



Portfolio Optimization in ESG-Driven Markets: Evidence from the SRI-KEHATI Index

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Abstract: The SRI-KEHATI Index comprises 25 companies whose shares adhere to Sustainable Responsible Investment (SRI) principles and Environmental, Social, and Governance (ESG) criteria. This study applies the Markowitz model and the Single Index model to construct optimal portfolios. Using the Markowitz model, nine stocks form an optimal portfolio with a return of 0.4% and a risk level of 1.16%. Meanwhile, the Single Index model identifies 13 stocks as part of an optimal portfolio, offering a return of 0.07% with a risk level of 0.91%. This research provides a practical framework for portfolio optimization in ESG-driven markets and contributes to the growing literature by demonstrating the applicability of these models in aligning financial performance with sustainable investment objectives.

Keywords: Optimal Portfolio, Markowitz, Single Index, ESG, Sustainable Investment.

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Introduction

The year 2020 was particularly challenging for many individuals due to the outbreak of Coronavirus Disease 19 (COVID-19). The pandemic had a profound impact on the global economy, significantly affecting stability in countries such as Indonesia (Susilawati et al., 2020). To mitigate the spread of the virus, many nations, including Indonesia, implemented preventive measures like lockdowns, business restrictions, and travel limitations. As a result, numerous business sectors shifted to digital platforms (online businesses) to adhere to health protocols. However, the economic repercussions were severe, leading to financial instability for many, with income reductions and job losses.

In response to these challenges, individuals sought alternative sources of income to secure their livelihoods. Among these strategies, investment has become a popular choice, with the capital market in Indonesia seeing significant growth in investor participation.

The number of investors in Indonesia has grown annually, according to statistics gathered by PT Kustodian Sentral Efek Indonesia (KSEI). There were 5,255,571 investors registered in Indonesia as of the end of 2023. Compared to the prior year, this number of investors has climbed by 1.55% (figure 1).

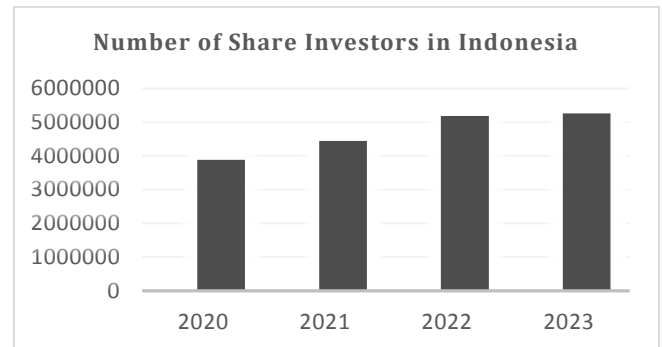


Fig. 1: Data on the number of stock investors in Indonesia

Investment involves abstaining from consumption to increase future consumption. Investment also aims to counterbalance the depreciation of money caused by inflation (Agustini et al., 2022). Acquiring shares is one of the most dangerous investments. Investors can reduce the risk by diversifying or buying several shares (a portfolio) (Sihaloho, 2021). Before investing, investors need to research a company, in particular by studying its dividends and profitability. According to Yulianto's studies (Agustina & Damayanty, 2024), timely financial reporting is essential to facilitate investor decision-making.

Investors ideally want to get the maximum return from their investment. Investing in the capital market, on the other hand, can offer promising returns even though investors must take more significant risks when compared to investing in assets that have no risk (Zvi Bodie et al., 2014). Investment risk can be reduced by diversifying. Diversification can be done by investors to reduce the risks they bear (Markowitz, 1952).

Post-pandemic economic recovery allows the government to implement sustainable development in line with the Sustainable

Development Goals (SDGs). The SDGs are a global agreement that aims to reduce poverty, overcome inequality, and preserve the environment. The program consists of four main pillars: social development, economy, environment, and improvement of law and governance (United Nations General Assembly, 2024). By creating products like green bonds, mutual funds with an emphasis on sustainable investing, and sustainability indexes, the Financial Services Authority (OJK) and the capital market industry encourage sustainable financing in the capital market sector (Otoritas Jasa Keuangan, 2024).

SRI-KEHATI, published by the KEHATI Foundation with reference to the United Nations Responsible Investment Principles (UNPRI), includes companies that apply Sustainable Responsible Investment (SRI) and Environmental, Social, and Governance (ESG) principles, which support a balance between business activities and environmental sustainability. This index is expected to create a balance between growth and environmental sustainability.

(Wahyuni & Darmayanti, 2019), Return is a rate of return that investors will receive in exchange for the risk load they have assumed in an investment that has been made or is expected to be obtained in the future. (Devi Fatiah Halmahera & Irvan F. C. Oentoeng, 2021), A portfolio is a combination of different assets chosen from different sectors to reduce the risks present in the portfolio. Various techniques can be used to determine the ideal portfolio, including the Markowitz model and the single-index model (Agustini et al., 2022).

The Markowitz model is considered more complicated in its calculations because it involves the calculation of variance and covariance. As a result, the Index One model emerged, which is a simplified version of the Markowitz model that links returns and risks to market portfolios. This model is based on the fact that stock price fluctuations follow market price indices, which suggests that stock returns may correlate with each other as a result of stock price changes. (Hartono, 2014). Sorting a number of companies based on their Excess Return to Beta (ERB) value creates the model's ideal portfolio. Furthermore, the cut-off point value (C*) is used to identify which stocks should be part of the ideal portfolio.

