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Is the Markowitz Model Still Effective in Forming an Optimal Stock Portfolio? Empirical Evidence from the IDX ESG Leaders Index

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Abstract: The current portfolio calculation was basically developed by Markowitz (1952) who gave rise to the Modern Portfolio Theory. However, along with the development of science, other models emerged in portfolio calculation. This study tried to provide a flashback to whether the Markowitz portfolio model is still effective in forming an optimal portfolio compared to other portfolio calculation models. This study used descriptive research with a quantitative approach. This study used secondary data in the form of daily stock prices of companies, including the IDX ESG Leaders Index on the Indonesia Stock Exchange for the period of December 2020 to March 2022. The results showed that 11 stocks out of 25 stock samples were included in the optimal portfolio in both the Markowitz model and the Single Index Model but with different stock compositions. In terms of portfolio performance, the Markowitz model is still superior to the Single Index Model. This can be seen from the calculation results of the three indexes used, including the Sharpe Index, Treynor Index, and Jensen Index. This study provided an important contribution that the Markowitz model portfolio formation can be used and has proven to perform well in the formation of a stock portfolio.

Keywords: Jensen Index, Markowitz, Sharpe Index, single index model, Treynor Index.

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INTRODUCTION

Investment is a commitment to a number of funds with an expectation of generating additional funds or increasing the value of funds (Kvietkauskienė, 2014). Investments are generally divided into two, consisting of investments in financial assets and in real assets. The trend of investing in financial assets is currently increasingly in demand, especially investment in the capital market. Data from the Indonesian Central Securities Depository (KSEI) in January 2021 showed a significant increase in the number of capital market investors. Data from the end of 2018 to the end of 2019 showed an increase in the number of investors from 1.62 million to 2.48 million.

This increase of 53.41% is still lower than the data from the end of 2019 to 2020. By the end of 2020, the number of investors had reached 3.88 million despite the ongoing pandemic. This indicates that businesses in the capital market are more of the people's choice than real businesses which are in a downturn during this pandemic due to the Large-Scale Social Restrictions.

Investment is a decision full of uncertainty and risk (Alayón, 2015). Investment choices cannot only rely on the expected return, but also must be willing to take risks (Pandey, 2012). To minimize the risk that will occur, investors need to analyze the stocks that are considered the safest and provide the expected return (Naqvi et al., 2017). Uncertainty about future outcomes results from poorly diversified asset allocations, and sustained economic expansion raises risk (Khan et al., 2020).The approach that can be taken by investors in achieving optimal results is to diversify or spread investment risk consisting of some financial instruments (such as stocks) that have a strong negative correlation to form an efficient stock portfolio (Hatemi-J et al., 2022).

The main problem in forming a stock portfolio is when choosing stocks that will be used as portfolio candidates. Therefore, investors can choose stocks in particular indexes in the capital market (Yunita, 2018). There are several index options in the Indonesian capital market, one of which is the IDX ESG Leaders index. Companies that are included in this index are ESG-based companies. ESG companies usually have a concern for the environment and surrounding communities by formulating a set of standards required for their operations (Rath et al., 2020). Companies with high ESG scores mean that they have better risk management. These companies certainly have a low cost of capital and it means a high valuation. The development of IDX ESG Leaders from being launched in December 2020 to March 2022 experienced fluctuations, which tended to increase in the last few months, as shown in Figure 1.

