JTAM (Jurnal Teori dan Aplikasi Matematika)
http://journal.ummat.ac.id/index.php/jtam
p-ISSN 2597-7512 | e-ISSN 2614-1175
Vol. 8, No. 3, July 2024, pp. 691-705

Analysis of the Single Index Model Optimal Portfolio Using the Sharpe and Treynor Measurement Index Related to Covid-19

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Article History:
Received : 05-01-2024
Revised : 29-04-2024
Accepted : 04-05-2024
Online : 17-07-2024

Keywords:
Single Index Model;
Sharpe;
Treynor.

ABSTRACT

The optimum portfolio is the preferred choice among investors for determining the most favorable combination of projected return and risk. This study seeks to ascertain the ideal portfolio performance of companies in the IDX30 index on the Indonesia Stock Exchange and know the value of the stock weight in each period, over three specific periods: before to the Covid-19 pandemic, at the peak of Covid-19 cases, and after a decline in Covid-19 instances. Stocks listed on IDX30 are stock companies that have high liquidity and large capitalization value on the capital market. The pre-Covid-19 era spanned from March 2019 to February 2020. The time of peak Covid-19 occurrences occurred from April 2021 to March 2022. Lastly, the period of declining Covid-19 instances extended from September 2022 to August 2023. The study employs the Single Index Model (SIM), using the Sharpe and Treynor measurement indices. The SIM will identify the relationship between the returns from each security and market returns to construct a portfolio. Meanwhile, Sharpe and Treynor Index measures the performance of portfolio. Based on the results of the analysis of optimal portfolio formation from 30 samples of IDX30 stocks, 4 stocks were obtained (ARTO, BBCA, BBRI, and BRPT) in the period before the Covid-19 pandemic, 14 stocks (ADRO, AKRA, ASII, BBCA, BBNI, BMRI, EMTK, ESSA, INCO, ITMG, MDKA, PTBA, TLKM, and UNTR) in the period when Covid-19 cases were peaking, and 7 stocks (AKRA, AMRT, BBCA, BBNI, BMRI, BRPT, and MEDC) in the period when Covid-19 cases were sloping. The Sharpe measurement index assessment had an average value in the period before the Covid-19 pandemic 1,7836; in the period when Covid-19 cases peaked it was 1,6051, and in the period when Covid-19 cases were sloping it was 0,7236. Meanwhile, the Treynor measurement index had an average value of in the period before the Covid-19 pandemic 0,8507; in the period when Covid-19 cases peaked it was 0,4095; and in the period when Covid-19 cases sloped it was 0,1317. The best period that has the highest Sharpe and Treynor index values is the period before the Covid-19 pandemic. The expected return value of the portfolio that was formed was 0,0601 in period I, 0,0509 in period II, and 0,0210 in period III. Meanwhile, the portfolio risk formed in period I was 0,1086, in period II it was 0,0150, and in period III it was 0,0089.

Crossref
https://doi.org/10.31764/jtam.v8i3.21249

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A. INTRODUCTION

The emergence of Covid-19 occurred in December 2019 in Wuhan, China. The global dissemination of Covid-19 was formally designated as a pandemic by the World Health Organisation (WHO) on March 11, 2020 (Altın, 2020). SARS-CoV-2 is the pathogen responsible for causing the viral disease known as Covid-19. Patients with severe Covid-19 disease will have acute respiratory problems, often starting one week after the first symptoms appear (Berlin et al., 2020). The clinical presentation of Covid-19 closely resembles that of other respiratory viruses, including symptoms such as fever, dry cough, dyspnea, and others (Gavin et al., 2020). Patients presenting symptoms should undergo confirmation of their diagnosis using nostril-based Polymerase Chain Reaction (PCR) testing (Strabelli & Uip, 2020). The Covid-19 virus has led to disruptions and limitations in the social, economic, health, and environmental domains in several nations (Sarkodie & Owusu, 2021). The outbreak of the Covid-19 pandemic has affected most of the industries that had to shut down during the quarantine period. The onset of the Covid-19 pandemic has had a significant impact on several companies, necessitating their closure throughout the quarantine period. The Covid-19 epidemic has caused a worldwide economic decline that has affected several financial sectors, including as stock markets, banking, and insurance (Goodell, 2020).

The rampant spread of the Covid-19 epidemic in Indonesia has had a substantial impact on the local economy. The stock price index (IHSG) had a decrease of 1.67% after the government's disclosure of its first Covid-19 case (Indrastuti, 2021). Gradually, the incidence of Covid-19 cases in Indonesia increased, resulting in a proportional intensification of its impact on financial markets (Khan et al., 2020). Stocks represent ownership of a company's worth, and the majority of investors choose to invest in stocks (Al Nimer et al., 2015). Stocks are a kind of financial instrument that may be traded on the capital market over a lengthy period of time (Yeşildağ & Özen, 2015). According to Güngör and Polat (2020), stocks are a crucial investment tool that may provide investors with the best level of return.

