

Markowitz and Single Index Models for Optimal Portfolio Formation: Evidence from SRI-KEHATI Index

Rahma Yunita¹ ✉, Erzalina Ayu Satya Megananda¹, Idris Idris¹, and Fuad Mas'ud¹

Universitas Diponegoro, Semarang, Indonesia¹

ABSTRACT

The growing integration of ESG criteria into investment frameworks has elevated both stock screening and portfolio construction as critical determinants of sustainable investment outcomes. This study compares the Markowitz Model and the Single Index Model (SIM) in constructing an optimal portfolio from ten SRI-KEHATI Index constituent stocks over January 2021 to February 2026. Using 265 weekly return observations, Kolmogorov-Smirnov normality tests confirmed distributional assumptions for both return and risk difference series, justifying the parametric paired-sample t-test. The Markowitz model produced a cross-sectoral portfolio comprising BBRI (32.43%), BMRI (32.58%), JSMR (33.53%), and DSNG (1.46%), while the SIM, applying a weekly risk-free rate of 0.09% and a cut-off rate of $\$C^* = 0.0002397\$$, identified BMRI (30.52%), JSMR (27.12%), BBNI (25.99%), and DSNG (16.37%). Despite their compositional differences, the two models yielded no statistically significant difference in return or risk, although the SIM recorded a higher Sharpe ratio. The findings suggest that within an ESG-screened universe, optimization methodology shapes portfolio structure without necessarily producing materially different performance outcomes, reinforcing the importance of evaluating both screening criteria and construction methodology as jointly consequential dimensions of sustainable portfolio design.

Keywords: Markowitz Model, Paired T-test, Single Index Model, SRI-KEHATI Index.

CORRESPONDING AUTHOR:

Rahma Yunita

Diponegoro University, Semarang, Indonesia

contact: rahmayunita@students.undip.ac.id

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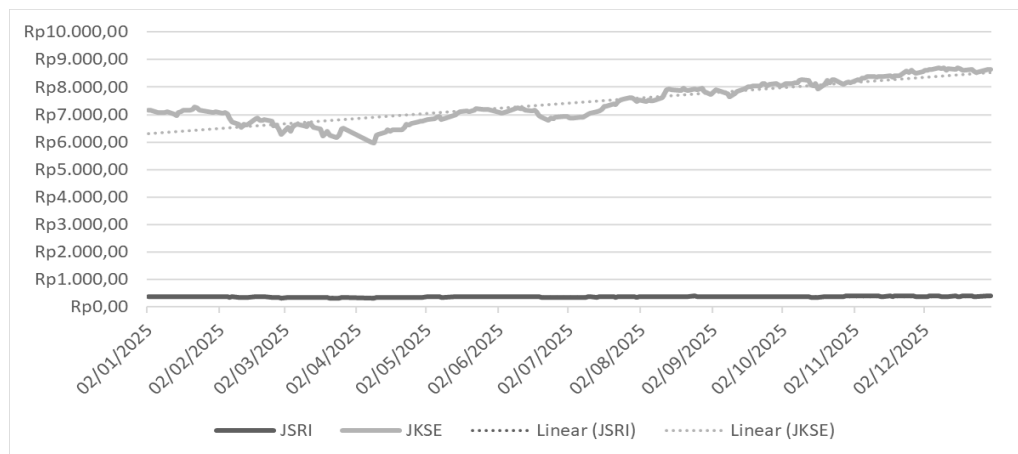
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1. | INTRODUCTION

Capital markets constitute a fundamental mechanism through which investors allocate resources across financial assets in pursuit of optimal risk-adjusted returns. A central strategy within this context is portfolio diversification, which aims to minimise risk by combining assets whose returns do not move in perfect unison. The theoretical basis for this practice derives from modern portfolio theory, introduced by Markowitz (1952), which asserts that rational investors select asset combinations yielding the maximum expected return for a given level of risk, or equivalently, the minimum risk for a targeted level of return.

The predominant quantitative approach for implementing portfolio optimization is the Markowitz model. This framework optimises portfolio weights by incorporating expected returns together with the full variance-covariance structure of asset returns, enabling identification of the efficient frontier the set of portfolios offering the highest return at each level of risk (Waluyo et al., 2025). While theoretically rigorous, the mean-variance model is computationally demanding, requiring estimation of $n(n+1)/2$ parameters as the investment universe grows. To address this limitation, Sharpe (1963) developed the Single Index Model (SIM), which reduces the parameter requirement to $3n + 2$ by attributing all inter-security covariance to a single common market factor (Yusup, 2022).

