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Downside Risk Measurement of Indonesian Financial and Energy Securities: A Value at Risk Perspective

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Abstract

This study employs Monte Carlo simulation methods to assess the Value at Risk (VaR) for two major Indonesian companies from different economic sectors: PT Asuransi Bina Dana Arta Tbk (ABDA) from the insurance sector and PT ABM Investama Tbk (ABMI) from the mining and energy sector. Using daily return data from December 2023 to November 2024, we analyze the risk profiles of these stocks individually and as portfolio components. Results reveal contrasting return-risk characteristics, with ABDA showing a negative expected return (-0.15%) and lower volatility (standard deviation of 1.12%), while ABMI exhibits a positive expected return (0.07%) with higher volatility (2.06%). Despite its lower standard deviation, ABDA demonstrates higher VaR values across all confidence levels, with a 95% one-day VaR of -2.04% compared to ABMI's -1.77%. A 40%/60% ABDA/ABMI portfolio achieves significant diversification benefits, with a standard deviation of 1.02% (lower than both individual stocks) and an improved VaR of -1.54%, representing risk reductions of 24.5% compared to ABDA and 13% compared to ABMI. For a hypothetical investment of IDR 100 million, these translate to reduced potential daily losses of IDR 508,258 and IDR 233,504 respectively. The findings highlight that effective diversification can be achieved through cross-sector allocation in the Indonesian market, even with a simple two-stock portfolio. This research contributes practical insights for investors seeking exposure to Indonesia's diverse economic sectors while managing downside risk through strategic cross-sector portfolio construction.

Keywords: Value at Risk; Monte Carlo simulation; cross-sector diversification; risk management; Indonesian capital market; emerging markets.

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1. Introduction

The Indonesian capital market features diverse sectors that significantly contribute to the nation's economic landscape, each with unique risk-return characteristics that warrant careful analysis. This study focuses on quantifying and comparing investment risks associated with two companies from distinct sectors: PT Asuransi Bina Dana Arta Tbk (ABDA) from the insurance sector and PT ABM Investama Tbk (ABMI) from the energy and mining sector, employing Value at Risk (VaR) methodology with a Monte Carlo simulation approach.

Risk assessment and management have evolved considerably in contemporary financial markets, with sophisticated methodologies developed to quantify potential losses under various market conditions. Among these, Value at Risk (VaR) has emerged as one of the most widely adopted frameworks for risk assessment, particularly valuable for analyzing investments across different economic sectors (Jorion, 2007). The Indonesian insurance and mining sectors,

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characterized by their distinct exposure to economic factors, regulatory frameworks, and market dynamics, present compelling case studies for applying advanced risk assessment methodologies.

Indonesia's economy has demonstrated resilience amid global uncertainties, supported by rich natural resources and growing domestic consumption. Within this economic framework, the insurance sector provides essential risk transfer mechanisms for individuals and businesses, while the mining and energy sector leverages the country's abundant natural resources to drive economic growth and export revenues. PT Asuransi Bina Dana Arta Tbk and PT ABM Investama Tbk represent significant entities within these respective sectors, with distinct operational focuses and risk characteristics that merit detailed analysis.

PT Asuransi Bina Dana Arta Tbk (ABDA) operates as a general insurance provider in Indonesia, offering various insurance products including fire, motor vehicle, engineering, liability, marine cargo, heavy equipment, health, and miscellaneous insurance. The company's financial performance is influenced by insurance market dynamics, claims experience, investment returns, and regulatory changes. In contrast, PT ABM Investama Tbk (ABMI) operates in the integrated energy sector, with principal activities in coal mining, mining contracting services, logistics, engineering, and power solutions. The company's performance is more directly tied to commodity price fluctuations, operational efficiencies, and energy market trends, creating fundamentally different risk profiles that can significantly impact investment decisions.

The significance of this research lies in several key aspects. First, while numerous studies have examined risk profiles of financial institutions and resource companies in developed markets, research focusing specifically on Indonesian insurance and mining companies using advanced VaR methodologies remains relatively limited. This study addresses this gap by providing a focused analysis of two major players from distinct sectors in Indonesia's economy.