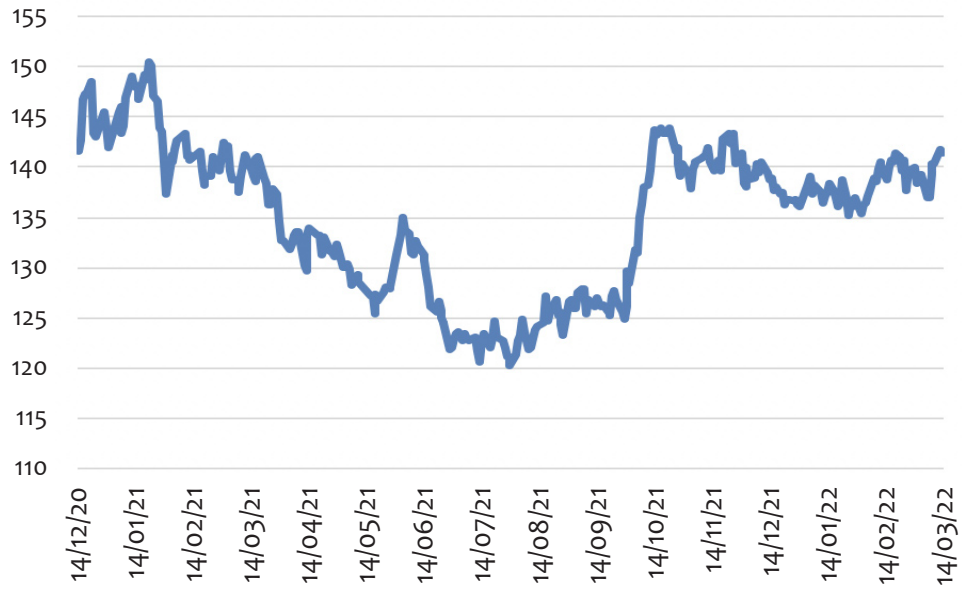

Figure 1 IDXESGL Development, December 2022-March 2022

Once the portfolio candidates have been selected from companies that are members of the IDX ESG Leaders index, an optimal portfolio will then be formed. The optimal portfolio is a portfolio that offers the lowest risk with the same rate of return or offers the largest rate of return with the same risk (Berk & Tutarli, 2021; Rutterford & Sotiropoulos, 2016a, 2016b). Fundamentally, the current portfolio calculation was developed by

Markowitz (1952) who gave rise to Modern Portfolio Theory. Markowitz showed that the variance of the rate of return is a measure of portfolio risk (Singh & Gautam, 2014). Portfolio risk is affected by the weighted average of each individual asset risk and the covariance between the assets that make up the portfolio (Pysarenko et al., 2019). The main assumption in this model is that investors tend to be risk-averse.

Sharpe (1963) developed a simpler calculation model than the calculation of the Markowitz model, which was the Single Index Model. The Single Index Model shows the relationship between the rate of return of each security and the rate of return on the market index and explains several steps in the formation of an optimal portfolio in a simple way compared to the Markowitz calculation method by calculating the portfolio variance and determining other variables as conditions for the formation of an optimal portfolio (Nurhayati et al., 2021). In the calculation, there is thus an input parameter that is needed in the calculation of the Markowitz model, which is the measurement of beta systematic risk where the influencing factor on stock prices is represented by the market return variable. It was found that the Single Index Model is the perfect model for optimal portfolio development (Marisetty, 2012; Oktaviani & Wijayanto, 2016).

Various studies have been conducted but there are inconsistencies in the results, especially in the composition of the stocks formed and the portfolio performance of each model. Results of a study by Rachmatullah et al. (2021) conducted on the Jakarta Islamic Index on the Indonesia Stock Exchange found 2 stocks that make up the optimal portfolio in the Markowitz model and 4 stocks that make up the portfolio in the Single Index Model. Based on the Treynor and Jensen indexes, the Markowitz model performs better than the Single Index Model but showed the opposite on the Sharpe Index. The portfolio built using the fundamental beta proportions outperforms the nave, Markowitz mean-variance, market, and bubble beta portfolios with larger Sharpe ratio in both the static and dynamic time-varying estimates, according to empirical results from India on 12 sectoral indices with NIFTY 500 as the market index (Hafsal & Raja Sethu Durai, 2020).

Muslim (2020) studied stocks that are included in the LQ45 Index using the Random Model, Single Index Model, and Markowitz Model calculations. They found that the portfolio performance of the Markowitz model is better than the performance of the Single Index Model based on the analysis of the Risk-Adjusted Return performance tested by calculating the Sharpe Index, Treynor Index, and Jensen Index, it can be concluded. Apart from these studies, there are many other studies that showed different Fields (Ginting et al., 2021; Hanif et al., 2021; Hidayat et al., 2022; Mba et al., 2022; Senthilkumar et al., 2021; Sikalo et al., 2022; Singagerda et al., 2019), thus it should be researched and studied further. This study tried to provide a flashback to whether the Markowitz portfolio model can still form an optimal portfolio compared to other portfolio calculation models, such as the Single Index Model. This study tries to provide a flashback to whether the Markowitz portfolio model can still form an optimal portfolio compared to other portfolio calculation models, such as the Single Index Model. To expand our research, we try to apply both models to the IDX ESG Leaders index.