The Indonesian capital market context renders this comparative analysis particularly pertinent. The SRI-KEHATI index, developed jointly by the Indonesia Stock Exchange (IDX) and the Yayasan Keanekaragaman Hayati Indonesia (KEHATI Foundation), screens constituent stocks against both financial performance and ESG criteria, producing a curated universe of companies committed to sustainable business practices. A notable phenomenon is that the SRI-KEHATI Index (JKSRI) has exhibited prolonged price stagnation over the past years, while the broader Jakarta Composite Index (JKI) continued on an upward trajectory (Investing, 2026). This divergence calls into question the investment efficiency of the index's current constituent composition and motivates a systematic enquiry into how optimal portfolios may be constructed from its stocks.



Source: Investing, 2026

Figure 1. Closing Price SRI-KEHATI Index vs IDX Composite with Trendline

Prior empirical work presents mixed evidence regarding the relative effectiveness of the two models. Waluyo et al. (2025) found that the Markowitz model generates more optimal portfolios due to its comprehensive covariance treatment, while Gunawan et al. (2024) reported that the SIM achieves a higher return-to-risk ratio through greater computational efficiency. Yusup (2022) further demonstrated that the SIM can yield practically efficient portfolios in specific market conditions. A critical gap in the existing literature is the absence of studies applying both models to an ESG-screened index.

Portfolio construction methodology is a critical layer in sustainable investing because it translates ESG preferences into concrete asset-allocation decisions while still maintaining the core investment objective of balancing return and risk. Wardhana and Hersugondo (2025) demonstrate that Environmental, Social, and Governance disclosure levels exert pronounced empirical effects on corporate firm value, profitability, and capital structures within the Indonesian market ecosystem. Within the Markowitz framework, sustainable portfolios can be constructed by extending mean-variance optimization to include ESG scores, sustainability constraints, drawdown risk, transaction costs, and multi-period investment limits (Boyd et al., 2024; Poddar et al., 2024; Sajadi et al., 2025). Meanwhile, the Single Index Model provides a more efficient alternative by simplifying covariance estimation through market beta, making it useful for ESG stock screening and practical portfolio formation, particularly when the investment universe is limited to sustainability-based indices (Saputra et al., 2024; Toma & Fulga, 2018). Thus, Markowitz offers a comprehensive risk-return-sustainability optimization framework, whereas the Single Index Model provides a simpler and more practical approach for forming an ESG-based optimal portfolio.

This study pursues three objectives: (1) to identify the optimal portfolio composition under the Markowitz MV model for SRI-KEHATI stocks; (2) to identify the optimal portfolio composition under the SIM for the same stock universe; and (3) to conduct a statistically rigorous comparison of the risk-return performance of both portfolios. Theoretically, this study contributes to the portfolio optimisation literature by applying both models to an ESG-screened index not previously examined in this comparative context, and by adopting a distribution-appropriate non-parametric test. Practically, the findings provide actionable guidance for investors and fund managers seeking the most effective portfolio construction method for ESG-compliant Indonesian equities within the SRI-KEHATI investment universe.

2. | LITERATURE REVIEW

Optimal Portfolio Theory

An optimal portfolio is generally understood as an asset combination that offers the most efficient balance between expected return and risk, where diversification is not merely achieved by increasing the number of assets but by selecting securities whose

return movements generate the most favourable risk–return structure. The foundation of this concept was established by Markowitz (1952), who argued that portfolio selection should consider expected return, variance, and covariance among assets; later studies extended this idea by showing that optimal portfolio performance is affected by estimation error, investment constraints, risk-measure selection, and market conditions (DeMiguel et al., 2009; Kan & Zhou, 2007; Kolm et al., 2014).

More recent empirical studies confirm that optimal portfolio formation remains highly context-dependent: Senthilkumar et al. (2021) found that sectoral and broad-market portfolios may generate different optimization outcomes; Huang et al. (2024) compared several portfolio strategies in the Taiwan stock market and emphasized diversification and out-of-sample performance measurement; Lorimer et al. (2024) showed that alternative downside and asymmetric risk measures can affect portfolio optimization results; Gunawan et al. (2024) demonstrated that Markowitz and Single Index Model portfolios can produce different stock compositions in Indonesian LQ45 stocks; Yusup (2022) found that the single-index model dominated mean–variance optimization in the Indonesian stock market; while Waluyo et al. (2025) reported the opposite result in Indonesian and Malaysian capital markets, where the mean–variance model produced more optimal portfolios. Therefore, optimal portfolio construction should be viewed as a model-sensitive and market-specific process, which makes further ESG comparison between Markowitz and Single Index Model portfolios relevant in ESG-based indices such as SRI-KEHATI.