Data on stocks that were regularly listed on the SRI-KEHATI index between 2020 and 2023 was used in this analysis. Table 1 shows that, when compared to other indexes, the SRI-KEHATI index has the most excellent dividend yield. This implies that the businesses listed in the SRI-KEHATI index might entice investors to the company.

Tab. 1: Comparison of Stock Index Dividends

Index	Dividend
SRI-KEHATI	4.21%
MSCI Indonesia	3.75%
IHSG	3.36%
LQ45	3.54%
IDX30	3.41%

Source: Processed secondary data, 2024

While stocks using a single index model that forms an optimal portfolio of the SRI-KEHATI index produce four stocks with a return of 4,01% and a risk of 38.87%, stocks using the Markowitz

model produce five stocks with a return of 0.12% and a risk of 38.87%, according to (Agustina & Damayanty, 2024) study, Optimal Portfolio Formation with a Single Index Model and Markowitz for Companies Listed on SRI-KEHATI.

(Khoirun Nisa & Listyani, 2024) Out of the 29 stocks processed, 12 were included in the Markowitz model's optimal portfolio, which had a return of 1.41% and a risk of 4.48%, and ten were included in the single index model's optimal portfolio, which had a return of 4.65% and a risk of 10.21%, per their study, Optimal Portfolio Formation with the Markowitz Model and the Single Index Model.

(Anwar et al., 2022) Twelve shares are included in the optimal portfolio of the Markowitz model, which has a return of 0.66% and risk of 3.22%, and nine shares are included in the optimal portfolio of the single index model, which has a return of 2.28% and a risk of 7.53%, according to their study, Comparative Analysis of Optimal Portfolio Formation on the Jakarta 70 Sharia Index (JII70) (Markowitz Model and Single Index Model Approach).

In 2020 (Komang Agus Adi Swara Putra & Made Dana, 2020) Out of the 28 stocks processed, six were included in the single index model's optimal portfolio, which had a return of 2.05% and a risk of 0.25%, and nine were included in the Markowitz model's optimal portfolio, which had a return of 1.16% and a risk of 2.80%, per their study, Comparative Study of Optimal Portfolio Performance: Single Index Model and Markowitz Model on LQ45 Stocks on the Indonesia Stock Exchange.

Given this context, an analysis utilizing the Markowitz model and the Single Index is required to ascertain the optimal portfolio for the SRI-KEHATI index. The public's strong interest in capital market investments during the pandemic is the reason for this; thus, it is important to weigh the risks and rewards of investing. This research aims to determine the anticipated return and optimal portfolio risk formed in equities, as well as how the Markowitz and Single Index models are used to determine the ideal portfolio while making investment decisions.

Literature Review

Theoretical Review

Investment

Investment is the financing of a sum of money in the hope of obtaining a particular supplement or profit on the funds or money. Therefore, investment is the postponement of current consumption in order to invest it in productive assets during a given period. (Hartono, 2014). (Muthohari, 2019), investing involves placing funds in financial assets with the aim of earning income in the future. The future income obtained from the investment is often referred to as a return. There are two types of return: realized return and expected return (Andi Mariani, 2021). The realized return corresponds to the return that has taken place, while the anticipated return corresponds to the return that investors expect to receive in the future. Financial assets can be invested in either directly or indirectly. Investment in financial assets can be direct or indirect. Direct investment involves buying financial assets directly from the company through intermediaries or other methods. Indirect investment involves buying shares in an investment company as part of the company's portfolio of financial assets (figure 2).

