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Optimal Portfolio Analysis Using Single index Model In combination with Stock Index: Indonesia Stock Exchange

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ABSTRACT

This research aims to identify the most effective method for forming an optimal portfolio by using the single index model calculation on theIndonesia Stock Exchange. This research uses 3 listed stock indices namely IDX30, IDXHIDIV20, and SRI-KEHATI. This research is descriptive quantitative with data collection techniques in the form of literature studies by studying journals, books and literature that have relevance to research. The sample of this study was obtained using purposive sampling technique with criteria that have been considered by the researcher. The type of data used is secondary data. This study uses two stages in analyzing the formation of the optimal portfolio, namely partial analysis on each index and in combination using the three stock indices. The results showed that the simulation of optimal portfolio formation with the highest return was obtained when the analysis was carried out jointly on the three stock indices with a valueof 9.07%.

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1. INTRODUCTION

The development of the Indonesian economy is inseparable from the role of the capital market organized on the Indonesia Stock Exchange. The capital market is a mediator that allows the

meetingof parties who will expand in business development with investors as parties who want to turn over their funds by expecting a rate of return on their invested funds. Investment is the allocation of a certain amount of funds or other resources at present with the intention of gaining future benefits (Tandelilin,2017).

The capital market is a meeting place for investors that provides financial investment options other than banking (Silalahi, Ningrum & Helia, 2021). The capital market serves as a platform for companies to sell shares in order to meet their long-term funding requirements. The capital market is considered liquid when sellers can quickly sell and buyers can quickly purchase securities. (Jogiyanto,2017). The Indonesian Capital Market has experienced a significant development over the past 15 years where there has been a growth in companies listed on the capital market as much as two times where in 2009 there were 398 companies and 2023 there were 868 companies (https://www.idx.co.id/).The development of the capital market is evident not only in the increase in the number of companiestrading shares but also in the significant rise in the number of investors, which surged from 1,122,668in 2017 to 11,228,382 in 2023.

There is not a single investor who wants a loss of capital paid into the company, in general, every investor will definitely expect profit, investors will choose stocks that provide high returns withlower risk (Iryani, 2019). The strategy used by investors to reduce risk is to combine various securitiesin their investment, or form a portfolio (Anggraeni & Mispiyanti, 2020).

Diversification is a way that investors can reduce the risk that investors may get. Diversificationis the concept of asset allocation that investors can choose between asset classes such as bonds, stocks,real estate. This asset allocation decision is an important decision that investors must make which willhave an impact on portfolio performance (Charles: 2010). Investors always want their portfolio to perform well. Every investor will not stop at the diversification stage by forming a portfolio to reduceexisting risks. A rational investor will inevitably choose the optimal portfolio (Hartono, 2014).

One method for selecting the optimal portfolio is the Single Index Model analysis, developed by William Sharpe to simplify Markowitz's optimal portfolio selection method. The Single Index Model relies on calculating daily stock prices and the stock index, where stock price movements alignwith the market price index (Cornuejols & Tutuncu, 2007).

Research on the single index model has been conducted quite a lot by researchers, such as thoseconducted by Arifin 2019, Iryani 2019, Nugroho 2019, Pratama 2019, Chasanah 2020, Hakim 2023, Novitasari 2023. Previous research on the single index model has primarily concentrated on identifyingthe optimal portfolio for each index on the Indonesia Stock Exchange. This study aims to evaluate a more effective method for using the single index model to determine the optimal portfolio.

Literature Review

Portofolio theory

Portfolio Theory was developed by Harry Markowitz in 1952, who is considered the key figurebehind its conceptualization. In that year, Markowitz published a groundbreaking paper titled “Portfolio Selection” in the Journal of Finance, which forms the foundation of Portfolio Theory.. Portfolio Theory has a concept where investors can increase profits and avoid risks by diversifying

portfolios so that investors have maximum profit potential with minimum risk of return (Febrianti et al., 2021).