The Markowitz Model

Markowitz theory, also known as the mean–variance model, is the core of modern portfolio theory because it formalizes the investor’s decision as an optimization problem involving expected return and portfolio risk, where risk is measured through variance and the interaction among assets is captured through covariance (Markowitz, 1952). The strength of this theory lies in its comprehensive treatment of diversification: an asset is not evaluated only by its own return and risk but also by how it co-moves with other assets in the portfolio. However, subsequent literature shows that the Markowitz framework is highly sensitive to input estimation, especially expected returns and covariance matrices; Best & Grauer (1991), Kan & Zhou (2007), and DeMiguel et al. (2009) proposed shrinkage, investment constraints, and sparse optimizations as solutions to improve robustness. More recent studies continue to apply and evaluate Markowitz theory in different settings: Keykhaei (2016) extended mean–variance optimization under uncertain exit time; Pal et al. (2021) combined portfolio formation with dynamic realignment using a Markowitz-based genetic algorithm; Lorimer et al (2024) revisited portfolio optimization by comparing alternative risk measures; Gunawan et al. (2024) applied Markowitz to LQ45 stocks; and Waluyo et al. (2025) found that the mean–variance model outperformed the Single Index Model in selected Indonesian and Malaysian capital market portfolios. These findings suggest

that Markowitz theory remains theoretically rigorous and empirically relevant, although its effectiveness depends on data quality, return frequency, covariance stability, investment constraints, and the chosen performance indicator.

The Single Index Model

The Single Index Model theory was introduced by Sharpe (1963) as a simplified alternative to the full Markowitz covariance structure by assuming that individual security returns are primarily driven by a common market index, so each stock can be represented through alpha, beta, market return, and residual risk. This model substantially reduces the number of required inputs because covariance among securities is approximated through their sensitivity to market movements, making the model more practical for large portfolios and less computationally demanding than the full mean–variance approach (Sharpe, 1963). Elton et al., (1977) further strengthened the operational relevance of the Single Index Model by developing simple criteria for optimal portfolio selection using excess return-to-beta ratios and cut-off points, while Toma and Fulga (2018) argued that robust estimation is important because traditional single-index estimators may be distorted by outliers in financial return data.

Empirical findings remain mixed: Yusup (2022) showed that the single-index model outperformed the mean–variance model in Indonesian LQ45 stocks when evaluated using the Sharpe ratio; Senthilkumar et al. (2021) found that Sharpe’s model performed better than Markowitz in several Indian sectoral and inter-sectoral portfolios; Huang et al. (2024) included single-index strategies in a broader comparison of portfolio selection methods; Gunawan et al. (2024) found that the Single Index Model could generate more efficient risk–return outcomes in LQ45 portfolio formation; but Waluyo et al. (2025) reported that the mean–variance model produced superior optimal portfolios in Indonesia and Malaysia. Thus, the Single Index Model is best positioned as a practical, beta-based optimization approach whose performance depends on the explanatory power of the market index, beta stability, residual variance, and the specific characteristics of the investment universe.

The SRI-KEHATI Index

The SRI-KEHATI Index is an ESG-oriented stock index in the Indonesian capital market that was launched on June 8, 2009, by Yayasan KEHATI in collaboration with the Indonesia Stock Exchange as a pioneer benchmark for sustainable and responsible investment in Indonesia. The index is constructed by referring to the United Nations’ Principles for Responsible Investment and emphasizes companies that apply Sustainable and Responsible Investment (SRI) principles as well as Environmental, Social, and Governance (ESG) standards.

It consists of 25 listed public companies on the Indonesia Stock Exchange, and its constituents are reviewed periodically every May and November. In the context of portfolio research, the SRI-KEHATI Index is relevant because it provides a sustainability-screened investment universe, meaning that the selected stocks are not only assessed from market and financial perspectives but also from sustainability,

governance, and responsible business considerations. Therefore, the index can be used to examine whether optimal portfolio formation methods, such as the Markowitz model and the Single Index Model, can generate efficient risk–return outcomes within an ESG-based stock universe (Yayasan KEHATI, n.d.).

Hypothesis Testing:

H1: There is a significant difference in portfolio returns between the Markowitz Model and the Single Index Model.

H2: There is a significant difference in portfolio risk between the Markowitz Model and the Single Index Model

H3: The Markowitz Model provides superior risk-adjusted performance compared with the Single Index Model in the SRI-KEHATI portfolio universe.

Prior Research

Recent studies comparing the Markowitz model and the Single Index Model show inconsistent findings, suggesting that portfolio performance depends strongly on the investment universe, market condition, return frequency, and the performance metric. Senthilkumar et al. (2021) compared the Markowitz framework and the Single Index Model in Indian sectoral and broad-market portfolios, showing that optimal portfolio outcomes vary between intra-sector investment universes; this finding is important because it indicates that model performance cannot be generalized across different index compositions. In the Indonesian market, Yusup (2022) compared the mean-variance and single-index models based on the Sharpe ratio, identifying that the single-index model yielded structurally superior parameters under specific high-volatility environments. Meanwhile, Waluyo et al. (2025), using IDX30 and FTSE Bursa Malaysia KLCI, found that the mean-variance model produced more optimal results than the Single Index Model. These contradictory findings are reinforced by Gunawan et al. (2024), who reported that the Markowitz and Single Index Model portfolios generated different return-risk characteristics and portfolio compositions in LQ45 stocks.