Engaging in capital market investments does not provide an exemption from both returns and risks. Investors will assess the prospective losses they are likely to encounter in the future (Sherwood & Pollard, 2018). Investors might mitigate the risk of losses by diversifying their holdings (Rabha & Singh, 2021). Enterprises requiring money may issue stocks and bonds to secure funding for their operations, while individuals with excess funds can allocate them in capital markets to generate returns (Jasman & Kasran, 2017). The capital market is seen as a crucial asset that strengthens a country's economy. This is evident in Indonesia via the measurable representation of companies that are listed on the stock market. Capital markets provide a possible opportunity for future financial benefit via investment (Odell & Ali, 2016). Capital markets facilitate a mutually beneficial connection between investors and entrepreneurs. Entrepreneurs may use capital markets to build their enterprises, while investors can allocate money in these markets to generate profits. A capital market is a marketplace where assets, such as bonds, stocks, and equity funds, are sold for more than one year. The purpose of this sale is to generate corporate capital or extra cash for future usage (Zakarias & Tumewu, 2015). The diversification of these assets may be achieved by investing not only in one company but also in other stocks. A collection of several of these equities would constitute a portfolio (Mary & Rathika, 2015).

An optimum portfolio is a preferred choice among investors for determining the anticipated return and minimizing risk. The objective of optimal portfolio construction is to adhere to the idea of diversification by constructing portfolios and allocating money among several assets rather than just one. Portfolios include a systematic approach to selecting a combination of assets that aims to optimize the anticipated return while considering the level of risk that the investor is willing to take on (Prasetyo & Suarjaya, 2020). An optimal portfolio is a portfolio that investors choose from a diverse group of assets on an efficient portfolio set. An optimum portfolio is a mix of the projected return and the lowest risk (Susanti et al., 2021).

The Single Index Model is a suitable framework for constructing an optimal portfolio. A Single Index Model establishes a correlation between the performance of individual securities and the overall market performance. The market index model computation yields an assessment of whether the price of a security is moving in tandem with a market price index (Nalini, 2014). The Sharpe and Treynor indexes are used to assess the performance of a portfolio. The Sharpe index is used to evaluate and compare the performance of different portfolios (Rachmad & Sugiharto, 2021). The treynor index is used to evaluate excess returns and analyze the impact of portfolio designs with varying degrees of systematic risk on returns (Zakarias & Tumewu, 2015). Forming a stock portfolio for an IDX30 company using the Single Index Model method aims to find out the best combination of stocks in a portfolio so that it can provide better recommendations to investors in allocating the fund.

This study aims to analyze the performance of stock portfolios using the Single Index Model. By measuring the effectiveness of the portfolio using the Sharpe and Treynor indices, investors can minimize the risk of losses. The analysis will focus on the monthly closing stock price data of stocks listed on IDX30. The equities listed on IDX30 are corporations with significant liquidity and a substantial market capitalization in the capital market. There are 30 equities mentioned that are considered favorable for investment due to their consistent prices and reduced risk compared to less traded stocks in capital markets. The study's findings are anticipated to provide investors valuable guidance in using Sharpe and Treynor's measurement indices for stock selection over three distinct periods: the pre-Covid-19 pandemic, the peak of Covid-19 cases, and the emergence of Covid-19 instances.

B. METHODS

The items used in this inquiry are the securities that were part of the IDX30 index before to the commencement of the Covid-19 outbreak, throughout the peak of Covid-19 instances, and the period of Covid-19-induced shutdown. The pre-Covid-19 era is from March 2019 to February 2020. The time of Covid-19 cases peaking is from April 2021 to March 2022. Lastly, the period for Covid-19 cases is from September 2022 to August 2023. There are a total of 30 stocks listed on IDX30 for each specific time.

The process of conducting optimal portfolio analysis utilizing the initial Single Index Model involves consolidating the closing prices of the stocks listed on the IDX30, computing the real return, surplus return, and anticipated return. Next, identify the excess return to beta (ERB) and ascertain the threshold amount. Subsequently, the stocks that are part of the optimal portfolio are selected based on the requirement that their excess return to beta (ERB) value exceeds the chosen cut-off point. Subsequently, ascertain the magnitude of the percentage allocated to each stock in the optimum portfolio and do computations to establish the anticipated return and risk of the portfolio. Subsequently, the index value is ascertained via the use of the Sharpe and Treynor index metrics.