METHODS

The data collection technique used was a documentation study with secondary data (list of issuers, daily closing price, IDX ESG Leaders index value, and BI-7 Day Repo Rate). The population in this study were companies included in the IDX ESG Leaders index for the period of December 14, 2020, to March 15, 2022. The sample determination used a purposive sampling technique with criteria in the form of companies that were consistently listed on the IDX ESG Leaders index for the period of December 14, 2020 to March 15, 2022 and had complete closing stock price data. By referring to the criteria, the sample collected was 25 companies.

Descriptive research through a quantitative approach was applied in this study to calculate the optimal portfolio through the Markowitz model and the Single Index Model. Meanwhile, the determination of the performance of the optimal portfolio of the Markowitz model and the Single Index Model used the calculation of the Sharpe Index, Treynor Index, and Jensen Index. The following (Table 1) are calculations in forming optimal portfolios and portfolio performance measurement:

Table 1 Calculations in Forming Optimal Portfolios and Portfolio Performance Measurement

Description	Calculation	Formula	
The Markowitz Model	Stock Returns	$R_i = \frac{P_t - P_{t-1}}{P_{t-1}}$	(1)
	Expected Stock Returns	$E(R_i) = \frac{\sum R_i}{n}$	(2)
	Stock Risk	$\sigma_i^2 = \frac{\sqrt{\sum (r_i - E(R_i))^2}}{n-1}$	(3)
	Covariance Between Two Stocks	$\sigma_{ij} = \sum \frac{\left[(R_i - E(R_i)) - (R_j - E(R_j))\right]}{n}$	(4)
	Expected Portfolio Return	$E(R_p) = \sum W_i E(R_i) + W_j E(R_j)$	(5)
	Portfolio Risk	$\sigma_p^2 = \sum W_i W_j \sigma_{ij}$	(6)
The Single Index Model	Stock Returns	$R_i = \frac{P_t - P_{t-1}}{P_{t-1}}$	(7)
	Expected Stock Returns	$E(R_i) = \frac{\sum R_i}{n}$	(8)
	Market Return	$R_m = \frac{Market\ Index_t - Market\ Index_{t-1}}{Market\ Index_{t-1}}$	(9)
	Expected Market Return	$E(R_m) = \frac{\sum R_m}{n}$	(10)
	Individual Variance Return	$\sigma_i^2 = \sum \frac{(R_i - E(R_i))^2}{n}$	(11)
	Market Return Variance	$\sigma_m^2 = \sum \frac{(R_m - E(R_m))^2}{n}$	(12)
	Covariance of Stock Return and Market Return	$\sigma_{im} = \sum \frac{\left[(R_i - E(R_i)) - (R_m - E(R_m))\right]}{n}$	(13)
	Beta	$\beta_i = \frac{\sigma_{im}}{\sigma_m^2}$	(14)