Therefore, the existing comparative literature does not provide a single dominant conclusion, creating a research gap for further testing in ESG-based stock universes such as SRI-KEHATI. Avramov et al. (2022) showed that ESG rating uncertainty affects the risk-return trade-off, social impact, and welfare implications of sustainable investing. More recent ESG portfolio studies by Chibane & Joubrel (2024), Müller & Joubrel (2025), and Wahid & Kowalewski (2025) further show that ESG uncertainty, ESG constraints, green-stock classification, and sustainable-investment preferences can alter portfolio return, volatility, diversifications, and efficient-frontier structure. Crucially, Wardhana and Hersugondo (2025) demonstrate that Environmental, Social, and Governance disclosure levels exert pronounced empirical effects on corporate firm value, profitability, and capital structures within the Indonesian market ecosystem, reinforcing why an asset optimization audit within this filtered index is heavily needed.

Based on these prior findings, the proposed study contributes to the literature by focusing specifically on the SRI-KEHATI Index, an ESG-oriented Indonesian stock universe, and by comparing the Markowitz Model and the Single Index Model through return and risk. This positioning is relevant because most previous direct comparisons use conventional indices such as LQ45, IDX30, KLCI, Nifty sectoral indices, or cryptocurrency assets, while ESG-related portfolio studies often focus on mean–variance optimization without directly comparing it with the Single Index Model. Therefore, comparing Markowitz and Single Index Model portfolios using SRI-KEHATI constituents can fill a narrower empirical gap: whether ESG-screened stocks in Indonesia produce significantly different return–risk outcomes when optimized through a full covariance-based model versus a market-index-based model.

3. | RESEARCH METHOD

This study adopts a quantitative, descriptive-comparative research design. The quantitative approach is appropriate given the study’s objective of measuring and analysing portfolio performance numerically on the basis of return and risk. The descriptive component characterises the data properties of SRI-KEHATI constituent stocks, while the comparative component evaluates the performance differential between portfolios constructed under the Markowitz model and the SIM.

The primary dataset consists of weekly closing prices for SRI-KEHATI constituent stocks over January 2021 to February 2026. All data are secondary, sourced from: (1) the Indonesia Stock Exchange (IDX); (2) Investing.com, accessed on 3 March 2026; and (3) Statistics Indonesia (BPS) for the Bank Indonesia 7-Day Reverse Repo Rate (BI7DRR) as risk-free rate benchmark. The SRI-KEHATI Index return series (JKSRI) serves as the market proxy for SIM computation. All data processing was performed using Microsoft Excel and IBM SPSS Statistics.

The study population consisted of the 25 stocks included in the SRI-KEHATI Index during the observation period. Purposive sampling was applied by selecting only stocks that were continuously included in the index from January 2021 to February 2026 and did not experience unusual market activity or trading suspension during the period. Based on these criteria, ten stocks were retained as the final sample, namely BBKA, BBNI, BBRI, BMRI, DSNG, INDF, JSMR, KLBF, SMGR, and UNVR. The use of these criteria ensured the availability of uninterrupted weekly closing price data for portfolio return and risk analysis. The weekly price series generated 266 observations for each stock; after transforming the price data into return, 265 return observations were available for further analysis.

Pelaksanaan empiris penelitian ini dilakukan secara sistematis melalui lima tahapan operasional yang berurutan. Pada tahap pertama, dilakukan perhitungan return mingguan masing-masing saham menggunakan rumus $R_{i,t} = (P_{i,t} - P_{i,t-1}) / P_{i,t-1}$, di mana $P_{i,t}$ merupakan harga penutupan saham ke- i pada minggu ke- t . Tahap kedua adalah optimasi portofolio menggunakan Model Markowitz dengan pendekatan mean-