1. Single Index Model

A Single Index Model (SIM) creates a linear relationship between the returns of individual securities and the returns of the whole market. The market index model assesses the correlation between the price of an asset and a market price index to see whether they move in the same direction (Hidayat et al., 2022). The SIM is a method of measuring a larger ERB value compared to a C_i value, and the other way around. If the ERB is smaller than the value of a C_i, then it is not included in an optimal portfolio. When building an ideal portfolio using SIM, many computations are required. These tasks encompass assessing the stock's performance and level of risk, estimating the anticipated return of the stock, computing the variability of stocks and markets, identifying the risk-free interest rate, calculating the beta coefficient, evaluating the ERB, determining the threshold rate and threshold point, and calculating the allocation weight of the stock fund (Yuwono & Ramdhani, 2017). The calculation formula to find the value of the return on the stock as follows:

$$R_{i_t} = \frac{P_{i_t} - P_{i_{t-1}}}{P_{i_{t-1}}}, \tag{1}$$

where R_{i_t} denote the stock i return during period t. The variable P_{i_t} denotes the price of stock i at time t, whereas $P_{i_{t-1}}$ reflects the difference between the price of stock i at time t and the price at the previous period. The calculation formula to find the return value of the market as follows:

$$R_{m_t} = \frac{P_{m_t} - P_{m_{t-1}}}{P_{m_{t-1}}}, \tag{2}$$

where R_{m_t} denote the IHSG's return during period t. P_{m_t} denotes the price of IHSG in period t, whereas $P_{m_{t-1}}$denotes the price of IHSG in period t minus the previous period. After obtaining the return value for stock i in each monthly period, the next step is to calculate the expected return, which is the average value of the return for stock i. The formula used to compute the expected value of return is as follows:

$$E(R_i) = \frac{\sum_{t=1}^{n} R_{i_t}}{n}, \tag{3}$$

where $\sum_{t=1}^{n} R_{i_t}$ is the sum of returns on stocks i in the period t to n, n is the amount of periods. If the stock has a value of $E(R_i) > 0$ then it will be resumed for further analysis, whereas if the value of $E(R_i) < 0$ then the stock can be ignored. This is because if the value of the expected return is positive, then the expected rate of return on each stock is greater than the rate of its decline so that it can provide a profit to the investor (Mulyani et al., 2022). The calculation formula for finding variance values for stock i and market as follows:

$$\sigma_i^2 = \frac{\sum_{t=1}^{n}(R_{i_t} - E(R_i))^2}{n} \quad \text{and} \quad \sigma_m^2 = \frac{\sum_{t=1}^{n}(R_{m_t} - E(R_m))^2}{n} \tag{4}$$

The calculation formula for finding excess return values is as follows:

$$ER = R_i - R_f \ , \tag{5}$$

where R_i is the actual value of the return of the stock *i* and R_f is a risk-free value (BI *Rate*). The next steps are to calculate the alpha (α) and beta (β) coefficients, as well as the variance error ($\sigma_{e_i}^2$). The alpha value (α) is used to ascertain the point at which the link between the genuine stock return *i* and the real market return intersects. The beta coefficient (β) is used to ascertain the gradient of the relationship between the genuine stock *i* return and the market's actual return (IHSG). The formula for computing variance error values is as follows:

$$\sigma_{e_i}^2 = \beta_i^2 \times \sigma_m^2 + \sigma_i^2 \ , \tag{6}$$

where $\sigma_{e_i}^2$ is the value of the variance error of stock *i*, β_i is the beta value of stock *i*, σ_m^2 is the market variance value, and σ_i^2 is a variance of stock *i*. Then identifying the stocks that are part of the most efficient portfolio. The formula used to calculate the values of A_i and B_i is given in Equation (7).

$$A_i = \frac{E(ER)_i \times \beta_i}{\sigma_{e_i}^2} \ , \tag{7}$$

where $E(ER)_i$ is the value of the expected excess return of the stock *i*, β_i is the beta value of stock *i*, and σ_{ei}^2 is the variance error value of stock *i*. B_i can be calculated using Equation (8).

$$B_i = \frac{\beta_i^2}{\sigma_{e_i}^2} \ , \tag{8}$$

where β_i is the beta value of stock *i*, and $\sigma_{e_i}^2$ is the variance error value of stock *i*. After obtaining the values A_i and B_i the next step is to find the value C_i is as follows:

$$C_i = \frac{\sigma_m^2 \times A_i}{1 + \sigma_m^2 \times B_i} \ , \tag{9}$$

The SIM is a strategy used in optimal portfolio analysis to compare the *ERB* with the cut-off rate (C_i) for each stock in security analysis. The *ERB* is computed as the difference between the expected return of the stock and the risk-free return, and then divided by the systematic risk. The formula for computing excess return to beta (*ERB*) values given in equation (10).