Second, by employing Monte Carlo simulation approaches for VaR calculation, this research moves beyond simplistic risk metrics and acknowledges the complex, often non-normal distribution of stock returns in emerging markets like Indonesia. This methodological sophistication allows for more accurate risk assessments that can better inform investment decisions across different sectors.

Third, the comparative analysis between individual stock risk profiles and portfolio combinations offers practical insights for diversification strategies across insurance and mining sectors within the Indonesian market. This bridges theoretical risk assessment with practical portfolio management applications for investors interested in gaining exposure to different segments of Indonesia's economy.

The importance of accurate risk assessment has been highlighted by numerous researchers. Campbell et al. (2001) demonstrated the utility of VaR frameworks for optimal portfolio selection, highlighting how these methodologies can help investors balance return objectives with risk constraints. Similarly, Blavatskyy (2022) proposed an expected return-expected loss approach that provides a nuanced perspective on optimal portfolio investment, recognizing that investors often conceptualize risk in terms of potential losses rather than abstract statistical measures of dispersion.

In emerging markets like Indonesia, traditional risk measurement approaches often fall short due to unique characteristics including higher volatility, reduced liquidity, and greater sensitivity to both local and global macroeconomic factors. As noted by Rajyaguru (2023), risk characteristics can vary significantly across different market environments and economic sectors, necessitating tailored approaches to risk assessment and management.

The application of Monte Carlo methods in finance has a rich history, with significant contributions from numerous researchers. These approaches are particularly valuable when dealing with non-linear securities or complex dependencies that challenge analytical solutions. Recent advances in computational capabilities have further enhanced the applicability of Monte Carlo approaches. Sharma and Shekhawat (2022) demonstrated how portfolio optimization could be enhanced through integrating advanced computational methods with risk assessment frameworks, offering improved predictive capabilities for complex market environments. Similarly, Zhu (2012) established important connections between return forecasting capabilities and optimal portfolio construction strategies, highlighting the relevance of sophisticated risk assessment approaches for effective investment decision-making across different economic sectors.

For companies like PT Asuransi Bina Dana Arta Tbk and PT ABM Investama Tbk, these considerations are particularly relevant. As major players in Indonesia's insurance and mining sectors, these companies' stock performances are influenced by a complex interplay of factors, including sectoral dynamics, regulatory developments, operational

efficiencies, and broader macroeconomic conditions. Traditional risk assessment approaches may struggle to capture these multifaceted influences, underscoring the need for more sophisticated methodologies like Monte Carlo simulations that can better account for complex dependencies and extreme scenarios.

2. Methods

This study employs a quantitative approach to assess the risk profiles of PT Asuransi Bina Dana Arta Tbk (ABDA) and PT ABM Investama Tbk (ABMI) through Value at Risk (VaR) calculations utilizing Monte Carlo simulation techniques. The methodological framework encompasses data acquisition, return calculation, descriptive statistical analysis, individual stock VaR estimation, portfolio construction, and portfolio VaR assessment.

The research utilizes secondary data consisting of daily closing prices for ABDA and ABMI stocks, obtained from Yahoo Finance for the period spanning December 1, 2023, to November 29, 2024. This timeframe captures recent market dynamics while ensuring sufficient data points for robust statistical analysis. The dataset includes daily closing prices adjusted for corporate actions such as dividends and stock splits, which serve as the foundation for calculating daily returns and subsequent risk metrics. Data preprocessing involved checking for missing values and non-trading days, with the dataset aligned to ensure that return calculations were based on matched trading days for both stocks, eliminating dates where either stock did not trade.

Daily returns were calculated using the simple return formula:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \quad (1)$$

where R_t represents the return on day t, and P_t and P_{t-1} represent the adjusted closing prices on days t and t-1 respectively. This formula captures the percentage change in price from one trading day to the next, providing a standardized measure of performance that enables comparison between stocks with different price levels. Expected returns for individual stocks were calculated as the arithmetic mean of historical returns, while volatility or risk was measured using standard deviation, which quantifies the dispersion of returns around their mean.