variance. Pada tahap ini, efficient frontier dibangun berdasarkan matriks varians-kovarians penuh dari sepuluh saham sampel, sedangkan portofolio optimal (tangency portfolio) ditentukan dengan memaksimalkan rasio Sharpe melalui minimisasi risiko portofolio dengan kendala tingkat return yang diharapkan dan total bobot portofolio sama dengan satu. Tahap ketiga menggunakan Single Index Model, di mana return saham dimodelkan sebagai $R_i = \alpha_i + \beta_i R_m + \epsilon_i$. Saham kemudian diurutkan berdasarkan nilai Excess Return to Beta (ERB), yaitu $[E(R_i) - R_{br}] / \beta_i [E(R_m) - R_{br}]$, dan hanya saham yang memiliki nilai ERB di atas cut-off rate ($C^*C^*C^*$) yang dimasukkan ke dalam portofolio. Bobot masing-masing saham dihitung menggunakan nilai Z_i dan dinormalisasi menjadi W_i . Pada tahap keempat, return portofolio mingguan dihitung menggunakan rumus $R_{p,t} = \sum (W_i \cdot R_{i,t})$, sehingga diperoleh deret waktu return selama 265 minggu untuk masing-masing model portofolio. Tahap terakhir meliputi pengujian normalitas dan analisis komparatif. Normalitas perbedaan return dan risiko antara kedua model diuji menggunakan uji Kolmogorov–Smirnov. Hasil pengujian menunjukkan bahwa data berdistribusi normal sehingga analisis perbandingan dapat dilakukan menggunakan uji parametrik paired-sample t-test. Dalam penelitian ini, tingkat bebas risiko menggunakan suku bunga Bank Indonesia 7-Day Reverse Repo Rate (BI7DRR) yang berkisar antara 3,75% hingga 4,75% per tahun selama periode penelitian. Berdasarkan data tersebut, rata-rata tingkat bebas risiko mingguan (R_{br}) yang digunakan untuk menentukan cut-off rate adalah sebesar 0,09% per minggu.

4. | RESULTS AND DISCUSSION

Table 2 presents the descriptive statistics for the weekly return time series of both optimal portfolios across the 265-week observation period spanning January 2021 to February 2026.

Table 2. Descriptive Statistics of Portfolio Returns

Portfolio	N	Mean Return	Std. Deviation	Minimum	Maximum
Markowitz	265	0.1109	3.0478	-12.34	12.01
SIM	265	0.2117	3.0865	-16.36	34.12

Source: SPSS output processed from IDX weekly closing price data

The Markowitz portfolio generated a mean weekly return of 0.1109% with a sample standard deviation of 3.0478%, showing a relatively symmetric return range bounded by a minimum of -12.34% and a maximum of 12.01%. In comparison, the Single Index Model (SIM) portfolio yielded a higher descriptive mean weekly return of 0.2117%. The sample standard deviation for the SIM portfolio stood at 3.0865%, representing a minimal variance increment relative to the Markowitz model despite its wider historical baseline return range (minimum -16.36%, maximum 34.12%).

Table 3 presents the optimal portfolio weights derived from each model.

Table 3. Optimal Portfolio Composition

Stock	Sector	Markowitz Weight (Wi)	SIM Weight (Wi)
BBRI	Banking	32.43%	0.00%
BMRI	Banking	32.58%	30.52%
BBNI	Banking	0.00%	25.99%
DSNG	Plantation (Palm Oil)	1.46%	16.37%
JSMR	Infrastructure (Toll Roads)	33.53%	27.12%
Total		100.00%	100.00%

The Markowitz Model identified an optimal portfolio comprising four stocks spanning two sectors: banking and infrastructure. The portfolio allocates the largest weight to JSMR (33.53%), followed by BMRI (32.58%), BBRI (32.43%), and a minimal allocation to DSNG (1.46%). This near-equal distribution across three dominant holdings reflects the model’s exploitation of the full variance-covariance matrix, which captures the cross-sectoral return dependencies between banking stocks and the infrastructure sector. The inclusion of JSMR alongside BBRI and BMRI introduces meaningful sectoral diversification, as the return dynamics of a toll road operator are structurally less correlated with those of commercial banks than would be the case within a homogeneous sector allocation. The marginal weight assigned to DSNG (1.46%) suggests that the plantation stock contributes a modest but non-negligible diversification benefit within the optimised portfolio, despite its relatively small allocation. The resulting composition is consistent with the Markowitz framework's objective of minimising portfolio variance for a given level of expected return, achieved through the deliberate combination of assets whose covariances reduce aggregate portfolio risk below what any individual stock could achieve in isolation. Thus, the efficient frontier generated by the Markowitz Model is presented in Figure 2.

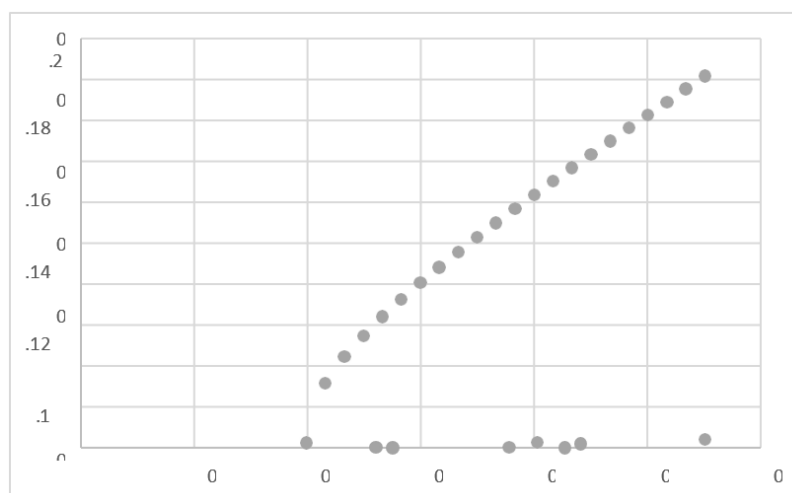


Figure 2. The Efficient Frontier of Markowitz Model Portfolio.