$$ERB_i = \frac{E(ER)_i}{\beta_i} \ , \tag{10}$$

where $E(ER)_i$ represents the expected excess return value of the stock i, β_i is the beta value of stock i. After obtaining the ERB value of each stock, the next step is to sort the stock according to the greatest value to the smallest, then determine the cut-off point value (C^*) by choosing the largest value C_i. An excess return to beta (ERB) value greater than the cut-off point value(C^*) is the stock that enters the optimal portfolio (Margana et al., 2017). The symbol $E(ER)_i$denotes the anticipated excess return value of stock i, whereas β_i represents the beta value of stock i. Once the ERB value of each stock has been obtained, the next step is to arrange the stocks in descending order based on their values. Then, the cut-off point value (C^*) may be determined by selecting the highest value C_i. A stock with an excess return to beta (ERB) value higher than the specified cut-off point value (C^*) is included in the optimum portfolio (Margana et al., 2017). The next step is to determine the weight of each stock in the optimal portfolio. The calculation formula to find the values Z_i and W_i is as follows:

$$Z_i = \frac{\beta_i}{\sigma^2_{e_i}} \ (ERB_i - C^*) \ , \tag{11}$$

where Z_i representing the Z value of stock i, β_i is the beta value of stock i, $\sigma^2_{e_i}$ is the variance value of the stock error i, ERB_i is the excess value of return to the beta of stock i, and C^* is a cut-off point value. Calculates the proportion of funds made after obtaining the value Z_i is given in Equation (12).

$$W_i = \frac{Z_i}{\sum_{i=1}^{k} Z_i} \ , \tag{12}$$

where W_i represents the proportion of the securities of the stock i, Z_i is the Z value of the stock i, k is the number of stocks in the optimum portfolio, and Z_i is an accumulation of the value of Z. Then, it can be ralculated that the expected return and the amount of risk linked to the portfolio. The system calculates the projected return and risk of the portfolio. The portfolio's expected return denotes the projected rate of return that an investor might anticipate receiving from the portfolio. The formula for computing the expected portfolio return is as follows:

$$E(R_p) = \alpha_p + \beta_p . E(R_m) \ , \tag{13}$$

where $E(R_p)$ representing portfolio expected return, α_p representing the portfolio's alpha value, β_p representing a portfolio beta value, and $E(R_m)$ representing market expected return. The formula of α_p and β_p are given in Equation (14).

$$\alpha_p = \sum_{i=1}^{k} W_i . \ \alpha_i \qquad \text{and} \qquad \beta_p = \sum_{i=1}^{k} W_i . \ \beta_i \tag{14}$$

Subsequently, the subsequent action is computing the risk associated with the portfolio. Risk refers to the lack of assurance about the rate of return that an investment will achieve. The return rate is a critical metric that reflects the success of the firm and its future risk. Additionally, it plays a key role in calculating the projected return rate (Aini et al., 2022). Portfolio risk is the disparity between the actual return and the anticipated return. The formula for calculating a portfolio risk value is as follows:

$$\sigma_p^2 = \beta_p^2 \cdot \sigma_m^2 + \left(\sum_{i=1}^{k} W_i . \beta_i \right), \quad (15)$$

where σ_p^2 is the portfolio risk value, β_p^2 is the sum of the beta value of the stock that enters the optimal portfolio, σ_m^2 is the variance return of the market (IHSG), W_i is a proportion of the securities of the stock *i* and β_i is a beta value on the stock *i*.

2. Sharpe Index

The Sharpe measurement index follows the criteria that a higher Sharpe value indicates better performance. This is because it is based on the comparison of the moving average of returns above the risk-free rate and the relatively low standard deviation (Verma & Hirpara, 2016). The Sharpe index quantifies the level of return achieved relative to the level of risk undertaken (Hartono et al., 2014). Assessment of the index measurement using Sharpe will be said to have a good performance if the Sharpe portfolio value is greater than the market Sharpe value. A positive and increasing Sharpe index indicates an improvement in portfolio performance. The calculation formula for finding the index value of Sharpe (Akçayir et al., 2014) is provided in Equation (16).

$$S_p = \frac{R_p - R_f}{\sigma_p} \quad (16)$$

The Sharpe portfolio index represented as S_p, is computed by taking the average return of the portfolio R_p, subtracting the average risk-free return rate R_f, and dividing the result by the standard deviation of the portfolio return σ_p, over the specified observation period.

