Analysis of Stock Portfolio Performance Optimization Using the Mean Absolute Deviation Model, Single Index Model , and Capital Asset Pricing Model

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Abstract. This research aims to analyze the formation of an optimal portfolio for LQ45 shares in the period before Covid-19 in 2017-2019 and the Covid-19 period in 2020-2022, as well as finding out which method performs better in forming an optimal portfolio. The object of this research includes stocks that are consistently listed on the LQ45 Index. The research methods used in forming optimal portfolios are the *Mean Absolute Deviation* (MAD) model, *the Single Index Model* (SIM), and *the Capital Asset Pricing Model* (CAPM) with measuring portfolio performance using the *Risk Adjusted Return method* , namely the Sharpe Index, Treynor Index, and Jensen Index. The research results show that the optimal portfolio with the *Mean Absolute Deviation* (MAD) model consists of 10 shares in the period before Covid-19 and 5 shares in the Covid-19 period, the optimal portfolio of the *Single Index Model* consists of 5 shares in the period before Covid-19 and 9 shares. shares in the Covid-19 period, while the optimal portfolio for *the Capital Asset Pricing Model* consists of 13 shares in the pre-Covid-19 period and 15 shares in the Covid-19 period. Of the three models, the results of calculating the performance index using the *Risk Adjusted Return method* (Sharpe Index, Treynor Index, Jensen Index) state that for the period before Covid-19 and the Covid-19 period the *Single Index Model* (SIM) has a higher value *than the Mean Absolute Deviation* and *Capital Asset Pricing Model* , so that the optimal portfolio with *the Single Index Model* has better performance.

Keywords: Optimal Portfolio, Mean Absolute Deviation, Single Index Model, Capital Asset Pricing Model, Risk Adjusted Return.

1. Introduction

Investment is an activity that is closely related in today's economic and business world. Investment can be interpreted as placing excess funds in an investment instrument for a certain period of time and in the future it is hoped that there will be a profit from the investment. One of the most popular types of financial investment instruments in the capital market is stock investment (Dewi & Vijaya, 2018).

The phenomenon currently occurring is where investors in the capital market when investing do not know which shares are worth investing in, which results in investors making investment decisions based on the opinions of public figures or

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suggestions from influencers. The presence of these influencers in the capital market can have an impact on investment losses if left unchecked, which can lead to a decline in investors' confidence in investing. Of course, this phenomenon occurs because there is still a lack of understanding of investor education when investing. This lack of investor understanding still occurs due to the low level of capital market financial literacy and the use of digital capital market technology which causes many investors to experience losses due to following investment trends with a lack of knowledge and knowledge (Putra & Warsini, 2022).

In investing, to get maximum profits with minimal risk, investors are advised to diversify their portfolio. Portfolio diversification is carried out by placing funds not only in one type of stock, but must consist of several types of shares in different fields. Diversification efforts will provide opportunities for greater profits if investors place their funds in the right company. The problem that occurs in forming a portfolio is that there are many possible portfolios that can be formed from a combination of risky assets available on the market. This combination can reach an unlimited number, so the question arises as to which portfolio investors will choose. If investors are rational then they will choose the optimal portfolio, namely "a portfolio with a combination of high expected returns and low risk" (Tandelilin, 2010) .

Portfolio theory relates to investors' estimates of risk and return expectations, which are measured statistically to create their investment portfolio. Portfolio theory begins with the assumption that future rates of return on securities can be estimated and then determines risk by varying the distribution of returns. With certain assumptions, portfolio theory produces a linear relationship between risk and return. The basic concept stated in a portfolio is how to allocate a certain amount of funds to various types of investments that will produce optimal profits.

A portfolio is categorized as efficient if it has the same level of risk, is able to provide a higher level of profit, or is able to produce the same level of profit, but with lower risk. Meanwhile, the optimal portfolio is the portfolio that an investor chooses from the many choices available in the efficient portfolio collection. Of course, the portfolio chosen by the investor is a portfolio that is in accordance with the investor's preferences regarding returns and the risks he is willing to bear (Tandelilin, 2010).