The Single Index Model, applying a constant weekly risk-free rate benchmark (Rbr) of 0.09% per week, identified an optimal portfolio of four stocks selected via their Excess Return-to-Beta (ERB) ratios relative to the unique cut-off threshold rate $C^* = 0.0002397\%$. Only candidate securities whose individual ERB values strictly exceeded this threshold were admitted into the final portfolio matrix. This selection logic distributed capital across BMRI (30.52%), JSMR (27.12%), BBNI (25.99%), and DSNG (16.37%), creating an investment structure spanning the banking, infrastructure, and plantation sectors.

The selection procedure ranked all candidate stocks in descending order of their ERB ratio, measuring the excess return generated per unit of systematic risk. Securities surpassing C^* were assigned positive weights, while underperforming assets were excluded. The active weights were determined by each stock's relative contribution to the ERB-to-residual-variance ratio. Consequently, BMRI received the largest capital allocation due to its premium combination of excess return and low systematic risk exposure, followed by JSMR, BBNI, and DSNG in descending order of their weighted contribution to portfolio efficiency. The resulting four-stock composition spans three distinct sectors, achieving cross-sectoral diversification that emerges naturally from the ERB ranking and residual variance filtration procedure rather than from an explicit covariance minimization routine.

Table 4 reports the results of the normality tests applied to the return and risk variables using the Kolmogorov-Smirnov and Shapiro-Wilk methods.

Table 4. Summary of Normality Test Results

Variable	Test	Statistic	Sig.	Conclusion
Return	Kolmogorov-Smirnov	0.039	0.200	Normal distribution
	Shapiro-Wilk	0.993	0.231	Normal distribution
Risk	Kolmogorov-Smirnov	0.028	0.200	Normal distribution
	Shapiro-Wilk	0.991	0.109	Normal distribution

The normality test results presented in Table 4 indicate that both the return and risk difference series satisfy the assumption of normality. For the return variable, the Kolmogorov-Smirnov test yielded a statistic of 0.039 ($p = 0.200$) and the Shapiro-Wilk test produced a statistic of 0.993 ($p = 0.231$), both exceeding the 0.05 significance threshold. Similarly, for the risk variable measured through rolling standard deviations, the Kolmogorov-Smirnov statistic of 0.028 ($p = 0.200$) and the Shapiro-Wilk statistic of 0.991 ($p = 0.109$) confirm normal distribution at the same significance level.

Given that both samples exceed $n = 50$; the Kolmogorov-Smirnov test with Lilliefors correction is the more appropriate reference for normality assessment, as the Shapiro-Wilk test is generally recommended for smaller samples and tends to lose sensitivity in larger datasets. Nonetheless, the convergence of both tests toward the same conclusion across all variables strengthens the reliability of the normality assumption. As both difference series are normally distributed, the parametric paired-

sample t-test constitutes the appropriate statistical method for the subsequent comparative analysis.

Table 5 presents the paired t-test results examining the return and risk distributions of the two portfolios.

Table 5. Paired t-test Result.

Pair	t	df	Sig. (2-tailed)
Return	-1.206	264	0.229
Risk	-0.930	261	0.353

The paired-sample t-test examining the weekly return distributions of the Markowitz and SIM portfolios yielded $t(264) = -1.206$ with a two-tailed significance of $p = 0.229$, a value that exceeds the conventional $\alpha = 0.05$ threshold. Consequently, the null hypothesis of no significant difference in return performance between the two portfolios cannot be rejected. This result indicates that, notwithstanding the structural and compositional differences inherent to each optimisation framework, both models generate statistically equivalent weekly return outcomes over the five-year observation period.

The paired-sample t-test applied to the four-week rolling standard deviation series, employed as the empirical proxy for portfolio risk, produced $t(261) = -0.930$ and $p = 0.353$, which similarly fails to attain statistical significance at the 0.05 level. The null hypothesis of no significant difference in portfolio risk between the two models is therefore retained. This finding establishes that the Markowitz and SIM portfolios not only yield equivalent return distributions but also impose statistically indistinguishable levels of weekly volatility upon investors, suggesting that the two optimisation approaches converge toward comparable risk profiles within the SRI-KEHATI investment universe despite their methodologically distinct approaches to covariance estimation and stock selection.