Description	Calculation	Formula	
	Alpha	$\alpha_i = E(R_i) - (\beta_i \cdot E(R_m))$	(15)
	Calculating Variance Residual Error/ Unsystematic Risk	$\sigma_{ei}^2 = \beta^2 \cdot \sigma_m^2 + \sigma_i^2$	(16)
	Risk Free Return	$R_f = \frac{\sum Rf}{n}$	(17)
	Excess Return to Beta (ERB)	$ERB = \frac{E(R_i) - R_f}{\beta_i}$	(18)
	Ai Value	$A_i = \frac{[E(R_i) - R_f]\beta_i}{\sigma_{ei}^2}$	(19)
	Bi Value	$B_i = \frac{\beta_i^2}{\sigma_{ei}^2}$	(20)
	Ci Value and - C* Cut-off Point	$C_i = \frac{\sigma_m^2[A_i]}{1+\sigma_m^2[B_i]}$	(21)
	Fund Proportion	$W_i = \frac{Z_i}{\sum Z_j}$ and $Z_i = \frac{\beta_i}{\sigma_{ei}^2}(ERB - C*)$	(22)
	Beta of the Portfolio	$\beta_P = \sum W_i \cdot \beta_i$	(23)
	Alpha of the Portfolio	$\alpha_p = \sum W_i \cdot \alpha_i$	(24)
	Unsystematic Risk Portfolio	$\sigma_{ep}^2 = \sum W_i \cdot \sigma_{ei}^2$	(25)
	Optimal Expected Portfolio Return	$E(R_p) = \alpha_p + \beta_p \cdot E(R_m)$	(26)
	Optimal Portfolio Risk	$\sigma_p^2 = \beta_p^2 \cdot \sigma_m^2 + \sigma_{ep}^2$	(27)
The Portfolio Performance Measurement	Sharpe Index	$S_p = \frac{TR_p - RF}{\sigma_p}$	(28)
	Treynor Index	$T_p = \frac{TR_p - RF}{\beta_p}$	(29)
	Jensen Index	$\alpha_p = (R_{pt} - RF_t) + [(\beta_p(R_{Mt} - RF_t)]$	(30)

Source: Hartono (2016); Rachmatullah et al. (2021); Suteja & Gunardi (2016)

RESULTS AND DISCUSSION

Before calculating using the Markowitz model and the Single Index Model, the expected stock and market returns, variance, standard deviation and risk free were first calculated to see whether these stocks were included in further calculations using the two models.

Table 2 Expected Stock and Market Returns, Variance, Standard Deviation, Risk Free

No.	Issuer Code	E(Ri)	Variance (σi^2)	Std Dev (σ_i)
1	ACES	-0.00148	0.00053	0.02300
2	AKRA	0.00094	0.00061	0.02461
3	ASII	0.00053	0.00039	0.01964
4	BBCA	-0.00094	0.00017	0.01297
5	BBNI	0.00087	0.00040	0.01997
6	BBTN	0.00003	0.00054	0.02323
7	BMRI	0.00063	0.00031	0.01759
8	BSDE	-0.00001	0.00055	0.02337
9	CTRA	0.00083	0.00083	0.02882
10	DMAS	-0.00076	0.00030	0.01733
11	ERAA	0.00152	0.00090	0.03001
12	EXCL	0.00029	0.00054	0.02326
13	HMSP	-0.00172	0.00028	0.01673
14	INTP	-0.00075	0.00053	0.02298
15	JSMR	-0.00061	0.00043	0.02069
16	MAPI	0.00007	0.00072	0.02685
17	MNCN	-0.00032	0.00054	0.02330
18	PWON	0.00002	0.00057	0.02393
19	RALS	-0.00001	0.00075	0.02732
20	SCMA	-0.00076	0.00126	0.03543
21	TBIG	0.00252	0.00094	0.03071
22	TLKM	0.00126	0.00036	0.01886
23	TOWR	0.00026	0.00047	0.02169
24	UNVR	-0.00250	0.00040	0.02010
25	WOOD	0.00077	0.00074	0.02724
E (R_m)				0.000049
Rf				0.00012

Source: processed data, 2022

There are 14 stocks that have a positive average daily expected return (Table 2), including: AKRA, ASII, BBNI, BBTN, BMRI, CTRA, ERAA, EXCL, MAPI, PWON, TBIG, TLKM, TOWR and WOOD, while there are 11 stocks that have a negative average daily expected return, including: ACES, BBCA, BSDE, DMAS, HMSP, INTP, JSMR, MNCN, RALS, SCMA, and UNVR. The highest average expected daily stock return is TBIG (0.00252) and the lowest is UNVR (-0.00250). The highest average daily stock risk is SCMA (0.00216) and the lowest is BBCA (0.00017). Other data related to the average market expected return obtained a value of 0.000049 and risk free of 0.00012.