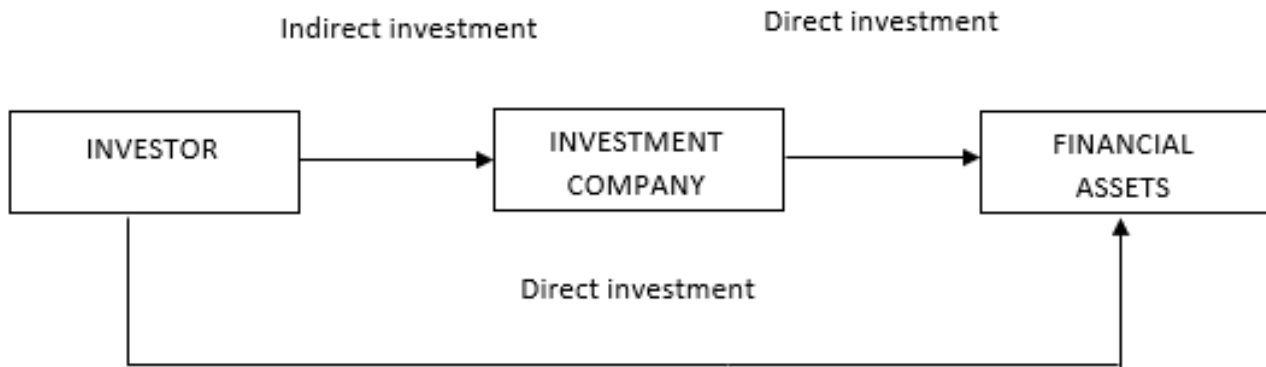


Fig. 2: Direct investment and indirect investment

Share

According to (Dwiana Sanjaya Putri & Nusa Muktiadji, 2017), shares represent a way of participating in a company's capital. Shares represent ownership of a company and enable shareholders to benefit from the company's profits, which differ according to the number of shares they hold. According to (Farhan Mingka et al., 2023), the number of shares held in a company indicates its ownership and gives the right to receive a share of its profits. An investment in shares offers the opportunity to receive dividends or a share in the company's profits, as well as capital gains, which are the difference between the purchase price and the sale price. On the other hand, investing in shares presents disadvantages or risks, such as the absence of dividends, loss of capital, liquidation of the company, and delisting from the stock exchange (Agustini et al., 2022). Regardless of the number of shares issued by a company, a share is a piece of paper that symbolizes its owner. Consequently, the shares of a corporation or limited liability company can constitute proof of ownership of the company's assets. The right to receive dividends on the company's profits is granted to the purchaser of the shares.

Composite Stock Price Index

A stock index, according to the Indonesia Stock Exchange, is a statistical metric that is frequently assessed and illustrates the general price movement of a certain group of equities. The objectives of a stock index are as follows (Dian Rusmiati et al., 2022):

- 1) Determine consumer perception.
- 2) Used for passive investment products such as mutual fund indices, ETFs, and their derivatives.
- 3) Active portfolio measurement.
- 4) Proxies for measuring and modeling risk-adjusted returns, risks, and performance, as well as proxies for asset classes in asset allocation.

Indeks SRI-KEHATI

On June 8, 2009, the Indonesia Stock Exchange (IDX) and the Indonesian Biodiversity Foundation (KEHATI) introduced the SRI-KEHATI index to promote ethical and sustainable investing. Chosen every six months, in April and October, the index consists of 25 issuers selected based on criteria such as transaction value, transaction frequency, market capitalization of at least Rp 1

trillion, and qualitative aspects such as financial condition and company growth prospects. The selection process consists of three stages: first, selecting core businesses, which avoid nine types of unsustainable businesses; second, assessing financial aspects with price acquisition ratio. In addition to helping investors choose stocks, this index encourages companies to improve their social and environmental performance (KEHATI, 2024).

Diversification

According to (Hartono, 2014), risk diversification is essential for investors because it allows them to reduce risk without compromising the returns received. Investors can diversify in several ways, as mentioned below.

- 1) Diversification with many assets
- 2) Random diversification
- 3) Markowitz diversification

Return

According to (Tandelilin, 2010), stock return is one of the factors that motivate investors to invest and is also a reward for the courage of investors to bear the risk of their investment. The gain that has happened is the gain that has happened, whereas the expected gain is the gain that investors anticipate receiving in the future (Hartono, 2014).

Risk

Risks are always there. It is uncertain whether a situation will occur in relation to a decision to be made based on specific considerations at this moment. Risk is if the expected investment does not turn out to be in accordance with expectations (Irfham Fahmi, 2018). Portfolio risk can be calculated by calculating the standard deviation or variation in the return value of a single security (Wahyuni & Darmayanti, 2019).

Portfolio Theory

The science of portfolio management looks at ways to reduce investment risk (Irfham Fahmi, 2018). According to (Agustini et al., 2022), Markowitz initially put forward the portfolio theory in an essay that served as its foundation in 1952. A portfolio is an assortment of investments designed to diversify and lower risk. According to (Hartono, 2014), an optimum portfolio is one that has the best balance between risk and projected return.

Markowitz Model

One model for determining a portfolio that shows how the relationship between investment risks and returns is formed is the Markowitz model. Its foundation is to give investors advice on how to minimize risks and maximize returns on each investment choice. Markowitz links the assessed risk to the standard deviation or variance with the expected return or average return using a quantitative approach to generate an efficient set and his ideal portfolio. Thus, the average variance approach is another name for this model (Hartono, 2014). The Markowitz model's foundation is its analysis of investors' risks and their ability to maximize profits on each investment choice. Harry Markowitz advises diversifying investments to reduce investment risks (Dewi, 2020). The fact that the Markowitz model only considers risks and projected returns, not risk-free assets, is another disadvantage (Ratna et al., 2016).

Single Index Model

William Sharpe was the first to establish the single-index idea in 1963. This model is used to make the Markowitz model computation simpler by giving the input parameters required for the formula (Hartono, 2014). Adiningrum states that you may evaluate the risks and returns of your portfolio with a single index model (Kartika DD, 2021). The discovery that a security's price moves in lockstep with the market price index is the basis for the concept of a single index. This outcome is obtained by sorting the Excess Return value by Beta and the cut-off point value. This implies that there can be a positive correlation between changes in market value and the stock rate of return (Dwiana Sanjaya Putri & Nusa Muktiadji, 2017).

Method

The study's subjects are businesses that were listed between 2020 and 2023 on the SRI-KEHATI index according to the following standards: (1) Businesses that were listed on the Indonesia Stock Exchange at the time (25 stocks); (2) SRI-KEHATI index companies that released closing stock prices during that time period (23 stocks); (3) SRI-KEHATI IDX companies that went public before that time period (22 stocks); (4) SRI-KEHATI IDX companies with positive Expected Return and positive Correlation (16 stocks); and (5) SRI-KEHATI IDX companies with BI Rate based on the research period 2020–2023 (16 stocks).