For portfolio analysis, returns were calculated using a weighted average of the individual stock returns:

$$R_p = w_{ABDA} \times R_{ABDA} + w_{ABMI} \times R_{ABMI} \quad (2)$$

where R_p is the portfolio return, w_{ABDA} and w_{ABMI} are the portfolio weights for ABDA and ABMI respectively (with $w_{ABDA} + w_{ABMI} = 1$), and R_{ABDA} and R_{ABMI} are the returns of the individual stocks. A portfolio with weights of 40% for ABDA and 60% for ABMI was constructed to examine diversification benefits across the insurance and mining sectors. The expected return of the portfolio was calculated as a weighted average of the expected returns of the individual stocks, while the portfolio standard deviation accounted for correlations between assets.

The Monte Carlo simulation approach was employed to model the distribution of potential future returns based on historical parameters. This method involves generating a large number of random scenarios to approximate the probability distribution of future outcomes. The procedure consisted of parameter estimation using historical return series to derive mean return (μ) and standard deviation (σ) for each stock; random return generation according to the normal distribution with the estimated parameters using the formula:

$$R_{sim} = \mu + \sigma \times Z \quad (3)$$

where Z represents a random draw from a standard normal distribution; simulation repetition 242 times to match the number of historical data points; and parameter re-estimation using the simulated returns to recalculate the mean and standard deviation for VaR calculation.

Value at Risk was calculated using the parametric approach based on the simulated return distribution. VaR at confidence level (1-α) was calculated as:

$$VaR_{1-\alpha} = \mu_{sim} - Z_{1-\alpha} \times \sigma_{sim} \quad (4)$$

where μ_{sim} is the mean of the simulated returns, σ_{sim} is the standard deviation of the simulated returns, and $Z_{1-\alpha}$ is the Z-score corresponding to the confidence level $(1-\alpha)$. Three confidence levels were used: 99% (α = 0.01), 95% (α = 0.05), and 90% (α = 0.1), with Z-scores obtained using the Excel function $NORM.S.INV(1-\alpha)$.

To enhance the stability and reliability of the VaR estimates, the Monte Carlo simulation was repeated multiple times, and the average VaR was calculated. This iterative approach helps reduce the impact of simulation randomness on the

final VaR estimates. To provide practical insights for investment decision-making, the VaR values were expressed in monetary terms for a hypothetical investment of IDR 100,000,000, enhancing the interpretability of the results by translating abstract percentages into concrete potential loss amounts that investors can more readily understand and incorporate into their risk management frameworks.

Through this comprehensive methodological approach, the study aims to provide a detailed assessment of the risk profiles of ABDA and ABMI, both individually and as portfolio components, offering valuable insights for investors seeking to navigate the Indonesian equity market with a focus on risk management across different economic sectors.

3. Results and Discussion

3.1. Descriptive Statistics of Return Series

The analysis begins with an examination of the descriptive statistics for the daily return series of PT Asuransi Bina Dana Arta Tbk (ABDA) and PT ABM Investama Tbk (ABMI). The statistical characteristics reveal contrasting return patterns between the insurance and mining sector stocks. ABDA exhibits a negative expected return of -0.15% per day, while ABMI shows a positive expected return of 0.07% per day. This difference indicates that during the study period, the mining sector stock (ABMI) generally delivered positive performance on average, while the insurance sector stock (ABDA) experienced a slight downward trend.

More striking is the difference in standard deviation between the two stocks. ABMI's standard deviation of 2.06% is nearly twice as high as ABDA's 1.12%, indicating that the mining stock exhibited substantially higher daily volatility compared to the insurance stock. This finding aligns with theoretical expectations and previous research by Mencía (2009), who noted that companies in resource sectors often demonstrate greater price sensitivity to commodity price fluctuations, economic indicators, and global market dynamics compared to financial services companies, which may have more stable revenue streams in certain market conditions.