Optimal Portfolio Calculation Using the Markowitz Model

Stocks that have a negative expected return value during the period studied were not included in the calculation because of the possibility that the stock is not profitable or experiences a loss so that investors do not choose the stock temporarily.

Table 3 Covariance Between Stocks of Optimal Portfolio-Making Candidates

	AKRA	ASII	BBNI	BBTN	BMRI	CTRA	ERAA	EXCL	MAPI	PWON	TBIG	TLKM	TOWR	WOOD
AKRA	0.0006	0.0001	0.0001	0.0002	0.0001	0.0002	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000
ASII	0.0001	0.0004	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0000	0.0000
BBNI	0.0001	0.0002	0.0004	0.0003	0.0002	0.0002	0.0001	0.0001	0.0002	0.0002	0.0001	0.0001	0.0000	0.0001
BBTN	0.0002	0.0002	0.0003	0.0005	0.0002	0.0003	0.0001	0.0002	0.0002	0.0002	0.0001	0.0002	0.0001	0.0000
BMRI	0.0001	0.0002	0.0002	0.0002	0.0003	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000
CTRA	0.0002	0.0002	0.0002	0.0003	0.0002	0.0008	0.0001	0.0001	0.0002	0.0004	0.0003	0.0001	0.0001	0.0001
ERAA	0.0000	0.0001	0.0001	0.0001	0.0001	0.0001	0.0009	0.0001	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001
EXCL	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0005	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001
MAPI	0.0001	0.0001	0.0002	0.0002	0.0001	0.0002	0.0002	0.0001	0.0007	0.0002	0.0001	0.0001	0.0000	0.0000
PWON	0.0001	0.0002	0.0002	0.0002	0.0001	0.0004	0.0001	0.0001	0.0002	0.0006	0.0001	0.0001	0.0000	0.0001
TBIG	0.0001	0.0001	0.0001	0.0001	0.0001	0.0003	0.0001	0.0001	0.0001	0.0001	0.0009	0.0001	0.0002	0.0001
TLKM	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0004	0.0001	0.0000
TOWR	0.0001	0.0000	0.0000	0.0001	0.0000	0.0001	0.0001	0.0001	0.0000	0.0000	0.0002	0.0001	0.0005	0.0001
WOOD	0.0000	0.0000	0.0001	0.0000	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0000	0.0001	0.0007

Source: processed data, 2022

Based on Table 3, it can be seen that the covariance between the two stocks has a positive value, which means that the return of each stock goes in the same direction, if one stock increases, the other will also increase. Below is the proportion of stocks that are able to compose an optimal portfolio using the Markowitz model obtained from the calculation results in the solver application:

Table 4 Optimal Stock Portfolio Proportion

No.	Issuer Code	Solver Value
1	AKRA	8.34%
2	ASII	9.51%
3	BBNI	0.00%
4	BBTN	0.00%
5	BMRI	18.60%
6	CTRA	0.00%
7	ERAA	4.34%
8	EXCL	4.63%
9	MAPI	8.48%
10	PWON	3.84%
11	TBIG	0.53%
12	TLKM	14.06%
13	TOWR	14.41%
14	WOOD	13.25%

Source: processed data, 2022

The results of the calculations on the solver application in Table 4 show that of the 14 candidate stocks that make up the optimal portfolio using the Markowitz method, only 11 make up the optimal portfolio, including: AKRA (8.34%), ASII (9.51%), BMRI (18.6%), ERAA (4.34%), EXCL (4.63%), MAPI (8.48%), PWON (3.84%), TBIG (0.53%), TLKM (14.06 %), TOWR (14.41%) and WOOD (13.25%). Meanwhile, the remaining 3 stocks, consisting of BBNI, BBTN, and CTRA are not included in the optimal portfolio.

Table 5 Portfolio Return, Portfolio Risk, and Optimal Portfolio Performance Using the Markowitz Model

Notes	Value
Portfolio Return	0.0661%
Portfolio Risk	0.0121%
Sharpe Index	4.9404%
Treynor Index	0.0666%
Jensen Index	0.0100%

Source: processed data, 2022

Table 5 shows that the portfolio return value based on the Markowitz model is 0.0661% and the portfolio risk value is 0.0121%, with a Sharpe Index value of 4.9404%, a Treynor Index value of 0.0666%, and a Jensen Index value of 0.0100%.