Considered jointly, the paired-sample t-test results across both performance dimensions, return and risk, provide consistent empirical support for the conclusion that no statistically significant difference exists between the Markowitz Model and the Single Index Model in terms of portfolio performance within the SRI-KEHATI Index. Both models, despite drawing upon fundamentally divergent optimisation logics, produce outcomes that are statistically equivalent across the two central dimensions of portfolio evaluation. This convergence of performance suggests that model selection within a sustainability-screened investment universe of this nature may appropriately be guided by practical and operational considerations rather than by anticipation of differential performance outcomes between the two methods. To complement these findings, the Sharpe ratio is calculated to assess risk-adjusted performance, indicating that the SIM portfolio achieves a higher Sharpe ratio (0.0395) compared to the Markowitz portfolio (0.0069). This suggests that, although the differences in return and risk are not statistically significant, the SIM portfolio demonstrates relatively greater

efficiency in converting risk into return; however, this difference should be interpreted with caution, as it is not supported by statistically significant differences in the underlying performance measures.

This study examined whether the Markowitz Model and the Single Index Model produce meaningfully different outcomes when applied to the SRI-KEHATI Index, evaluating both return and risk dimensions. The findings reveal that the two models are statistically comparable in terms of both return and risk performance.

The paired-sample t-test applied to weekly portfolio returns yielded $t(264) = -1.206$ with $p = 0.229$, confirming that the null hypothesis of no significant difference cannot be rejected. This finding is consistent with prior evidence from Senthilkumar et al. (2021) and Gunawan et al. (2024), who similarly documented that the performance of portfolio optimization models depends heavily on the characteristics of the investment universe. However, it contradicts the findings of Waluyo et al. (2025) and Yusup (2022), who found significant differences between the two models in broader, more volatile indices like IDX30 and LQ45. The result, however, warrants careful interpretation. The SIM portfolio's descriptively higher mean weekly return of 0.2117% relative to the Markowitz portfolio's 0.1109% does not necessarily reflect a meaningful performance advantage, but rather indicates a modest difference that is not statistically significant.

The paired-sample t-test applied to the four-week rolling standard deviation series yielded $t(261) = -0.930$ with $p = 0.353$, indicating that no statistically significant difference exists in portfolio risk between the two models. Although the SIM portfolio exhibits a slightly higher standard deviation (3.0865%) compared to the Markowitz portfolio (3.0478%), this difference is not statistically meaningful. These findings suggest that both optimisation approaches produce similar volatility levels within the SRI-KEHATI investment universe despite their methodologically distinct approaches to covariance estimation and stock selection.

Considered jointly, the two sets of findings indicate that the Markowitz and SIM models deliver comparable performance across both return and risk dimensions. This result implies that the differences in optimisation structure and portfolio composition do not translate into materially different realised outcomes. However, when evaluated using risk-adjusted performance measures, a different pattern emerges. The Sharpe ratio indicates that the SIM portfolio (0.0395) outperforms the Markowitz portfolio (0.0069), suggesting relatively greater efficiency in converting risk into return in economic terms. Nevertheless, this apparent advantage should be interpreted with caution, as it is not supported by statistically significant differences in either return or risk.

5. | DISCUSSION

From a theoretical standpoint, the Markowitz model's use of the full variance-covariance matrix enables identification of interdependencies among assets, potentially supporting broader diversification. In contrast, the Single Index Model simplifies the covariance structure by relying on a single market factor, resulting in a more concentrated allocation. While these structural differences influence portfolio composition, the empirical results indicate that they do not lead to statistically different performance outcomes within the observed period. This finding aligns with prior studies (Gunawan et al., 2024; Lyu et al., 2022; López Prol & Kim, 2022), which suggest that differences in optimisation models do not always translate into significant performance gaps.

The specific characteristics of the SRI-KEHATI Index provide additional context for interpreting these results. As an ESG-screened benchmark, the index represents a constrained investment universe in which stocks are selected based on both financial and sustainability criteria. Wardhana and Hersugondo (2025) proved that ESG disclosure levels have a significant impact on firm value, profitability, and capital structure in Indonesia. Within such a filtered environment, the opportunity for extreme diversification benefits may be limited, which may explain why different optimisation approaches ultimately yield similar performance outcomes. In this context, the Markowitz model's diversification advantage and the SIM's efficiency in stock selection appear to converge toward comparable realised results.

ESG integration is often discussed at the level of stock selection, but less frequently at the level of portfolio construction methodology. The present findings highlight that, even when portfolios are derived from the same ESG-screened universe, differences in optimisation techniques may influence portfolio structure without necessarily affecting overall performance. This suggests that the choice of optimisation model may be driven more by practical considerations such as data requirements, computational simplicity, and ease of implementation rather than by expectations of superior performance. The Single Index Model requires fewer data inputs specifically $3n + 2$ parameters compared to $n(n+1)/2$ parameters in the Markowitz Model making it computationally easier to manage and rebalance over time without sacrificing portfolio return and risk performance.