The contrasting return-risk profiles of these stocks—ABMI offering positive returns with higher volatility versus ABDA showing negative returns with lower volatility—represent an interesting investment dichotomy that provides the foundation for potential diversification benefits through portfolio construction across these distinct economic sectors.

3.2. Monte Carlo Simulation Results

The Monte Carlo simulation introduced interesting variations in the expected returns and standard deviations of both stocks. For ABDA, the expected return shifted from a negative -0.15% in the historical data to a positive 0.08% in the simulated data, while the standard deviation increased slightly from 1.12% to 1.29%. Conversely, ABMI's expected return changed from a positive 0.07% to a negative -0.11%, with a substantial decrease in standard deviation from 2.06% to 1.03%.

These significant shifts in parameters highlight the impact of random variation in the simulation process and provide a broader perspective on the potential range of return-risk characteristics that investors might experience. The reduced standard deviation for ABMI in the simulated data suggests that the simulation may be capturing a more stable range of potential scenarios than observed in the historical period, potentially reflecting mean-reverting tendencies in mining sector volatility as described by Liu (2024) in studies of resource company return patterns.

The reversal of expected returns between the two stocks in the simulation is particularly noteworthy, as it suggests potential cyclicality or mean reversion in the performance of these sectors. This aligns with research by Yan et al. (2024) on sectoral rotation patterns in emerging markets, where periods of underperformance in one sector may be followed by recovery, while outperforming sectors may experience subsequent corrections.

3.3. Value at Risk for Individual Stocks

The VaR results reveal a significant finding: contrary to what the historical standard deviation alone would suggest, ABDA consistently exhibits higher VaR values than ABMI across all confidence levels, despite its lower historical volatility. At the 95% confidence level, which is commonly used in risk management practices, ABDA has a VaR of -2.04%, indicating a potential daily loss of IDR 2,044,944 on a IDR 100 million investment. In contrast, ABMI's VaR at the same confidence level is -1.77%, corresponding to a potential loss of IDR 1,770,190.

This seemingly counterintuitive result—with the lower historical volatility stock (ABDA) showing higher potential losses—can be attributed to several factors: the shift in expected return in the Monte Carlo simulation, the VaR calculation formula where a more negative μ can lead to a larger VaR even if σ is smaller, and potential non-normality in the return distributions. These findings align with research by Schuhmacher et al. (2021), who argued that traditional volatility measures may insufficiently capture downside risk when return distributions exhibit significant skewness or other non-normal characteristics. This highlights the value of VaR as a more comprehensive risk measure for comparing stocks across different economic sectors with potentially different return distribution shapes.

The difference in VaR between the two stocks is relatively consistent across confidence levels. At 99% confidence, ABDA's VaR (-2.92%) exceeds ABMI's (-2.46%) by approximately 19%, a substantial difference for risk management purposes. This pattern suggests that ABDA may have fatter left tails in its return distribution, indicating a higher probability of extreme negative returns compared to ABMI, despite its lower overall volatility.

3.4. Portfolio Analysis

To assess the potential diversification benefits from combining ABDA and ABMI stocks, a portfolio with weights of 40% for ABDA and 60% for ABMI was constructed. The portfolio's expected return (0.04%) is positioned between the expected returns of the individual stocks (-0.15% for ABDA and 0.07% for ABMI), being positively influenced by the higher weight assigned to the better-performing ABMI stock. The most striking finding, however, is the portfolio's standard deviation (1.02%), which is lower than both individual stocks' standard deviations (1.12% for ABDA and 2.06% for ABMI).

This reduction in portfolio volatility below the level of both component stocks is a powerful demonstration of diversification benefits. The fact that the portfolio's standard deviation is even lower than that of the less volatile stock (ABDA) suggests a low or even negative correlation between the returns of these stocks from different economic sectors. This finding supports research by Utz and Steuer (2024), who documented enhanced diversification benefits when combining assets from sectors with fundamentally different economic drivers and business cycles.