Optimal Portfolio Calculation Using the Single Index Model

Similar to the Markowitz model, stock candidates that have a negative expected return value during the period studied are not included in the calculation. Then, the calculation will be continued by finding the optimal portfolio using the Single Index Model and how its performance is seen based on the Sharpe Index, Treynor Index and Jensen Index.

Table 6 shows the value of alpha, beta, and unsystematic risk of each company which will then be used for calculating the determination of candidate stocks to form the optimal portfolio using the Single Index Model.

Based on Table 7, we can see that the value of the C* value is 0.00023 which is obtained from the largest Ci value. Using the criteria of stocks forming the optimal portfolio that obtains ERB value > C*, the stocks that make up the optimal portfolio are obtained, including: AKRA, ASII, BBNI, BMRI, CTRA, ERAA, EXCL, TBIG, TLKM, TOWR and WOOD.

Based on Table 8, it shows that the weights of each stock making up the optimal portfolio using the Single Index Model are: AKRA (0.02406 or 2.406%), ASII (0.16475 or 16.475%), BBNI (0.13391 or 13.391%), BMRI (0.17472 or 17.472%), CTRA (0.07822 or 7.822%), ERAA (0.01321 or 1.321%), EXCL (0.22985 or 22.985), TBIG (0.00934 or 0.934%), TLKM (0.06207 or 6.207%), TOWR (0.10546 or 10.546%) and WOOD (0.00441 or 0.441%). Beta of the portfolio is 1.07282. And the unsystematic risk of the portfolio is 0.00047.

Table 9 shows that the portfolio return value based on the Single Index Model is 0.0620% and the portfolio risk value is 0.0599%, with a Sharpe Index value of 2.0540%, a Treynor Index value of 0.0469%, and a Jensen Index value of -0.0037%.

Table 6 Alpha, Beta, and Unsystematic Risk

No.	Issuer Code	α	β	Unsystematic Risk
1	AKRA	0.00090	0.74329	0.00067
2	ASII	0.00048	1.10320	0.00052
3	BBNI	0.00080	1.36239	0.00061
4	BBTN	-0.00004	1.32922	0.00074
5	BMRI	0.00057	1.12897	0.00045
6	CTRA	0.00075	1.45896	0.00107
7	ERAA	0.00148	0.87755	0.00099
8	EXCL	0.00024	1.00108	0.00065
9	MAPI	0.00003	0.86422	0.00080
10	PWON	-0.00003	1.11099	0.00071
11	TBIG	0.00247	0.98955	0.00105
12	TLKM	0.00120	1.07771	0.00049
13	TOWR	0.00023	0.57047	0.00051
14	WOOD	0.00075	0.31369	0.00075

Source: processed data, 2022

Table 7 Alpha, Beta, and Unsystematic Risk

No.	Issuer Code	Excess Return	Ai	Bi	Ci	ERB
1	AKRA	0.00082	0.91307	827.651	0.00009	906.45
2	ASII	0.00041	0.87652	2333.816	0.00008	2662.60
3	BBNI	0.00075	1.68964	3062.723	0.00014	1812.65
4	BBTN	-0.00009	-0.16316	2397.849	-0.00001	-14696.06
5	BMRI	0.00051	1.27571	2822.921	0.00011	2212.82
6	CTRA	0.00071	0.96812	1992.881	0.00009	2058.50
7	ERAA	0.00140	1.24668	780.796	0.00013	626.30
8	EXCL	0.00017	0.26735	1535.118	0.00003	5742.01
9	MAPI	-0.00005	-0.05085	928.486	-0.00001	-18259.17
10	PWON	-0.00010	-0.14949	1737.691	-0.00001	-11624.20
11	TBIG	0.00240	2.26010	930.434	0.00023	411.68
12	TLKM	0.00114	2.52648	2392.952	0.00022	947.15
13	TOWR	0.00014	0.15963	641.948	0.00002	4021.48
14	WOOD	0.00065	0.27096	130.699	0.00003	482.36