3. Treynor Index

The Treynor Index measurement can be calculated by dividing the surplus investment return or return above the risk-free level by the beta value (Agussalim et al., 2017). The beta value is a measure of the sensitivity of an investment to market risk. A high-value treynor index will indicate that an investment has yielded a higher return for the amount of market risk it took (Ho et al., 2014). Assessment of the index measurement using Treynor will be said to have a good performance if the Treynor portfolio value is greater than the market Treynor value. If the Treynors value is positive and increases, then the stock portfolio performance is better. The calculation formula for finding the value of the Treynor index (Zerey & Terzi, 2015) is given in Equation (17).

$$T_p = \frac{R_p - R_f}{\beta_p} \tag{17}$$

where T_p represent the value of the Treynor portfolio index, R_p denote the average portfolio return p throughout the observation time, R_f indicate the mean rate of risk-free return during the observation period, and β_p represent the beta portfolio for the observation period.

C. RESULT AND DISCUSSION

1. Description Data

The research utilises secondary data on the monthly closing price of the stock listed on IDX30, taken from <u>*http://www.finance.yahoo.com.*</u> The period used in the analysis is before Covid-19 was from March 2019 to February 2020; the peak period of Covid-19 cases was from April 2021 to March 2022; and the period of Covid-19 infection was from September 2022 to August 2023. This study analyses the optimum performance of the Single Index Model portfolio on IDX30 stocks in the following three periods: (a) Period I: March 2019 to February 2020; (b) Period II: April 2021 to March 2022; and (c) Period III: September 2022 to August 2023. On IDX30 stocks, there are 30 stocks listed between August 2023 and January 2024. However, there are two stocks that are not included in the analysis because they are not available in the desired period, namely the stocks of PT Bukalapak.com Tbk (BUKA) and PT GoTo Gojek Tokopedia Tbc (GOTO). According to *finance.yahoo.com*, the stock of BUKA opened on August 6, 2021, and the stock of GOTO on April 11, 2022, as shown in Table 1.

Table 1. Stocks on IDX30

No	Stocks Code	Company Name
1	ADRO	PT Adaro Energy Indonesia Tbk
2	AKRA	PT AKR Corporindo Tbk
3	AMRT	PT Sumber Alfaria Trijaya Tbk
4	ANTM	PT Aneka Tambang Tbk
5	ARTO	PT Bank Jago Tbk
6	ASII	PT Astra International Tbk
7	BBCA	PT Bank Central Asia Tbk
8	BBNI	PT Bank Negara Indonesia (Persero) Tbk
9	BBRI	PT Bank Rakyat Indonesia (Persero) Tbk
10	BMRI	PT Bank Mandiri (Persero) Tbk
11	BRPT	PT Barito Pacific Tbk
12	**BUKA**	**PT Bukalapak.com Tbk.**
13	CPIN	PT Charoen Pokphand Indonesia Tbk
14	EMTK	PT Elang Mahkota Teknologi Tbk
15	ESSA	PT Surya Esa Perkasa Tbk
16	GOTO	PT GoTo Gojek Tokopedia Tbk
17	HRUM	PT Harum Energy Tbk
18	INCO	PT Vale Indonesia Tbk
19	INDF	PT Indofood Sukses Makmur Tbk
20	ITMG	PT Indo Tambangraya Megah Tbk
21	KLBF	PT Kalbe Farma Tbk
22	MDKA	PT Merdeka Copper Gold Tbk
23	MEDC	PT Medco Energi Internasional Tbk
24	PGAS	PT Perusahaan Gas Negara Tbk
25	PTBA	PT Bukit Asam Tbk
26	SMGR	PT Semen Indonesia (Persero) Tbk
27	TLKM	PT Telekomunikasi Indonesia Tbk
28	TOWR	PT Sarana Menara Nusantara Tbk
29	UNTR	PT United Tractors Tbk
30	UNVR	PT Unilever Indonesia Tbk

2. Expected Return of Stock

The projected return may be determined by summing the returns of each stock throughout periods I, II, and III. Then divided by the number of study periods of 12 months. A good stock is a stock that has a value of $E(R_i) > 0$. Systematically, the calculation is expressed in Equation (3). The following is an example of calculating the expected return on ADRO shares for period I:

$$E(R_{ADRO}) = \frac{\sum_{t=1}^{12} R_{ADRO}}{12} = \frac{(0{,}0229) + (-0{,}0261) + (-0{,}0077) + ... + (-0{,}0571)}{12} = \frac{-0{,}1585}{12} = -0{,}0038$$