Single Index Model

The Single Index Model is a relatively simple method because it can reduce the calculated variables, but still with the calculation of a longer period and a larger sample, so that more accurate results will be obtained and can answer the problem of uncertainty of stock investment in the capital market. The assumption underlying the single index model is that securities will only be correlated ifthey respond similarly to market returns (Tandelilin, 2017). The calculation for the single index modelis as follows:

1. Calculate the realz return (Ri) and expected return (E(Ri)) of each stock
   a. Realized return formula

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

   Ri = stock return rate
   P_t = stock price in period t
   P_{t-1} = stock price before period t
   b. Expected return formula

   $$E(R_i) = \frac{\sum R_i}{n}$$

   $E(R_i)$ = average expected return of stock i
   Ri = stock return rate in period i
   n = amount of data

2. Calculate the market return (RM), expected return (E(RM)), and market risk. The formula used is :

a. Formula for calculating market return

$$R_m = = \frac{INDEKS_t - INDEKS_{t-1}}{INDEKS_{t-1}}$$

INDEKSt = t-time composite stock price index
INDEKS$t-1$ = stock price index before time t

b. Calculating the average level of market return (Rm)

$$E(R_m) = \frac{\sum_1^N R_m}{N}$$

$E(R_m)$ = average market rate of return

R_m = market rate of return
N = amount of data

c. Calculating stock risk (σi^2) and market risk (σm^2)

$$\sigma^2 i = \frac{\sum_1^N (R_i - E(R_i))^2}{N}$$

$$\sigma^2 m = \frac{\sum_1^N (R_m - E(R_m))^2}{2}$$

σi^2 = Variance of stock returns

Ri = *Return that has occurred from the stock (Realized Return)*
$E(R_i)$ = *Expected return of the stock (Expected return)*

Rm = *Return that has occurred from the market (Realized market)*
$E(Rm)$ = *Expected return from the market (Expected Return Market)*
N = Number of periods of realized stock/market return

3. Calculating the stock covariance with the market which reflects the relationship betweenstock returns and market returns. The formula used is

$$\sigma im = (Ri - E(Ri)).(Rm - E(Rm))$$

σim = covariance between security I and the market
Ri = *stock return*
E(Ri) = expected *return*
Rm = market *return*
E(Rm) = expected market *return*

4. Calculate the beta and alpha of each stock. The formulas for calculating beta and alphaare

$$\beta i = \frac{\sigma im}{\sigma m2}$$

$$\beta t = \frac{\Sigma_{t=1}^{N} (R_i - \bar{R}_t)(R_m - \bar{R}_m)}{\Sigma_{t=1}^{N} (R_m - \bar{R}_m)}$$

βi = beta of i-th security
σim = covariance between security return and market return
$\sigma m2$ = market variance

For Alpha stocks the formula is

$$\alpha i = E(R_i) - \beta . E(R_m)$$

5. Find the variance or residual error

$$\sigma ei^2 = \sigma i^2 - \beta i^2 . \sigma m^2$$

σi^2 = variance of stock i
βi^2 = Beta of stock i squared
σm^2 = market variance
σei^2 = variance of the i-th security residual error

6.Calculating Excess Return to Beta (ERB). The formula used:

$$ERB_i = \frac{E(R_i) - R_f}{\beta_i}$$

ERB = Excess Return to Beta i
E(Ri) = average expected return of
stock iRf = *risk-free asset return*
βi = Parameter that measures the expected change in Ri if there is a change inRm

7. Calculating the value of Ai and Bi

$$A_I = \frac{E(R_i) - R_f . \beta_i}{\sigma ei^2}$$

$$\beta i^2 = \frac{\beta i^2}{\overline{\sigma ei^2}}$$

E(Ri) = *expected return of the stock*

Rf = *risk-free return*
βi = beta of stock i
σei^2 = *stock residual error variance*

8. Calculating the candidate cut-off rate

$$C = \frac{\sigma m^2 \sum_{j=1}^{i} \frac{(E(R_i) - Rf).\beta i}{\sigma ei^2}}{1 + \sigma m^2 \sum_{i=1}^{i} \left(\frac{\beta i^2}{\sigma ei^2}\right)}$$

$$C = \frac{\sigma m^2 \Sigma^i \; A}{1 + am^2 \Sigma^i_{i=1} Bi}$$

Ci = *cut-off rate*
E(Ri) = *expected return of the stock*
Rf = *risk-free return*
σei^2 = *stock residual error variance*
σm^2 = market return variance
βi^2 = square of stock beta

9. To determine the optimal portfolio, once the Expected Rate of Return (ERB) for each stock is calculated and ranked from highest to lowest, the next step is to compare these values with the highest C value. This comparison helps identify which individual stocks have a higher ERB, making them eligible for inclusion in the portfolio.