The aim of this study is to determine the efficacy of stock-based portfolio management in the SRI-KEHATI index. Using the Single Index Model and the Markowitz technique, this study will examine stock selection and the optimal approach for assembling a portfolio of SRI-KEHATI index equities between 2020 and 2023. The study will evaluate the portfolio risk and expected optimal returns of both methods in addition to determining the proportion of money invested in each stock. The secondary data utilized in this study came from <https://www.idx.co.id> , <https://id.investing.com>, and <https://www.bi.go.id>.

The variables used in forming the optimal portfolio are as follows:

1. The formula is used to determine each stock's return (Hartono, 2014).

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

Description:

- R_i : i^{th} stock return
- P_t : current investment price
- P_{t-1} : last period investment price

2. Use the formula to get each stock's monthly projected return. (Hartono, 2014).

$$E(R_i) = \frac{\sum_{t=1}^n R_{it}}{n}$$

Description:

- $E(R_i)$: expected return value
- R_{it} : the first asset in the i^{th} period
- n : number of historical data observations for a sample of n

3. Use the formula to determine each stock's variance and standard deviation. (Hartono, 2014).

$$SD = \frac{\sum_{t=1}^n [R_{it} - E(R_i)]^2}{n}$$

Description:

- SD : standard deviation
- R_{it} : the first asset in the i^{th} period
- $E(R_i)$: expected return value
- n : number of historical data observations for a sample of n

$$\sigma_i^2 = SD_i^2 = \frac{\sum_{t=1}^n [R_{it} - E(R_i)]^2}{n}$$

Variance is the square of the standard deviation.

4. Figuring out the variation coefficient. Expected return and asset risk are the two investing elements that need to be taken into account. Both elements may be taken into account using this correlation coefficient. Utilizing the formula for calculation:

$$CV_i = \frac{\text{Risiko}}{\text{Return Ekspektasian}}$$

Description:

- CV_i : coefficient of variation for asset- i
- Risk : generally used standard deviation

5. Use the formula to get the covariance between the shares of the sample firms. (Hartono, 2014).

$$\sigma_{ij} = \frac{\sum_{t=1}^n [(R_{it} - E(R_i)) \cdot (R_{jt} - E(R_j))]}{n}$$

Description:

- σ_{ij} : return covariance between stock i and stock j
- R_{it} : return on stock i period t
- R_{jt} : return on stock j period t
- $E(R_i)$: expected return of stock i
- $E(R_j)$: expected return of stock j
- n : number of observations from historical data for a sample of n

6. The method was utilized to determine the correlation between the shares of the sample firms (Hartono, 2014). The degree of movement association between each stock's two realized

returns and each of its deviations is displayed by the correlation coefficient.

$$r_{AB}\rho_{AB} = \frac{\text{Cov}(R_A, R_B)}{\sigma_A \cdot \sigma_B}$$

7. Calculate the percentage of money that comes from the stocks in the candidate portfolio. The Markowitz model-based portfolio risk function serves as the goal function. The optimization solution model is expressed as follows. The formula's objective function (Hartono, 2014).

$$\sigma_p^2 = \sum_{i=1}^n \sum_{j=1}^n W_i \cdot W_j \cdot \sigma_{ij}$$

8. Use Microsoft Excel's Excel Solver to calculate the return and risk. This program may be used to determine sample weights that will create an ideal portfolio.
9. Determine the ideal portfolio's risk and projected return. The same procedure is used in the sixth-stage computation to calculate anticipated return and variance.
10. Figuring out expected return (IHSG) and market return.

The market index, such as the IHSG (composite stock price index), that can be chosen for the IDX market is the market return. The formula may be used to determine the market return. (Hartono, 2014).

$$R_{mt} = \frac{\text{IHSG}_t - \text{IHSG}_{t-1}}{\text{IHSG}_{t-1}}$$

Description:

- R_{mt} : period-t market return (IHSG)
 IHSG_t : period-t composite stock price index
 IHSG_{t-1} : composite stock price index during the prior period. The return that investors anticipate the market will produce is known as the expected market return, and it may be computed using the following formula:

$$E(R)_M = \frac{\sum_{n-1}^n R_M}{n}$$

Description:

- $E(R)_M$: expected market return
 R_M : market return on day-t
 n : number of observations from historical data for a sample of-n

11. Figuring out the market and stocks' variation and standard deviation (IHSG). The formula may be used to determine stock variance. (Tandelilin, 2010):

$$\sigma_i^2 = \frac{\sum_{i-1}^n (R_{it} - E(R_i))^2}{n - 1}$$

The following formula may be used to determine the standard deviation of stocks:

$$\sigma_i = \sqrt{\sigma_i^2}$$

The following formula can be used to determine the market variance (IHSG):

$$\sigma_M^2 = \frac{\sum_{i=1}^n (R_M - E(R_M))^2}{n - 1}$$

The following formula is used to compute market standard deviation (IHSG):

$$\sigma_M = \sqrt{\sigma_M^2}$$

12. Figuring out each stock's alpha and beta the coefficient known as beta quantifies how market returns impact changes in stock returns. The following formula can be used to determine beta:

$$\beta_i = \frac{\sigma_{R_i, R_M}}{\sigma_M^2}$$

Description:

- σ_{R_i, R_M} : covariance of stock return i with market return (IHSG)
 σ_M^2 : variance of market return (IHSG)

Alpha is a variable that can be computed using the formula and is unaffected by market results. (Hartono, 2014):

$$\alpha_i = E(R_i) - (\beta_i \cdot E(R_M))$$

Description:

- α_i : alpha of stock-i
 $E(R_i)$: the expected return of stock-i
 $E(R_M)$: market expected return

13. Determining the residual error's variance.

The degree of unsystematic risk specific to the business is indicated by the variance of the residual error, which may be computed using the formula below:

$$\sigma_{ei}^2 = \sigma_i^2 - (\beta_i^2 \cdot \sigma_M^2)$$

14. Figuring out each stock's excess return to beta (ERB). The excess projected return of the risk-free return is divided by beta to determine the excess return to beta. The formula can be used to determine the degree of excess return to beta (ERB) (Hartono, 2014).

$$ERB = \frac{E(R_i) - R_{BR}}{\beta_i}$$

Description :

- ERB : Excess Return to Beta of security-i
 $E(R_i)$: Expected return of stock-i
 R_{BR} : risk-free asset return
 β_i : beta of security-i

15. Calculating the Cut-off Rate (Ci).

A criterion known as the Cut-off Rate (Ci) is used to decide whether or not a stock may be included in a portfolio. Ci may be computed by first using the following formula to get the values of A and B for each security I (Hartono, 2014):

$$A_i = \frac{[E(R_i) - R_{BR}]\beta_i}{\sigma_{ei}^2}$$

$$B_i = \frac{\beta_i^2}{\sigma_{ei}^2}$$

After obtaining the values A and B, the next step is to find the value of Ci, calculated using the formula (Hartono, 2014):

$$C_t = \frac{\alpha_M^2 \sum_{j=1}^i A_j}{1 + \alpha_M^2 \sum_{j=1}^i B_j}$$

Description:

- α_M^2 = variance of the market index return

16. Determining the Cut-off Point (C*)

The Cut-off Point is the most significant value of C_i (Hartono, 2014).

17. Determining the optimal portfolio candidate

The criterion determines the ideal portfolio if the stock $ERB \geq C^*$.

18. Calculate the proportion of each stock in the portfolio.

The calculation of the fund proportion is done after the portfolio is formed, and it is calculated using the formula (Hartono, 2014):

$$W_i = \frac{Z_i}{\sum_{j=1}^k Z_j}$$

Description:

- W_i : proportion of security-i
- k : the amount of assets in the optimal portfolio
- Z_i : weighted stock index-i

Where $Z_i = \frac{\beta_i}{\sigma_{ei}^2} (ERB_i - C^*)$

Description:

- Z_i : weighted stock index-i
- β_i : beta of security-i
- σ_{ei}^2 : variance of the residual error of security-i
- ERB_i : Excess Return to Beta of security-i
- C^* : the Cut-off Point value which is the largest C_i value

19. Determine the portfolio's expected return and variance so that the risk of the portfolio may be assessed.

The expected return, which is used to determine portfolio risk, is the weighted average of the individual returns of each stock in the portfolio, (Hartono, 2014):

$$E(R_p) = (\alpha_p + \beta_p \cdot E(R_M))$$

The following formula can be used to determine the alpha and beta of a portfolio:

$$\alpha_p = \sum_{i=1}^n W_i \cdot \alpha_i$$

$$\beta_p = \sum_{i=1}^n W_i \cdot \beta_i$$

Meanwhile, risk can be calculated using the formula (Hartono, 2014):

$$\sigma_p^2 = \beta_p^2 \cdot \sigma_M^2 + (\sum_{i=1}^n W_i \cdot \sigma_{ei})^2$$

Description:

- σ_p^2 : variance portfolio
- $\beta_p^2 \cdot \sigma_M^2$: market related risk
- $W_i \cdot \sigma_{ei}^2$: weighted average of each company's unsystematic risk

Result and Discussion

Public companies listed on the Indonesia Stock Exchange between 2020 and 2023 and currently listed on the SRI-KEHATI STOCK EXCHANGE are the subject of this study. The SRI-KEHATI IDX stock index uses secondary data from daily time series data, such as stock prices, BI ratios, and the Composite Stock Price Index (IHSG), to construct an ideal portfolio based on the Markowitz Model and Single Index. The Markowitz approach and Single Index are used to generate an optimum portfolio of 16 companies. The following standards were used to choose the study's sample:

Tab. 2: Research Sample

No	Stock Name	Code
1	PT Astra Agro Lestari Tbk	AALI
2	PT Aneka Tambang Tbk	ANTM
3	PT Astra Otoparts Tbk	AUTO
4	PT Bank Central Asia Tbk	BBCA
5	PT Bank Negara Indonesia (Persero) Tbk	BBNI
6	PT Bank Rakyat Indonesia (Persero) Tbk	BBRI
7	PT Bank Tabungan Negara (Persero) Tbk	BBTN
8	PT Bank Mandiri (Persero) Tbk	BMRI
9	PT Dharma Satya Nusantara Tbk	DSNG
10	PT Indofood CBP Sukses Makmur Tbk	ICBP
11	PT Vale Indonesia Tbk	INCO
12	PT Indofood CBP Sukses Makmur Tbk	INDF
13	PT Indocement Tunggul Prakarsa	INTP
14	PT Japfa Comfeed Indonesia Tbk	JPFA
15	PT Jasa Marga Tbk	JSMR
16	PT Kalbe Farma Tbk	KLBF
17	PT Siloam International Hospitals Tbk	SILO
18	PT Semen Indonesia (Persero) Tbk.	SMGR
19	PT Sawit Sumbermas Sarana Tbk	SSMS
20	PT Timah Tbk	TINS
21	PT Telkom Indonesia (Persero) Tbk	TLKM
22	PT Unilever Indonesia Tbk.	UNVR