Table 2. Expected Return Value

No	Stocks Code	Value of $E(R_i)$			No	Stocks Code	Value of $E(R_i)$		
		Period I	Period II	Period III			Period I	Period II	Period III
1	ADRO	-0,0038	0,0795	-0,0123	15	HRUM	-0,0164	0,0950	-0,0038
2	AKRA	-0,0540	0,0329	0,0171	16	INCO	-0,0250	0,0407	0,0003
3	AMRT	-0,0019	0,0553	0,0275	17	INDF	-0,0042	-0,0084	0,0120
4	ANTM	-0,0378	0,0129	0,0028	18	ITMG	-0,0431	0,0842	-0,0160
5	ARTO	**0,5035**	0,0413	-0,0890	19	KLBF	-0,0137	0,0038	0,0077
6	ASII	-0,0196	0,0206	-0,0048	20	MDKA	0,0557	0,0696	-0,0139
7	BBCA	0,0114	0,0219	0,0100	21	MEDC	-0,0260	0,0061	0,0312
8	BBNI	-0,0163	0,0361	0,0070	22	PGAS	-0,0494	0,0105	-0,0215
9	BBRI	0,0083	0,0069	0,0217	23	PTBA	-0,0421	0,0247	-0,0274
10	BMRI	0,0029	0,0225	0,0272	24	SMGR	-0,0115	-0,0312	0,0067
11	BRPT	0,0583	-0,0025	0,0297	25	TLKM	-0,0074	0,0258	-0,0157
12	CPIN	-0,0148	-0,0169	-0,0092	26	TOWR	0,0033	0,0006	-0,0137
13	EMTK	-0,0391	0,0171	-0,0894	27	UNTR	-0,0349	0,0170	-0,0157
14	ESSA	-0,0563	0,1378	-0,0386	28	UNVR	-0,0273	-0,0450	-0,0172

A good stock is a stock that has a value of $E(R_i) > 0$ which means that the stock is able to provide a profit to the investor. Table 2 shows that the value $E(R_i) > 0$ is found in 7 shares that entered the criterion in period I, there are 23 shares which enter the criteria in period II, and there are 14 shares in the criteria in period III.

3. Determination of Optimal Input Stock Portfolio

When using the Single Index Model to determine stock investments, the use of excess return to beta and cut-off point values is employed to identify the optimal allocation of money for each company. The IHSG is the benchmark index used to compare against the portfolio. In order to establish the stock valuation reference, it is necessary to identify the cut-off point value (C^*) for the selection of stocks in the optimum portfolio. The determination of the cut-off point value, denoted as (C^*) may be seen as the maximum value on C_i, as shown in Table 3.

Table 3. Nilai Excess Return to Beta (*ERB*) and C_i

No	Stocks Code	Period I	
		ERB	C_i
1	ARTO	0,0777	0,0029
2	BBCA	0,0098	0,0029
3	BBRI	0,0034	0,0009
4	BMRI	-0,0019	-0,0004
5	BRPT	0,0250	0,0031
6	MDKA	-0,2004	-0,0017
7	TOWR	-0,0024	-0,0002

No	Stocks Code	Period III	
		ERB	C_i
1	AKRA	0,0123	0,0005
2	AMRT	0,0110	0,0014
3	ANTM	-0,0021	-0,0001
4	BBCA	0,0100	0,0008
5	BBNI	0,0063	0,0002
6	BBRI	-0,1415	-0,0004
7	BMRI	0,0150	0,0024
8	BRPT	0,0123	0,0010
9	INCO	-0,0027	-0,0003
10	INDF	-0,0118	-0, 0008
11	KLBF	-0,0097	-0,0002
12	MEDC	0,0073	0,0008
13	SMGR	0,0012	0,0001

No	Stocks Code	Period II	
		ERB	C_i
1	ADRO	0,0872	0,0014
2	AKRA	0,0168	0,0018
3	AMRT	-0,0525	-0,0008
4	ANTM	0,0035	0,0005
5	ARTO	-0,0180	-0,0016
6	ASII	0,0066	0,0013
7	BBCA	0,0141	0,0022
8	BBNI	0,0072	0,0014
9	BBRI	0,0015	0,0003
10	BMRI	0,0085	0,0017
11	EMTK	0,0067	0,0005
12	ESSA	0,0401	0,0021
13	HRUM	-0,1159	-0,0004
14	INCO	0,0174	0,0020
15	ITMG	0,0375	0,0040
16	KLBF	0,0006	0,0001
17	MDKA	0,0572	0,0023
18	MEDC	0,0027	0,0001
19	PGAS	0,0016	0,0003
20	PTBA	0,0089	0,0010
21	TLKM	0,0489	0,0017
22	TOWR	0,0017	0,0001
23	UNTR	0,0166	0,0004

The selection of shares that are included in the optimal portfolio is required to determine the cut off point value (C^*) as the share valuation reference. The determination of the cut-off point value (C^*) can be seen at the greatest value on C_i. Thus, determining the shares that enter into the optimal portfolio can be seen with the value $ERB > C^*$. Then, if can be viewed the stocks that entered into the optimum portfolio in the period I are 4 shares (ARTO, BBCA, BBRI, and BRPT), in period II are 14 shares (ADRO, AKRA, ASII, BBCA, BBNI, BMRI, EMTK, ESSA, INCO, ITMG, MDKA, PTBA, TLKM, and UNTR), and in period III are 7 shares (AKRA, AMRT, BBCA, BBNI, BMRI, BRPT, dan MEDC).