In diversifying a portfolio, several optimal portfolio formation models can be determined using the Mean Absolute Deviation model, Single Index Model, and Capital Asset Pricing Model as considerations for investors when investing their funds. In general, calculating the risk value using the Mean Absolute Deviation (MAD) method introduced by Konno and Yamazaki (1991) is to determine the average absolute value of the MAD deviation from the level of realized return to the expected return which can then be solved using linear programming (Wulandari et al., 2018). Furthermore, Sharpe in 1964 put forward a single index model by considering profit and risk in two components, each of which states profit and unsystematic risk, as well as individual profit and systematic risk related to the market (Mulyati & Murni, 2018), then the third model is Capital The Asset Pricing Model was first proposed by Sharpe, Lintner, and Mossin in the mid-1960s. CAPM is a model that connects the expected rate of return from a risky asset with the risk of that asset under balanced market conditions.

After forming a portfolio, investors carry out a performance assessment of the portfolio. The aim is to analyze and find out whether the portfolio that has been

formed can increase the possibility of achieving investment objectives so that we can find out which portfolio has better performance. Each portfolio analysis model uses assumptions that are characteristic of the model, making these models different from others.

These differences can be the advantages or disadvantages of each analysis model, so by comparing the portfolio analysis models, it will be known which portfolio analysis model has the best performance in forming an optimal stock portfolio. In this research, the measurement of portfolio performance using the Mean Absolute Deviation model, Single Index Model , and Capital Asset Pricing Model is measured using the Risk Adjusted Return method (Sharpe, Treynor, and Jensen). This portfolio performance calculation model will produce the best analysis model in preparing an optimal portfolio which can later be used by analysts, investors and other interested parties as consideration for making investment decisions.

The difference between this research and previous research is that the previous research used SBI (Bank Indonesia Certificate) data as a risk-free asset, whereas in this research it uses bond interest rate data as a risk-free asset. Apart from that, this research also measures optimal portfolio performance based on the Risk Adjusted Return method on three portfolio forming models at once, and compares this performance in two conditions, namely conditions before Covid-19 and during Covid-19.

This research uses the LQ45 index on the Indonesian Stock Exchange. Researchers chose the LQ45 index because the companies included are companies that have good performance. If you look at the shares traded on the IDX, only 45 companies' shares meet the criteria and many investors are interested in investing their funds in LQ45 shares. Apart from that, LQ45 shares are liquid shares or are easily traded so they can form a portfolio with optimal results between risk and expected return (Oktaviani & Wijayanto, 2016).

The period taken in this research is the period before Covid-19, namely 2017-2019 and the period during Covid-19, namely 2020-2022. The emergence of the corona virus or Covid-19 outbreak in Indonesia resulted in the capital market experiencing various challenges, especially at the beginning of 2020 which experienced a decline due to the corona virus outbreak. The Covid-19 pandemic in Indonesia has affected the capital market and caused changes in trading times on the Indonesian Stock Exchange and this is a negative signal (bad news) which causes investors to be more interested in selling their share ownership. Because one of the most popular capital market instruments in Indonesia is shares, so to minimize investment risk, investors can diversify, namely by combining various shares in their investments, in other words they form a portfolio (Oktaviani M., 2022). The purpose of selecting the research period is to compare the portfolio performance of the Mean Absolute Deviation model, Single Index Model , and Capital Asset Pricing Model before Covid-19 and during Covid-19, so that it can provide benefits and information for investors in choosing a portfolio formation method using best performance.

2. Literature Review

2.1 Portofolio Theory

Modern portfolio theory was first known through the academic work of Markowitz (1952), through this work Markowitz was later dubbed the father of modern portfolio theory. Markowitz (1952) stated that the portfolio selection process begins with relevant beliefs about the future and ends with portfolio selection. Modern portfolio theory was founded from the observation that investors do not only have one investment, but create a portfolio based on a number of personal investments.
Portfolio theory emphasizes efforts to find optimal investment combinations that provide maximum rates of return at a certain level of risk. Portfolio theory shows that the investment selection process is not just a matter of determining and adding up each characteristic of the securities that make up the portfolio. The implication of this theory is that investors should combine risky assets in one portfolio to minimize risk (Iqbal & Ritonga, 2018). Expected return and portfolio risk are measured using the formula:

$$E(R_P) = \sum_{i=1}^{N} \_ \ .E(R\_i)$$

$$\sigma_p{}^2 = \sum_{i=1}^{N} \_ \ \_ \ \_i = 1\text{^}N \sum_{j=1}^{N} \_ \ \_ \ \_j$$