10. Calculating the proportion of funds for each stock. The formula used is

$$W_i = \frac{X_i}{\Sigma_{i=1} N} \; XI$$

Where

$$X_i = \frac{\beta i}{\sigma ei^2} \quad (ERB - C^*)$$

Wi = Percentage of funds invested in each stock

Xi = Scale of the scales on each stock

Xj = Total scale of scales for each stock

11. Calculating the expected return and risk of the optimal portfolio

a. Beta Portofolio

$$\beta p \underset{t=1}{=} \Sigma^N \; Wi.\beta i$$

b. Alpha portofolio

$$ap = \Sigma_{t=1}^{N} Wi.\alpha i$$

12. Calculating the expected return of the portfolio, the formula used is

$$E(R_p) = a_p + \beta_p.E(R_m)$$

13. Calculating portfolio risk. The formula used is

$$ap^2 = \beta p^2.aM^2 + (\sum_{i-1}^{n} Wi.\sigma_{ei})^2$$

2. METHOD

This research employs a descriptive quantitative approach. Quantitative descriptive research is a method used to explain a particular event through numerical data, with the goal of illustrating a phenomenon and its relationships to the readers (Sugiono, 2019).

Research Design

This research uses stock indices listed on the Indonesian stock exchange, namely the IDX30 index, SRI Kehati, and IDX High Devidend 20. This research was analyzed using the Microsoft Excelapplication

Participants/Sample Selection and Data Sources

This study uses a probability sample method using purposive sampling with certain criteria.

The criteria used in sampling in this study are as follows

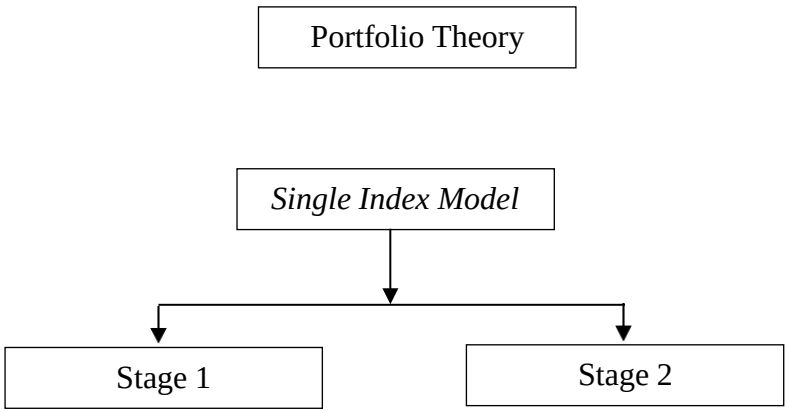
a. Companies listed in the IDX30 stock index for the 2023 period.
b. Companies listed in the High Dividend 20 stock index for the 2023 period.
c. Companies listed in the SRI-KEHATI stock index for the 2023 period.

Instrumentation/Data Collection

The data for this research is derived from secondary sources, with stock prices obtained from Yahoo Finance. The analysis was performed using the single index model and conducted with Microsoft Excel.

Research Model

In this study, the single index model analysis was conducted in two stages. The first stage involved finding the optimal portfolio for each stock index listed on the Indonesian Stock Exchange individually. The second stage combined all companies from the three indices and analyzed them usingthe single index model. The aim of this study is to determine the most effective method for applying the single index model to identify the optimal portfolio.



Return

Picture 1. Research Model

3. RESULTS AND DISCUSSION

Results

Stage 1 Analysis

IDX 30 Stock Index

No	Code	βi	ERBi	Wi
1	BBRI	0.649951475	0.0225533	18.59%
2	BMRI	0.949152906	0.0215074	42.01%
3	BBNI	0.777433497	0.0204453	14.20%
4	BRPT	1.971574746	0.0151364	2.11%
5	BBCA	0.363912311	0.0144061	23.09%
		Total		100.00%

Table 1. Optimal Portfolio Proportion of IDX 30 Index

Table 1 shows the optimal portfolio recommendations with the proportion of share ownership in theIDX30 index as follows BBRI 18.59%, BMRI 42.01%, BBNI 14.20%, BRPT 2.11%, BBCA 23.09%.

Code	Investment Return
BBRI	1.14%
BMRI	3.79%
BBNI	0.37%
BRPT	-0.23%
BBCA	1.27%
Total	6.34%

Table 2. Investment Return IDX 30 Stock Index

In table 2, it is known that the return value on optimal portfolio investment in the IDX30 stock indexis 6.34%.