4. Calculation of Stock Weight

Once the stocks that are included in the optimum portfolio have been identified, the subsequent task is to ascertain the allocation or proportion of each stock. The calculation of the share weight value can be seen in the example of calculating the weight of ARTO shares using Equation (11).

$$Z_{ARTO} = \frac{\beta_{ARTO}}{\sigma^2_{e\,ARTO}} (ERB_{ARTO} - C^*) = \frac{6,4237}{1,2548} (0,0777 - 0,0031) = 0,3818$$

So, the weight value for ARTO shares using Equation (12) is as follows.

$$W_{ARTO} = \frac{Z_{ARTO}}{\sum_{j=1}^{k} Z_j} = \frac{0,3818}{5,0160} = 0,761 = 7,61\%$$

Table 4. Weighing value of stocks entering the Optimal Portfolio

No	Stocks Code	Period I Stock Weight
1	ARTO	7,61%
2	BBCA	66,42%
3	BBRI	1,97%
4	BRPT	23,99%
Amount		100%

No	Stocks Code	Period III Stock Weight
1	AKRA	9,45%
2	AMRT	13,19%
3	BBCA	24,69%
4	BBNI	6,88%
5	BMRI	33,53%
6	BRPT	8,64%
7	MEDC	3,61%
Amount		100%

No	Stocks Code	Period II Stock Weight
1	ADRO	11,14%
2	AKRA	6,03%
3	ASII	1,61%
4	BBCA	10,06%
5	BBNI	1,21%
6	BMRI	3,42%
7	EMTK	0,68%
8	ESSA	4,26%
9	INCO	5,64%
10	ITMG	13,29%
11	MDKA	13,91%
12	PTBA	1,88%
13	TLKM	24,08%
14	UNTR	2,78%
Amount		100%

Based on Table 4, in the period I the largest weight value was at PT Central Bank Asia Tbk (BBCA) with a weight of 66.42%. In the period II, the greatest weight value is at PT Telecommunication Indonesia Tbc (TLKM) with the weight of 24.08%. While in the period III, the largest weight value was in PT Bank Independent Tbk (BMRI) with weight of 33.53%. The company that is still in the optimum portfolio in period I, II, and III is PT Bank Central Asia Tbc (BBCA).

5. Calculation of Return Expectations and Risk

The computation of the portfolio's expected return value is to ascertain the anticipated rate of return that investors anticipate in the future. The objective of assessing the risk value of a portfolio is to ascertain the magnitude of potential losses that investors may incur over a certain time frame, as shown in Table 5.

Table 5. Return Value Expectations and Risk on Portfolios and Markets

Value	Period		
	I	II	III
$E(R_m)$	-0,0132	0,0141	-0,0024
$E(R_p)$	0,0601	0,0509	0,0210
σ_m^2	0,0012	0,0003	0,0004
σ_p^2	0,1086	0,0150	0,0089

Based on Table 5, the portfolio expected return value formed using the Single Index Model method for period I was 0.0601, period II was 0.0509, and period III was 0.0210. Thus, the portfolio's expected return value is greater than the market's anticipated return value for each period. This indicates that the portfolios' expected return values yield a better value compared to market expectations. The portfolio risk formed in period I was 0,1086, in period II was 0,0150, and in period III was 0,0089.

6. Sharpe and Treynor Measurement Index

The calculation of the Sharpe and Treynor indices is intended to determine how much portfolio performance has been formed in a given period. Thus, comparisons are obtained between the calculations of the sharpe and treynor indexes in periods I, II, and III. An example of Sharpe index calculation using Equation (16) carried out on ARTO shares is as follows.

$$S_p = \frac{R_p - R_f}{\sigma_p} = \frac{18{,}5112 - 0{,}0192}{3{,}9729} = 4{,}6548$$

An example of calculation the Treynor index using Equation (17) carried out on ARTO shares is as follows.

$$T_p = \frac{R_p - R_f}{\beta_p} = \frac{18{,}5112 - 0{,}0192}{2{,}8090} = 2{,}8789$$

Table 6. Sharpe and Treynor Index Measurement Values

Period I

No	Stock Code	Measurement Index: Sharpe	Measurement Index: Treynor
1	ARTO	4,6548	2,8789
2	BBCA	1,1640	0,1725
3	BBRI	0,3778	0,0623
4	BRPT	0,9379	0,2891
Average		1,7836	0,8507