Source: Processed secondary data, 2024

Table 3 shows the expected return on SRI-KEHATI index shares for the 2020-2023 period. Table 3 shows that from a population of 22 shares, there are 16 shares that have a positive expected return. There is a possibility that the issuer's shares can provide profits for investors in the future. Apart from that, 6 shares have negative expected return values, meaning there is a possibility that these shares will not provide profits for investors in the future. PT Aneka Tambang Tbk. (ANTM) is the stock with the largest expected return of 0.00126 or 0.126% and PT Unilever Tbk (UNVR) is the stock with the lowest expected return of -0.00066 or -0.066%. The value of 0.126% to -0.066% shows the high return investors will get daily.

Tab. 3: Rate of Return and Risk of Single Securities

No	Stock Name	E(Ri)	σ_i
1	AALI	- 0,00047	0,02370
2	ANTM	0,00126	0,03320
3	AUTO	0,00091	0,02254
4	BBCA	0,00049	0,01671
5	BBNI	0,00006	0,02772

6	BBRI	0,00051	0,02187
7	BBTN	- 0,00021	0,02603
8	BMRI	0,00019	0,02721
9	DSNG	0,00053	0,02623
10	ICBP	0,00010	0,01790
11	INCO	0,00061	0,02960
12	INDF	- 0,00004	0,01844
13	INTP	- 0,00040	0,02577
14	JPFA	0,00008	0,02649
15	JSMR	0,00022	0,02405
16	KLBF	0,00024	0,02239
17	SILO	0,00048	0,04032
18	SMGR	- 0,00030	0,02635
19	SSMS	0,00062	0,02876
20	TINS	0,00028	0,03316
21	TLKM	0,00018	0,01930
22	UNVR	- 0,00066	0,02166

Source: Processed secondary data, 2024

Based on the 16 stocks included in the portfolio formation candidates, there are 240 stock combinations that have positive covariance values, meaning that the two variables move in the same direction. The results of sample calculations for the IDX SRI-KEHATI index show that all of its securities produce positive covariance numbers, which means they tend to move in the same direction. For example, ANTM and TINS have the highest covariance of 0.00083 because they both have a good fundamental history.

If the two are combined into one portfolio, the company will move in the same direction because the company's condition is quite stable.

The correlation coefficient will show the extent to which returns are related between one security and another. Based on the correlation coefficient calculation from the SRI-KEHATI IDX Index sample, all samples are positively correlated, which means they will not provide risk reduction benefits. The weighted average of the individual hazards of the assets in the portfolio is the sole risk that results from this combination.

Portfolio Optimal Model Markowitz

This study focuses on the Markowitz Model's smallest optimal risk portfolio, known as the minimum variance portfolio, or MVP (Hartono, 2014). Investors with behavior like this are known as risk averse, or investors who prefer to avoid risk. After knowing the expected value of covariance, correlation coefficient and stock return, each is shown in table 4, and the calculation of the proportion of funds is carried out using the Markowitz model. This calculation was carried out using the Microsoft Excel solver feature.

Based on table 4, the Markowitz Model with the smallest risk preferences forms 9 stock combinations and the largest proportion of funds in PT Indofood Sukses Makmur Tbk (ICBP) is 21.31%. This figure is identified as providing greater profit potential than other stocks. Apart from that, the smallest proportion of funds is in shares of PT Siloam Internasional Hospitals Tbk (SILO), which is only 3.31%. The mix of shares that forms the optimal portfolio in table 4 produces the best returns and risks based on the portfolio with the lowest level of risk with a certain return.

The expected return on the portfolio obtained by investors based on the stock combination in table 4 is 0.04%, with a portfolio risk level of 1.16%. The portfolio risk level is smaller than the risk of each stock in the research sample. Overall, the Markowitz Model's optimal portfolio assumption of least risk preference has been shown to provide the smallest level of risk with a given return.

Tab. 4: Fund proportion, expected returns, and portfolio risks use the Markowitz Model based on the smallest risk preference

No	Assets	Proportion	Return	Risk
1	AUTO	9,54%	0,09%	2,25%
2	BBCA	20,61%	0,05%	1,67%
3	DSNG	10,70%	0,05%	2,62%
4	ICBP	21,31%	0,01%	1,79%
5	JSMR	3,32%	0,02%	2,41%
6	KLBF	9,92%	0,02%	2,24%
7	SILO	3,31%	0,05%	4,03%
8	SSMS	8,31%	0,06%	2,88%
9	TLKM	12,63%	0,02%	1,93%
Expected Return of Portfolio			0,04%	
Risk of Portfolio			1,16%	

Source: Processed secondary data, 2024

Optimal Portfolio Single Index Model

The single-index model states that securities will correlate if they exhibit the same market reaction (Hartono, 2014). If market returns climb, most stocks will rise as well, and vice versa. An ideal portfolio made up of assets with high ERB values is created using the Single Index model, which also employs the cut-off point to identify the upper and lower bounds of an ERB value. The discrepancy between the return of a risk-free investment and the expected return asset is called the additional return for beta (ERB); it is computed by beta and is often referred to as the return

premium per unit of risk. The sensitivity of SRI-KEHATI securities returns to market returns (IHSG) is measured by beta (β). Additionally, the projected level of return from SRI-KEHATI securities that is independent of the market rate of return (IHSG) is known as alpha (α) (Hartono, 2014). According to table 5, if market returns rise by one unit and stock returns rise by 0.01775, TINS shares have the greatest beta value, which is 0.01775. One special risk that illustrates the extent of unsystematic risk in the organization is residual error variance (σ_{ei}^2) (Hartono, 2014).

