiority. The most pronounced advantage appears in the Sharpe and Sortino ratios, indicating that the improvement in risk-adjusted performance is primarily driven by lower volatility and downside risk rather than higher absolute returns.

5. Conclusion

This study applied the Markowitz Mean-Variance model to compare the portfolio performance of Islamic and conventional bank stocks listed on the Indonesia Stock Exchange over the 2021–2023 period. The empirical analysis yielded several noteworthy findings.

First, Islamic banking stocks (BRIS and BPAA) exhibited superior individual risk-return profiles compared to conventional banking stocks (BBRI and BMRI), with higher expected returns and lower standard deviations. Second, the cross-category correlations between Islamic and conventional stocks were substantially lower than within-category correlations, implying diversification gains from mixing the two stock types. Third, optimal portfolios constructed using both Minimum-Variance and Maximum-Sharpe objectives assigned predominantly higher weights to Islamic banking stocks. Fourth, Islamic portfolios outperformed conventional portfolios on all four risk-adjusted performance metrics examined: Sharpe Ratio, Treynor Ratio, Jensen's Alpha, and Sortino Ratio.

These findings carry practical implications for retail and institutional investors operating in Indonesia. The superior risk-adjusted performance of Islamic banking portfolios suggests that Shariah-compliant restrictions do not impose a performance penalty and may in fact serve as a risk management mechanism. For policymakers and regulators, the results underscore the growing systemic importance of Islamic banking equity as a distinct and valuable asset class within the Indonesian capital market.

Limitations of this study include its restriction to four issuers and a single three-year window. Future research should extend the analysis to a broader universe of Islamic and conventional stocks, incorporate transaction costs and liquidity constraints, and apply robust portfolio optimization techniques such as Black-Litterman or Conditional Value-at-Risk (CVaR) minimization. Cross-country comparisons within the ASEAN region would also enrich the literature.

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