Source: processed data, 2022

Table 8 Alpha, Beta, and Unsystematic Risk

No.	Issuer Code	Zi	Wi	α_p	β_p	σ^2ep
1	AKRA	1111996.34	0.02406	0.00002	0.01788	0.00001
2	ASII	7615266.73	0.16475	0.00008	0.18175	0.00006
3	BBNI	6189627.34	0.13391	0.00011	0.18244	0.00005
4	BMRI	8076257.38	0.17472	0.00010	0.19726	0.00005
5	CTRA	3615619.08	0.07822	0.00006	0.11412	0.00006
6	ERAA	610413.70	0.01321	0.00002	0.01159	0.00001
7	EXCL	10624500.48	0.22985	0.00006	0.23010	0.00012
8	TBIG	431913.88	0.00934	0.00002	0.00925	0.00001
9	TLKM	2868852.42	0.06207	0.00007	0.06689	0.00002
10	TOWR	4874445.09	0.10546	0.00002	0.06016	0.00005
11	WOOD	203950.62	0.00441	0.00000	0.00138	0.00000
Total		46222843.05	1.00000	0.00057	1.07282	0.00047

Source: processed data, 2022

Table 9 Portfolio Return, Portfolio Risk, and Optimal Portfolio Performance Using the Single Index Model

Notes	Value
Portfolio Return	0.0620%
Portfolio Risk	0.0599%
Sharpe Index	2.0540%
Treynor Index	0.0469%
Jensen Index	-0.0037%

Source: processed data, 2022

Comparison of Optimal Portfolio Results Between the Markowitz Model and the Single Index Model

Table 10 shows the comparison of the optimal portfolio results of the Markowitz Model and the Single Index Model. The portfolio returns generated by the Markowitz model and the Single Index Model are 0.0661% and 0.0620%, respectively. It can be seen that these results are not much different but the Markowitz model offers a lower level of risk. Therefore, it can be considered that the Markowitz model is still consistently focused on efforts to achieve an optimal portfolio by reviewing the expected return at a certain level of risk, thus investment diversification from this model is very useful for reducing overall portfolio risk. These findings are in line with research conducted by Rachmatullah et al (2021), that the optimal portfolio results from the two models have differences in terms of the expected return value generated, where the Markowitz model has a higher expected return than the Single Index Model.

Table 10 Comparison of Optimal Portfolio Using the Markowitz Model and the Single Index Model

	Markowitz	Single Index Model
Portfolio Return	0.0661%	0.0620%
Portfolio Risk	0.0121%	0.0599%
Sharpe Index	4.9404%	2.0540%
Treynor Index	0.0666%	0.0469%
Jensen Index	0.0100%	-0.0037%

Source: processed data, 2022

The Sharpe index shows the value of portfolio return after deducting the return on risk-free assets, then the portfolio return is adjusted to the amount of risk in the investment portfolio. Therefore, the Sharpe Index will show that for every risk inherent in the investment portfolio, the return on the portfolio will be higher or lower than investing in risk-free assets. In terms of portfolio performance, the Sharpe Index portfolio using the Markowitz model is higher than that of the Single Index Model, which is 4.9404% and 2.0540%, respectively, which means that the Markowitz model performs well.

The Treynor Index value for the portfolio using Markowitz is higher than that using the Single Index Model, which is 0.0666% and 0.0469%, respectively. The Treynor Index uses the security market line as a benchmark unlike the Sharpe Index. In this case, there is an assumption that the portfolio has been well diversified, so the risk that is considered relevant is systematic risk (beta) (Khan et al., 2019; Nasir et al., 2021). Beta measures the tendency of a portfolio's returns to change in response to changes in overall market returns. If the portfolio has a high number of volatile shares, it will have a beta value higher than 1. On the other hand, if the investment has only a small number of volatile shares, the beta value of the investment will be less than one. Thereby, the Markowitz model can be considered to have been well diversified with a relatively lower beta value.