The simulated portfolio shows a slightly higher expected return (0.07% compared to 0.04%) and a marginally lower standard deviation (0.98% compared to 1.02%) than the historical portfolio. These minor changes suggest that the portfolio's risk-return characteristics are relatively stable across different simulation scenarios, potentially indicating the robustness of cross-sector diversification benefits in the Indonesian market.

3.5. Portfolio Value at Risk

The portfolio VaR results demonstrate significant diversification benefits. At the 95% confidence level, the portfolio VaR (-1.54%) is lower than the VaR of both ABDA (-2.04%) and ABMI (-1.77%). This represents a risk reduction of 24.5% compared to ABDA and 13% compared to ABMI, highlighting the substantial benefit of diversification across insurance and mining sectors in the Indonesian economy.

The pattern holds across all confidence levels. At 99% confidence, the portfolio VaR (-2.20%) shows improvements compared to both ABDA (-2.92%) and ABMI (-2.46%). Similarly, at 90% confidence, the portfolio VaR (-1.18%) is lower than both individual stocks' VaR values (-1.57% for ABDA and -1.40% for ABMI).

When translated into monetary terms for a hypothetical investment of IDR 100 million, the diversification benefits become even more apparent. At the 95% confidence level, an investment of IDR 100 million in the portfolio could experience a maximum daily loss of approximately IDR 1,536,686, which is IDR 508,258 less than the potential loss for ABDA and IDR 233,504 less than for ABMI. This tangible reduction in potential loss highlights the practical value of cross-sector diversification, even with a simple two-stock portfolio spanning the insurance and mining sectors of the Indonesian economy.

3.6. Comparative Analysis and Investment Implications

The comparative analysis reveals several important patterns. First, ABDA consistently exhibits higher VaR values than ABMI across all confidence levels, despite its lower historical standard deviation. This highlights the importance of using comprehensive risk measures like VaR rather than relying solely on standard deviation for risk assessment, particularly when comparing stocks across different economic sectors.