This gap between ESG screening and portfolio-level risk management echoes broader concerns in the sustainable finance literature regarding the distinction between the appearance and the substance of sustainability integration. Just as greenwashing in corporate reporting refers to the selective disclosure of favourable ESG metrics without substantive change in underlying practice, a portfolio that satisfies ESG screening criteria at the stock level while concentrating exposure in a limited set of risk factors may fulfil the formal requirements of sustainable investment mandate without fully capturing its intended objectives. While the Markowitz model produces a more balanced allocation and the SIM tends toward greater concentration, the empirical

results of this study indicate that these structural differences do not translate into statistically significant differences in overall portfolio risk. This suggests that, within the SRI-KEHATI investment universe, both models remain broadly consistent with ESG-oriented investment principles despite their differing allocation structures.

The five-year observation window spanning January 2021 to February 2026 encompasses distinct market phases, including the post-COVID-19 equity recovery, the global inflation and interest rate-cycle of 2022–2023, and the subsequent period of monetary normalisation. The finding that both portfolios exhibit statistically comparable levels of rolling volatility suggests that their risk characteristics remain broadly consistent across varying market conditions, rather than being driven by a specific regime. This cross-cycle stability is particularly relevant for sustainable investors whose mandates are long-term in nature and whose stakeholders have limited tolerance for short-term volatility regardless of its source. The SRI-KEHATI Index's own underperformance relative to the Jakarta Composite Index over the same period further underscores that ESG screening alone does not guarantee competitive market performance; the construction methodology applied to the screened universe remains an important factor in shaping the realised investment experience. These findings reinforce the importance of integrating both optimisation methodology and sustainability considerations in portfolio construction to ensure alignment between financial outcomes and ESG objectives.

6. | CONCLUSION

This study constructed and compared optimal portfolios from the Markowitz Model and the Single Index Model using SRI-KEHATI Index constituent stocks over a five-year weekly observation period spanning January 2021 to February 2026.

First, the two models produce statistically comparable return outcomes. The paired-sample t-test on weekly portfolio returns yielded $t(264) = -1.206$ with $p = 0.229$, providing no basis to reject the null hypothesis of no significant difference in return performance. Although the SIM portfolio generated a descriptively higher mean weekly return of 0.2117% relative to the Markowitz portfolio's 0.1109%, this difference is not statistically significant and therefore does not indicate methodological superiority.

Second, the two models also exhibit statistically comparable levels of portfolio risk. The paired-sample t-test applied to four-week rolling standard deviations produced $t(261) = -0.930$ with $p = 0.353$, indicating that no statistically significant difference exists in portfolio volatility between the two approaches. Although the SIM portfolio displays a slightly higher weekly standard deviation (3.0865%) relative to the Markowitz portfolio (3.0478%), the magnitude of this difference remains economically modest and statistically insignificant. These findings suggest that the distinct optimisation structures underlying the two models do not translate into materially different realised risk outcomes within the SRI-KEHATI investment universe.

Third, the joint consideration of return and risk results indicates that both models ultimately deliver comparable portfolio performance despite their fundamentally different optimisation frameworks. However, when evaluated using risk-adjusted performance measures, the SIM portfolio achieves a higher Sharpe ratio (0.0395) compared to the Markowitz portfolio (0.0069), suggesting relatively greater efficiency in converting risk into return. Nevertheless, this apparent advantage should be interpreted cautiously, as it is not supported by statistically significant differences in the underlying return and risk measures. Within the SRI-KEHATI context specifically, these findings underscore that portfolio optimisation methodology remains an important determinant of portfolio structure and allocation characteristics, even when the resulting performance outcomes remain broadly similar.

The findings further suggest that ESG-oriented portfolio construction should not be evaluated solely at the level of stock screening, but also at the level of portfolio optimisation methodology. Although the Markowitz model produces a more diversified allocation structure and the SIM exhibits greater concentration, both approaches remain broadly consistent with ESG-oriented investment objectives within the observed investment universe. This indicates that differences in optimisation methodology may influence portfolio composition and implementation characteristics without necessarily producing statistically different investment outcomes.

The practical implication of these findings is that model selection in sustainable portfolio construction may be guided more appropriately by investor preferences, implementation considerations, and institutional constraints rather than by expectations of materially different performance outcomes between methods. For institutional investors operating under ESG mandates, both models may serve as viable approaches depending on their tolerance for concentration, diversification preferences, and operational complexity. Future research extending this comparative framework to other ESG equity benchmarks across ASEAN capital markets would contribute to determining whether the performance convergence documented herein represents a broader empirical characteristic of optimisation within sustainability-screened investment universes.

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Declaration of Conflicting Interests

The authors declare that there is no conflict of interest.

Ethical Approval and Originality Statement

Ethical approval was obtained for this study. The manuscript represents original work and has not been previously published, nor is it under consideration by another journal.

Data Disclosure Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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