The Jensen Index shows a difference between the actual return of the portfolio and the expected return of the portfolio, if the portfolio is on the capital market line. The value of the Jensen Index is the difference between the abnormal return of the portfolio in a particular period and the portfolio risk premium that should be received using a certain level of systematic risk according to the CAPM model. The use of the Jensen Index is also to see that the difference between the two returns is statistically significant. The Jensen Index value for the Markowitz model of 0.0100% is a higher value than the Single Index Model of -0.0037%. The Markowitz model shows a positive value, so that the portfolio generates excess returns.

These findings are in accordance with research conducted by Muslim (2020), and Hidayat et al. (2022) that the portfolio formed with the Markowitz model tends to perform better. The implication of our findings is that the formation of an optimal portfolio using the Markowitz model is better than the Single Index Model in terms of risk and return, especially for companies that are included in the IDX ESG Leaders index. An interesting thing is that even though the return generated by the Markowitz model is higher than the single index model, the level of risk is lower than the single index model. Furthermore, the results of the calculation of portfolio performance using the Sharpe Index, Treynor Index, and Jensen Index show the same results that the portfolio formed by the Markowitz model performs better than the single index model. The portfolio performance shows that the excess return is positive and the beta value is relatively lower, so it can be said that the portfolio has been well diversified.

CONCLUSION

Based on the Markowitz model and the Single Index Model, the stocks that make up the optimal portfolio on the IDX ESG Leaders index are 11 stocks, but with different compositions. The portfolio returns generated by these two indexes are relatively not much different, but in terms of risk, the Markowitz model has a relatively low portfolio risk. Portfolio performance through the Sharpe Index, Treynor Index and Jensen Index shows that Markowitz model performs better than the Single Index Model. The Markowitz model still plays a significant role in building investment portfolios for more than 6 decades. Its mean-variance framework and the weighted average return of each proportional individual asset in the portfolio from one observation period have proven to be reliable enough to generate an optimal portfolio. Although the Markowitz model has several underlying assumptions, in which the distribution of asset returns is assumed to be normal, investors are considered to achieve maximum returns. Meanwhile, risk averse in choosing what investments to invest, investors are considered capable of making rational decisions, investment decisions from every investor have equal access to all available information, and no transaction fees are charged (Ginting et al., 2021). Future studies can apply other portfolio formation models as a basis for comparison, such as the Bayes-Stein model, Black-Litterman model, 3-Fund Portfolio Combination, and add performance measurements using omega ratio and sortino ratio. In addition, future research can try to use the ESG Sector Leaders IDX KEHATI, ESG Quality 45 IDX KEHATI, and other ESG-based indices other than the Indonesia Stock Exchange to strengthen our findings.

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APPENDIX

Appendix A. Research Sample (25 companies)

No.	Issuer Code	Issuer Name
1	ACES	Ace Hardware Indonesia Tbk.
2	AKRA	AKR Corporindo Tbk.
3	ASII	Astra International Tbk.
4	BBCA	Bank Central Asia Tbk.
5	BBNI	Bank Negara Indonesia (Persero) Tbk.
6	BBTN	Bank Tabungan Negara (Persero) Tbk.
7	BMRI	Bank Mandiri (Persero) Tbk.
8	BSDE	Bumi Serpong Damai Tbk.
9	CTRA	Ciputra Development Tbk.
10	DMAS	Puradelta Lestari Tbk.
11	ERAA	Erajaya Swasembada Tbk.
12	EXCL	XL Axiata Tbk.
13	HMSP	H.M. Sampoerna Tbk.
14	INTP	Indocement Tunggal Prakarsa Tbk.
15	JSMR	Jasa Marga (Persero) Tbk.
16	MAPI	Mitra Adiperkasa Tbk.
17	MNCN	Media Nusantara Citra Tbk.
18	PWON	Pakuwon Jati Tbk.
19	RALS	Ramayana Lestari Sentosa Tbk.
20	SCMA	Surya Citra Media Tbk.
21	TBIG	Tower Bersama Infrastructure Tbk.
22	TLKM	Telkom Indonesia (Persero) Tbk.
23	TOWR	Sarana Menara Nusantara Tbk.
24	UNVR	Unilever Indonesia Tbk.
25	WOOD	Integra Indocabinet Tbk.

Source: idx.co.id (processed data, 2022)