Periode III

No	Stock Code	Measurement Index: Sharpe	Measurement Index: Treynor
1	AKRA	0,3921	0,1269
2	AMRT	0,9706	0,1402
3	BBCA	0,6680	0,1505
4	BBNI	0,2527	0,0989
5	BMRI	1,8440	0,2154
6	BRPT	0,5990	0,1333
7	MEDC	0,3387	0,0568
Average		0,7236	0,1317

Period II

No	Stock Code	Measurement Index: Sharpe	Measurement Index: Treynor
1	ADRO	2,5564	1,4501
2	AKRA	1,2526	0,2225
3	ASII	0,9634	0,0854
4	BBCA	1,6880	0,1974
5	BBNI	1,1098	0,0920
6	BMRI	1,3689	0,1173
7	EMTK	0,1223	0,0299
8	ESSA	2,5125	0,7307
9	INCO	1,4199	0,2364
10	ITMG	3,9142	0,6846
11	MDKA	2,7646	0,9359
12	PTBA	0,6020	0,0980
13	TLKM	1,8276	0,6888
14	UNTR	0,3690	0,1634
Average		1,6051	0,4095

Table 7. Comparison of Sharpe and Treynor Measurement Index on Market and Portfolio

		Period		
		I	**II**	**III**
Market	Sharpe	-1,3853	2,7462	-0,9243
	Treynor	-0,1730	0,1653	-0,0687
Portofolio	Sharpe	1,7836	1,6051	0,7236
	Treynor	0,8507	0,4095	0,1317

Assessment of the index measurement using Sharpe and Treynor would be said to have a good performance if the value of Sharpe's and treynor's portfolios was greater than that of the market Sharpe and Treynor. During the period I, the Sharpe and Treynor portfolios have a greater value than the Sharp and treynor market values. In the period II, the portfolio's Sharpe values have a smaller value than that of the market, whereas the Portfolio of Treynors has a larger value than it that of the market value. In period III, Sharpe's and Treynor's portfolios have a smaller value than the Sharpe and treynor markets. Thus, the periods that have a good performance are periods I and II. So, periods which the have the best performance to make investments are seen from the values of Sharpe and Treynor, which is period I (before the Covid-19 pandemic).

D. CONCLUSION AND SUGGESTIONS

The optimum portfolio using the Sharpe and Treynor measurement index is seen from the average value of Sharpe measuring index, the highest value being in the pre-covid-19 pandemic period of 1,7836 compared to the peak period of covid-19 cases of 1,6051 and the record period of 0,7236. As seen from the average value of the Treynor measurement index, the highest value was in the pre-covid-19 pandemic period of 0,8507 compared to the peak period of Covid-19 cases of 0,4095 and the period of Covid-19 of 0,1317. Periods that have a good performance by having Sharpe and Treynor portfolio values greater than Sharpe's and treynor's market values are the period before the covid-19 pandemic. The results of the optimal portfolio in the period before the Covid-19 pandemic, when Covid-19 cases peaked, and when Covid-19 cases were sloping will be compared using Sharpe and Treynor measurement index calculations. So the investors can identify a good period to invest in shares, namely the period before the Covid-19 pandemic, with the number of shares in the optimal portfolio being four shares (ARTO, BBCA, BBRI, and BRPT) with a respective weight value of ARTO of 7,61%, BBCA of 66,42%, BBRI at 1,97%, and BRPT at 23,99%.

In writing this thesis, the author only uses optimal portfolio analysis with the Single Index Model. It is best to compare with other methods, such as the Capital Asset Pricing Model (CAPM), Mean Absolute Deviation (MAD), and Markowitz Model, to determine optimal portfolio performance that is better and more profitable. In contrast to the Single Index Model method, which uses calculations to measure the value of return and portfolio risk with the assumption that stock return movements are only related to market returns, the CAPM method uses undiversified risk calculations from a single portfolio by comparing it with the diversified risk from a diversified portfolio. Meanwhile, the MAD method offers an alternative portfolio solution through linear programming. In solving portfolio problems, MAD focuses more on quadratic programming. The Markowitz method is also known as the mean-variance model, which emphasizes efforts to maximize expected returns and minimize uncertainty or risk in selecting and compiling an optimal portfolio.

In the measurement index, the author uses the Sharpe and Treynor index. The author can then also compare it with the Jensen index to see significant differences between the three measurement indices. In contrast to Treynor and Sharpe, namely methods that can accept mutual fund investment as long as the excess return is positive, the Jensen model only accepts mutual fund investment if it can produce a return that exceeds the expected return or minimum rate of return. Future researchers are also expected to estimate the potential risk of decreasing the return value of the portfolio using Value at Risk (VaR).

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