2.2 Capital Market

The capital market is a meeting between parties who have excess funds and parties who need funds by buying and selling securities. The capital market can also be interpreted as a market for buying and selling securities that generally have a lifespan of more than one year, such as shares and bonds. The capital market functions as an intermediary institution. This function shows the important role of the capital market in supporting the economy because the capital market can connect parties who need funds with parties who have excess funds. In addition, the capital market can encourage the creation of efficient fund allocation, because with the existence of the capital market, parties with excess funds (investors) can choose investment alternatives that provide the most optimal returns. The assumption is that investments that provide relatively large returns are the most productive sectors on the market. Thus, funds originating from investors can be used productively by these companies (Tandelilin, 2010).

2.3 Investment

Investment is a commitment of a certain amount of funds or other resources made at this time, with the aim of obtaining a certain amount of profit in the future. An investor buys a number of shares now with the hope of gaining profits from an increase in share prices or a number of dividends in the future, as a reward for the time and risks associated with the investment (Tandelilin, 2010).

2.4 Return

Return is income expressed as a percentage of the initial investment capital. Investment income in shares is the profit obtained from buying and selling shares, where if there is a profit it is called capital gain and if there is a loss it is called capital loss (Tandelilin, 2010). According to Samsul (2006), stock returns are income expressed as a percentage of the initial investment capital. Investment income in shares includes profits from buying and selling shares, where if there is a profit it is called capital gain and if there is a loss it is called capital loss. Return is measured using the formula:

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

2.5 Risk

Risk is the magnitude of the deviation between the expected rate of return and the rate of return obtained, the greater the deviation means the greater the risk (Mulyati & Murni, 2018). Tandelilin (2010) suggests that risk is the possible difference between the actual return received and the expected return. The greater the possible difference, the greater the risk of the investment. Risk is measured using the formula:

$$\sigma_i{}^2 = \sum_{i=1}^{n} \frac{R\_i - E[Ri])^2}{n-1}$$

2.6 Mean Absolute Deviation

Mean absolute deviation (MAD) introduced by Konno and Yamazaki (1991) is an optimal portfolio model in the form of linear programming which is solved using the simplex method. The goal of solving problems with linear programming is related to optimization problems, namely the maximum or minimum goal of something where the level of achievement of this goal is limited by constraints that reflect the limitations of the capacity of time, product, and capabilities possessed. The values of the decision variables resulting from the process of achieving this goal are referred to as feasible solutions. A feasible solution that can provide the largest objective function value (for the maximum case) or the smallest (for the minimum case) is called the optimal solution (Rangkuti, 2013). The simplex method can be solved using the following equation:
Minimizing the objective function:

$$\sigma(w) = MAD_1 W_1 + MAD_2 W_2 + \ldots\ldots + MAD_n W_n$$

With constraints:

$$E(R_1)W_1 + E(R_2)W_2 + \ldots\ldots + E(R_n)W_n \geq R_{investor}$$

$$W_1 + W_2 + \ldots . + W_n = 1$$

$$0 \leq W_i \leq u_i, dengan\ i = 1,2, \ldots, n$$

Mean absolute deviation is the mean of the absolute value of the deviation of each observation value Ri(t)from E(Ri)(Wulandari et al., 2018) which is measured using the following formula:

$$MAD_I = \left[\left|R_{i(t)} - E(R_i)\right|\right]$$

2.7 Single Index Model

Sharpe in 1964 put forward a single index model by considering profit and risk in two components, each of which expressed profit and unsystematic risk, as well as individual profit and systematic risk related to the market. The assumption used in the single index model is that "securities will be correlated if these securities have the same response as market returns". The level of profit for a single index stock model can be expressed as follows (Husnan, 1998):

$$E(R_i) = \alpha_i + \beta_i E(R_m)$$

2.8 Capital Asset Pricing Model

The capital asset pricing model (CAPM) was developed by (Sharpe, 1964) and (Lintner, 1965) from Modern Portfolio theory (Markowitz, 1952) and (Tobin, 1958). CAPM is a model that connects the expected rate of return from a risky asset with the risk of that asset under balanced market conditions. The following is the function of the CAPM equation (Tandelilin, 2010):