High Devidend 20 Stock Index

No	Code	βi	ERBi	Wi
1	BBRI	0.649951475	0.0225533	25.43%
2	BMRI	0.949152906	0.0215074	56.13%
3	BBNI	0.777433497	0.0204453	18.44%
		Total		100.00%

Table 3. Optimal Portfolio Proportion of High Devidend 20 Index

The table above shows the proportion of share ownership in the IDXHIDIV20 stock index with thelargest ownership in BBRI 25.43%, BMRI 56.13%, BBNI 18.44%

Code	*Investment Return*
BBRI	1.57%
BMRI	5.06%
BBNI	0.48%
Total	7.11%

Table 4. Investment Return IDXHIDIV20 Stock Index

In Table 4, it is known that the return value on optimal portfolio investment in the IDXHIDIV20stock index is 7.11%.

Indeks Saham SRI-KEHATI

No	Code	βi	ERBi	Wi
1	JSMR	0.696625898	0.050249	50.96%
2	BBRI	0.649951475	0.0225533	10.63%
3	BMRI	0.949152906	0.0215074	23.44%
4	BBNI	0.777433497	0.0204453	7.69%
5	BBCA	0.363912311	0.0144061	7.27%
		Total		100.00%

Table 5. Optimal Portfolio Proportion of SRI-KEHATI

The table above shows the proportion of share ownership in the SRI KEHATI stock index withownership of JSMR 50.96%, BBRI 10.63%, BMRI 23.44%, BBNI 7.69%, BBCA 7.27%.

Code	*Investment Return*
JSMR	5.61%
BBRI	0.65%
BMRI	2.11%
BBNI	0.20%
BBCA	0.40%
Total	8.97%

Table 6. Investment Return of SRI-KEHATI Stock Index

In Tebel 6, it is known that the return value on the optimal portfolio investment in the SRI KEHATIstock index is 8.97%.

Stage 2 Analysis

No	Code	βi	ERBi	Wi
1	JSMR	0.696625898	0.050249	54.30%
2	BBRI	0.649951475	0.0225533	11.41%
3	BMRI	0.949152906	0.0215074	25.18%
4	BBNI	0.777433497	0.0204453	8.27%
5	BRPT	1.971574746	0.0151364	0.85%
		Total		100.00%

Table 7. Optimal Portfolio Proportion of Stage 2 Analyis

The table above shows the proportion of share ownership in Phase 2 of the Indonesia Stock Exchange with the largest ownership in JSMR 54.30%, BBRI11.41%, BMRI 25.18%, BBNI 8.27%,BRPT 0.85%.

Code	*Investment Return*
JSMR	5.97%
BBRI	0.70%
BMRI	2.27%
BBNI	0.22%
BRPT	-0.09%
Total	9.07%

Table 8. Investment Return Optimal Portfolio Stage 2

In table 8, it is known that the return value on optimal portfolio investment in Phase 2 Model 1 of theIndonesia Stock Exchange is 9.07%.

Discussion

NO	Index Name	Return	Optimal Portfolio
1	IDX30	6.34%	BBRI,BMRI,BBNI, BRPT, BBCA
2	SRI-KEHATI	8.97%	JSMR, BBRI, BMRI, BBNI, BBCA
3	IDXHIDIV20	7.11%	BBRI, BMRI, BBNI
4	Indonesia Stock exchange (IDX 30, IDXHIDIV20, SRI-KEHATI	9.07%	JSMR, BBRI, BMRI, BBNI,BRPT

Table 9. Comparison of Optimal Portfolio Investment Return

In Stage 1, the analysis was conducted on each stock index on the Indonesian Stock Exchange,including IDX30, SRI-KEHATI, and IDXHIDIV20, with the highest return observed in the SRI- KEHATI stock index. In Stage 2, a combined analysis of all companies listed in the three stock indiceswas performed, yielding the highest return value of 9.07%. Stage 2 identified five stocks recommended for the optimal portfolio: JSMR, BBRI, BMRI, BBNI, and BRPT. These stocks are drawn from thecombination of the three stock indices.

4. CONCLUSION

This study demonstrates that the optimal portfolio using the single index model can be determined either individually for each stock index or by combining indices, as done in Stage 2. Forinvestors seeking higher and maximum returns, it is advisable to combine multiple stock indices andperform an optimal portfolio analysis.

The implications of this study offer investors insights into designing a more effective optimal portfolio using single index model analysis. Additionally, this research provides practical benefits byguiding investors in making informed investment decisions, thereby helping them avoid losses associated with selecting an inappropriate stock portfolio.

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