Tab. 5: Beta (β), Alpha (α), Residual Error Variant (σ_{ei}^2)

No	Stock Code	β_i	α_i	σ_{ei}^2
1	ANTM	0,01763	0,00126	0,00110
2	AUTO	0,00991	0,00091	0,00051
3	BBCA	0,01195	0,00049	0,00028
4	BBNI	0,01609	0,00006	0,00077
5	BBRI	0,01621	0,00050	0,00048
6	BMRI	0,01651	0,00019	0,00074
7	DSNG	0,00642	0,00053	0,00069
8	ICBP	0,00782	0,00010	0,00032
9	INCO	0,01501	0,00060	0,00088
10	JPFA	0,01341	0,00007	0,00070
11	JSMR	0,01289	0,00022	0,00058
12	KLBF	0,00899	0,00024	0,00050
13	SILO	0,00665	0,00047	0,00163
14	SSMS	0,00641	0,00062	0,00083
15	TINS	0,01775	0,00028	0,00110
16	TLKM	0,01141	0,00018	0,00037

Source: Processed secondary data, 2024

The proportional excess return of a single unit of risk that cannot be diversified is calculated using the ERB ratio, which is based on beta. From January 2020 to December 2023, 0.00012 is the monthly RBR value that is utilized. Consequently, the $E(R_i)$ value must be higher than the RBR value to select the optimal portfolio. Compared to bank investments, stock investors will generate higher profits. The SRI-KEHATI value of ERB in this study is displayed in table 6 in order of highest to lowest ERB value.

The cut point (C^*) is computed following the use of a single index model to determine the ideal portfolio.

Following the computation of A_j and B_j variables, the C_i value is determined by computing the intersection point (C^*). Table 6, which displays the A_j and B_j values, reveals that the PT Telkom Indonesia (Persero) Tbk (TLKM) shares have the highest C_i value, 0.0000092 or 0.00092%. The best stock portfolio will contain equities with an ERB value higher than the ideal ERB value limit, as indicated by a relatively high ERB value limit.

Tab. 6: A_j , B_j , and C_i Values of Individual Shares

No	Stock Code	ΣA_j	ΣB_j	C_i
1	ANTM	0,0356655	0,5251328	0,0000041
2	AUTO	0,0145965	0,1932685	0,0000017
3	BBCA	0,0617840	1,3809500	0,0000072
4	BBNI	0,0769526	3,7204855	0,0000089

5	BBRI	0,0733839	1,9307842	0,0000085
6	BMRI	0,0786744	3,0343600	0,0000091
7	DSNG	0,0390911	0,5850676	0,0000045
8	ICBP	0,0738244	4,1674432	0,0000085
9	INCO	0,0479340	0,8695936	0,0000055
10	JPFA	0,0752772	3,9767112	0,0000087
11	JSMR	0,0780018	2,6661062	0,0000090
12	KLBF	0,0747551	2,0921187	0,0000087
13	SILO	0,0403662	0,6122907	0,0000047
14	SMSS	0,0181364	0,2429915	0,0000021
15	TINS	0,0766599	2,3788250	0,0000089
16	TLKM	0,0791380	3,3835472	0,0000092

Source: Processed secondary data, 2024

With an ERB value of 0,075 or 7,75%, PT Astra Otoparts Tbk (AUTO) shares have the highest ERB value. This means that, when using the Single Index Model, AUTO shares will rank among the best stocks in the portfolio.

Additionally, at -0.076, or -7.76%, the shares of PT Indofood CBP Sukses Makmur Tbk (ICBP) have the lowest ERB value. Consequently, ICBP shares are not included in the ideal portfolio of the Single Index Model.

Tab. 7: Optimal portfolio stock selection

No	Stock Code	ERBi		Ci	Description
1	ANTM	0,06213	>	0,0000041	Optimal
2	AUTO	0,07552	>	0,0000017	Optimal
3	BBCA	0,02708	>	0,0000072	Optimal
4	BBNI	-0,00649	<	0,0000089	Not Optimal
5	BBRI	0,02110	>	0,0000085	Optimal
6	BMRI	0,00183	>	0,0000091	Optimal
7	DSNG	0,05716	>	0,0000045	Optimal
8	ICBP	-0,00762	<	0,0000085	Not Optimal
9	INCO	0,02941	>	0,0000055	Optimal
10	JPFA	-0,00654	<	0,0000087	Not Optimal
11	JSMR	0,00467	>	0,0000090	Optimal
12	KLBF	0,00850	>	0,0000087	Optimal
13	SILO	0,04684	>	0,0000047	Optimal
14	SMSS	0,07119	>	0,0000021	Optimal
15	TINS	0,00664	>	0,0000089	Optimal
16	TLKM	0,00133	>	0,0000092	Optimal