$$E(R_i) = Rf + \beta_i [E(R_m) - Rf]$$

2.9 Portofolio Performance

Performance assessments need to be carried out to find out whether investment choices provide the best results or not. Measuring portfolio performance by the Mean Absolute Deviation model, Single Index Model, and Capital Asset Pricing Model is

measured using the Risk Adjusted Return method (Sharpe, Treynor, and Jensen). The higher the index (Sharpe, Treynor, and Jensen) of a portfolio compared to other portfolios, the better the portfolio's performance. The results of (Sharpe, Treynor, and Jensen) ratios that are positive are considered good, while the negative (Sharpe, Treynor, and Jensen) ratios are considered bad.

2.10 Sharpe Index

The Sharpe index was developed by William Sharpe and is often called the reward-to-variability ratio. The Sharpe index bases its calculations on the concept of the capital market line as a benchmark, namely by dividing the portfolio risk premium by its standard deviation. Thus, the Sharpe index is used to measure the risk premium for each unit of risk in the portfolio. The sharpe index according to Tandelilin, (2010) can be calculated using the following formula:

$$\hat{S}_P = \frac{\underline{R}_P - \underline{R}_f}{\sigma_P}$$

2.11 Treynor Index

The method for calculating the Treynor index is basically the same as calculating the Sharpe index, only the risk measured by the standard deviation of the Sharpe index is replaced with the portfolio beta. So, the Treynor index according to (Tandelilin, 2010) can be calculated using the following formula:

$$\hat{T}_P = \frac{\underline{R}_P - \underline{R}_f}{\hat{\beta}_P}$$

2.12 Jensen Index

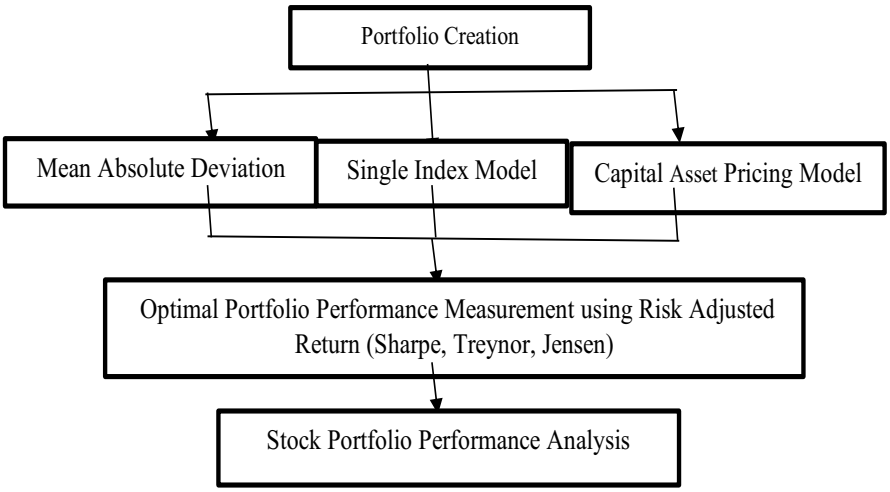
The Jensen Index is an index that shows the difference between the actual rate of return obtained by a portfolio and the expected rate of return if the portfolio is on the capital market line. The Jensen Index according to Tandelilin, (2010) can be calculated using the following formula:

$$\hat{J}_P = \underline{R}_P - \left[\underline{R}_f + \left(R_M - \underline{R}_f\right)\hat{\beta}_P\right]$$