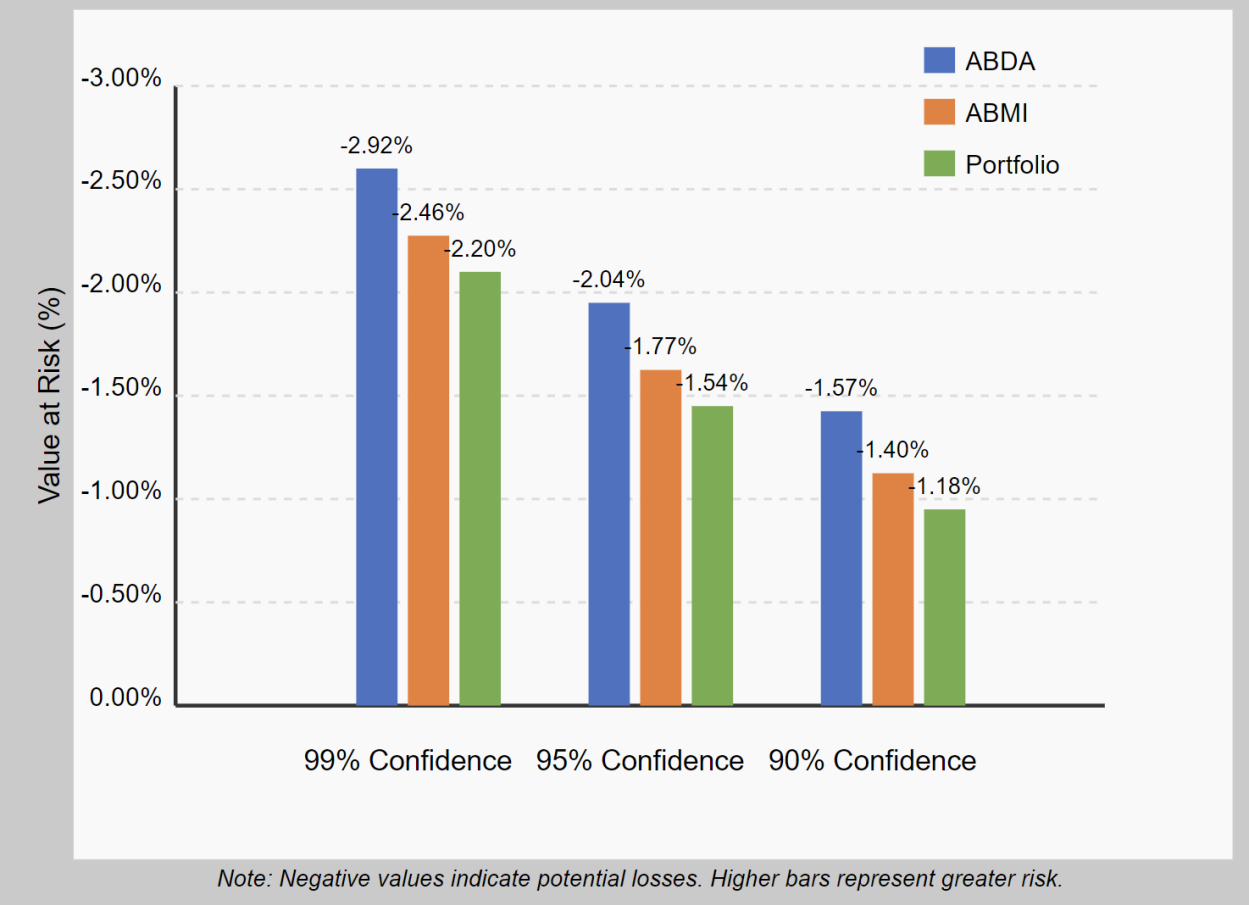

Fig. 1. Comparison of Value at Risk (VaR) Measures

Second, the portfolio VaR values are consistently lower than both individual stocks' VaR values, indicating that the diversification benefit is substantial even with just two assets from different sectors. This supports the fundamental principle of modern portfolio theory that combining assets with imperfect correlations can reduce overall portfolio risk below the levels of individual asset risks, with particularly strong effects when combining assets from sectors with different economic drivers as noted by Miao et al. (2023).

Third, the relative benefit of diversification appears relatively consistent across different confidence levels, suggesting that portfolio construction helps mitigate both moderate and extreme downside risks. This finding suggests that the diversification benefit is robust across different risk scenarios, making it a valuable strategy for investors with varying risk tolerance levels who seek exposure to different sectors of the Indonesian economy.

These findings have several important implications for investment strategies. The significant diversification benefits observed between insurance and mining stocks suggest that Indonesian investors should consider cross-sector allocation as a fundamental component of their portfolio strategy, rather than concentrating investments within a single sector. For risk-averse investors focused on minimizing potential losses, the portfolio approach offers a clearly superior risk profile compared to single-stock investments, even if it means potentially sacrificing some upside from the better-performing stock. The portfolio not only reduces risk but also maintains a positive expected return (0.04%), offering a more efficient risk-return profile than either stock individually. While this study used a fixed 40/60 weighting scheme, the strong diversification effect suggests that further risk reduction might be achieved through optimal weight allocation based on minimum-variance or maximum Sharpe ratio objectives. The comparison of VaR shown on Fig, 1.

As emphasized by Yu et al. (2020), understanding the unique risk characteristics of individual securities from different economic sectors and their interaction effects is essential for effective portfolio modeling with practical considerations. The findings of this study contribute to this understanding by providing specific risk metrics for two major Indonesian stocks from distinct sectors and demonstrating the quantifiable benefits of cross-sector diversification.

While this study provides valuable insights, several limitations should be acknowledged. The analysis is based on a one-year data period, which may not capture longer-term risk dynamics or structural changes in the companies' risk profiles. The study employs a basic Monte Carlo simulation approach based on the assumption of normally distributed returns, and the portfolio analysis focuses on a fixed weighting scheme. Future research could extend the analysis to longer timeframes, incorporate more sophisticated simulation approaches, explore optimal portfolio weights, and include other major players in Indonesia's insurance and mining sectors, as well as other key sectors like banking, telecommunications, and consumer goods, to provide a more comprehensive cross-sectoral risk assessment.