Source: Processed secondary data, 2024

Table 7 presents 16 consistent stocks in SRI-KEHATI for the 2020-2023 period, and only 13 stocks were selected as optimal portfolio stocks using the Single Index Model. The shares selected are shares of PT Aneka Tambang Tbk (ANTM), PT Astra Otoparts Tbk (AUTO), PT Bank Central Asia Tbk (BBCA), PT Bank Rakyat Indonesia (Persero) Tbk (BBRI), PT Bank Mandiri

(Persero) Tbk (BMRI), PT Dharma Satya Nusantara Tbk (DSNG), PT Indofood CBP Sukses Makmur Tbk (INCO), PT Jasa Marga Tbk (JSMR), PT Kalbe Farma Tbk (KLBF), PT Siloam International Hospitals Tbk (SILO), PT Sawit Sumbermas Sarana Tbk (SMSS), PT Timah Tbk (TINS), and PT Telkom Indonesia (Persero) Tbk (TLKM).

Based on table 8, the Single Index Model with the smallest risk preference forms 13 stock combinations and the most significant proportion of funds in PT Astra Otoparts Tbk (AUTO) is 22.43%. This figure is identified as providing greater profit potential than other stocks. Apart from that, the smallest proportion of funds is in PT Telkom Indonesia (Persero) Tbk (TLKM) shares, which is only 0.61%. The mix of shares that forms the optimal portfolio in table 8 produces the best returns and risks based on the portfolio with the lowest level of risk with a certain return.

Investors may anticipate a portfolio return of 0.07% with a risk level of 0.91% based on the stock combination shown in table 8. Every stock in the research sample has a higher risk than the portfolio as a whole. Overall, it has been shown that the least risk preference optimal portfolio assumption of the Single Index Model provides the lowest level of risk for a given return.

Tab. 8: Fund proportions, expected return, and portfolio risk use the Markowitz Model based on the smallest risk preference

No	Assets	Proportion	Return	Risk
1	ANTM	15,14%	0,13%	3,32%
2	AUTO	22,43%	0,09%	2,25%
3	BBCA	17,64%	0,05%	1,67%
4	BBRI	10,89%	0,05%	2,19%
5	BMRI	0,62%	0,02%	2,72%
6	DSNG	8,12%	0,05%	2,62%
7	INCO	7,68%	0,06%	2,96%
8	JSMR	1,58%	0,02%	2,41%
9	KLBF	2,32%	0,02%	2,24%
10	SILO	2,92%	0,05%	4,03%
11	SSMS	8,41%	0,06%	2,88%
12	TINS	1,63%	0,03%	3,32%
13	TLKM	0,61%	0,02%	1,93%
Expected Return of Portfolio			0,07%	
Risk of Portfolio			0,91%	

Source: Processed secondary data, 2024

Conclusion

Following a comparison of the Markowitz model with the single index model for optimum portfolio creation on companies in the SRI-KEHATI Index, the following findings were reached:

1. The Markowitz model states that a portfolio's expected return is 0.04%, while the risk is 1.16%. Included are 9 stocks: a proportion of 9.54% for AUTO, a proportion of 20.61% for BBCA, a proportion of 10.70% for DSNG, a proportion of 21.31% for ICBP, a proportion of 3.32% for JSMR, a proportion of 9.92% for KLBF, a proportion of 3.31% for SILO, an 8.31% proportion for SMSS, and a 12.63% proportion for TLKM.
2. The Index One model predicts a 0.07% portfolio return and a 0.91% risk. Among the 13 stocks are ANTM (15.14%), AUTO (22.43%), BBCA (17.64%), BBRI (10.89%), BMRI (0.62%), DSNG (8.12%), INCO (7.68%), JSMR (1.58%), KLBF (2.32%), SILO (2.92%), SMSS (8.41%), and TINS (1.6%).
3. Concerning sustainability-based (ESG) companies, this study contrasts two methods for creating an ideal portfolio: the Markowitz Model and the Single Index Model. Because the Single Index Model yields a return of 0.07% with a low risk of 0.91%, it is better suited for investors who are risk averse.

On the other hand, the Markowitz Model is better suited for investors who are prepared to accept chances in exchange for higher possible profits because it gives a return of 0.04% with a higher risk of 1.16%.

Depending on the degree of risk tolerance of each investor, both models provide investing ideas. The Markowitz Model is a solid option for more cautious investors since it provides consistency and efficient risk management. However, investors with an aggressive profile, who are prepared to assume greater risk in exchange for greater potential rewards, find the Single Index Model more alluring. Investing in ESG-based stocks, which emphasize beneficial effects on the environment and society, allows investors to support sustainability activities and optimize financial returns by selecting a model that fits their needs and investment goals.

This study has limitations arising from the following:

- 1) The study only uses two models, namely the Markowitz Model and the Single Index Model without considering the existence of short sales.
- 2) The research object only focuses on stocks included in companies that prioritize sustainability or ESG (Environmental, Social, and Governance) only.

Since researchers think there are still issues with this study, more research is anticipated:

- 1) To make the formed portfolio more varied and give investors a different perspective from other models, additional models such as the Sharpe Model should be included, or short sells should be considered while applying the Markowitz and Single Index models.
- 2) Study the formation of an ideal portfolio on other instruments, such as mutual funds, using different research subjects, such as companies that prioritize sustainability or ESG (Environmental, Social, and Governance) for the 2020–2023.

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