4. Conclusion

This study employed Value at Risk (VaR) analysis with Monte Carlo simulation to assess and compare the risk profiles of PT Asuransi Bina Dana Arta Tbk (ABDA) from the insurance sector and PT ABM Investama Tbk (ABMI) from the mining sector. The research provides several valuable findings that contribute to both theoretical understanding and practical investment applications within the Indonesian cross-sectoral context.

The analysis reveals distinctly different risk-return characteristics between these two companies from different economic sectors. During the study period, ABDA exhibited a negative expected daily return of -0.15% with a relatively low standard deviation of 1.12%, while ABMI showed a positive expected return of 0.07% with a substantially higher standard deviation of 2.06%. This contrast represents a classic trade-off between the more stable but underperforming insurance sector stock and the more volatile but better-performing mining sector stock.

Despite ABDA's lower historical volatility measured by standard deviation, the Value at Risk analysis demonstrated that it consistently presented higher potential losses across all confidence levels, with a 95% VaR of -2.04% compared to -1.77% for ABMI. This finding highlights the importance of using comprehensive risk measures that account for both the central tendency and dispersion of returns rather than relying solely on traditional volatility metrics when comparing stocks across different economic sectors.

A key contribution of this research pertains to the substantial diversification benefits achieved by combining insurance and mining stocks in a portfolio. The 40% ABDA/60% ABMI portfolio demonstrated significantly improved risk characteristics, with a standard deviation of 1.02% (lower than both component stocks) and a VaR at 95% confidence of -1.54%, representing risk reductions of 24.5% compared to ABDA and 13% compared to ABMI. This finding underscores that effective diversification benefits can be realized through cross-sector allocation in the Indonesian market, even with a simple two-stock portfolio spanning fundamentally different economic sectors.

When translated into monetary terms for a hypothetical investment of IDR 100 million, these risk reductions become more tangible. At the 95% confidence level, the maximum expected daily loss for the portfolio (IDR 1,536,686) is IDR 508,258 less than for ABDA and IDR 233,504 less than for ABMI. These concrete figures highlight the practical value of cross-sector diversification strategies within Indonesia's equity market.

From a methodological perspective, the Monte Carlo simulation approach proved effective in capturing the risk characteristics of these stocks from different sectors, providing robust VaR estimates across multiple confidence levels. The application of iterative simulations ensured stability in the VaR calculations, resulting in reliable risk metrics that investors can confidently use in decision-making processes.

For investors and market participants, these findings offer several practical implications. First, Indonesian equity investors should consider cross-sector allocation as a fundamental component of their portfolio strategy, rather than concentrating investments within a single sector, regardless of its perceived stability or growth potential. Second, the portfolio approach not only reduces risk but also maintains a positive expected return (0.04%), offering a more efficient risk-return profile than either stock individually. Third, while this study used a fixed weighting scheme, the strong diversification effect suggests that further risk reduction might be achieved through optimal weight allocation strategies.

The research contributes to the growing body of literature on risk assessment in emerging markets by providing specific insights into the Indonesian context, focusing on major companies that represent significant components of different sectors of the country's economy. The findings highlight both the unique characteristics of these companies from different sectors and the broader applicability of advanced risk management tools in emerging market contexts.

The limitations of this study suggest opportunities for future research, including longer-term analyses, more sophisticated simulation methodologies, optimal portfolio weight determination, and incorporation of additional sectors.

These extensions would further refine our understanding of risk dynamics across different sectors in Indonesia's equity market and provide more comprehensive guidance for investment decision-making.

As a final assessment, this study demonstrates that meaningful variations in risk profiles exist between companies from different sectors in the Indonesian market, and these variations can be effectively managed through strategic cross-sector portfolio construction. The Monte Carlo VaR approach provides a robust framework for quantifying these risk characteristics, offering valuable insights for investors seeking to navigate the complex risk landscape of Indonesia's diverse economic sectors.

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