3. Research Methods

This research focuses on describing or explaining the results of portfolio optimization calculations using the Mean Absolure Deviation model, Single Index Model, and Capital Asset Pricing Model, and evaluating optimal portfolio performance using the Risk Adjusted Return method (Sharpe, Treynor, and Jensen) so that the portfolio those that have been built still have good performance and are in line with investment objectives. The things that will be described in this research are all related to forming

an optimal portfolio of LQ45 shares using the Mean Absolute Deviation method, Single Index Model, and Capital Asset Pricing Model with Risk Adjusted Return (Sharpe, Treynor, and Jensen) as a measure of portfolio performance in the period before Covid-19 2017-2019 and the period during Covid-19 2020-2022. This research uses secondary data obtained from the Indonesian Stock Exchange website, namely www.idx.co.id, closing share price data obtained from the website www.investing.com, Composite Stock Price Index (IHSG) data obtained from the website www.finance .yahoo.com, and bond interest rate data, namely the interest rate which is the reference for the risk-free interest rate. The conceptual framework of this research is as follows:



4. Research Result

4.1 Data Description

Table 1. Number of samples for the period before Covid-19, 2017-2019

Number of Companies who were consistently registered in LQ45 in the pre-covid-19 period 2017-2019	45
Number of companies consistently registered consecutively on the LQ45 share list during the pre-Covid-19 period 2017-2019	31
Number of Samples	31

Table 2. Number of Samples for the Covid-19 Period 2020-2022

Number of Companies consistently registered in LQ45 during the Covid-19 period 2020-2022	45
Number of companies consistently registered consecutively on the LQ45 share list during the Covid-19 period 2020-2022	31
Number of Samples	31

4.2 Mean Absolute Deviation

Table 3. Optimal Portfolio Mean Absolute Deviation for the Period Before Covid-19

No	Stock code	Investment Weight	E(Rp)	
1	BBCA	40%	0.01639047	0.044734235
2	BBNI	0		
3	BBRI	20%		
4	BBTN	0		
5	BMRI	40%		
6	EXCL	0		
7	INCO	0		
8	INTP	0		
9	SMGR	0		
10	WIKA	0		
Total		100%		

Based on table 3, it can be observed that in the period before Covid-19 the mean absolute deviation model produced 10 stocks that were suitable to be used as optimal portfolio candidates with an expected portfolio return of 0.01639047 and a portfolio risk of 0.044734235. The shares with the largest proportion in the mean absolute deviation model for the pre-covid-19 period 2017-2019 were shares of PT Bank Central Asia Tbk (BBCA) and shares of PT Bank Mandiri Tbk with a proportion of funds of 40% each. This figure has been identified as providing greater profit potential compared to other stocks. Apart from that, the smallest proportion of funds is shares in PT Bank Rakyat Indonesia Tbk (BBRI) with a proportion of funds of 20%.

Table 4. Optimal Portfolio Mean Absolute Deviation for the Covid-19 Period

No	Stock code	Investment Weight	E(Rp)

1	ADRO	30%		
2	ANTM	0		
3	INCO	30%	0.030118218	0.194568721
4	ITMG	10%		
5	TBIG	30%		
Total		100%		

Based on table 4, it can be observed that during the Covid-19 period the mean absolute deviation model produced 5 stocks that were suitable to be used as optimal portfolio candidates with an expected portfolio return of 0.030118218 and a portfolio risk of 0.194568721. The shares with the largest proportion in the mean absolute deviation model for the 2020-2021 Covid-19 period are ADRO, INCO and TBIG shares with a fund proportion of 30% each. This figure has been identified as providing greater profit potential compared to other stocks. Apart from that, the smallest proportion of funds is ITMG shares with a fund proportion of 10%.

4.3 Single Index Model

Table 5. Optimal Single Index Model Portfolio for the Period Before Covid-19

No	Stock code	Investment Weight	E(Rp)	
1	EXCL	6%		
2	BBCA	79%		
3	ICBP	9%	0.020183864	0.035227513
4	SRIL	1%		
5	BBRI	5%		
total		100%		

Based on table 5, it can be observed that in the period before Covid-19 the single index model produced 5 stocks that were suitable to be used as optimal portfolio candidates with an expected portfolio return of 0.020183864 and a portfolio risk of 0.035227513. The shares with the largest proportion in the single index model for the pre-Covid-19 period 2017-2019 were PT Bank Central Asia Tbk (BBCA) shares with a fund proportion of 79%. This figure has been identified as providing greater profit potential compared to other stocks. Apart from that, the smallest proportion of funds is shares in PT Sri Rejeki Isman Tbk (SRIL) with a proportion of funds of 1%.

Table 6. Optimal Single Index Portfolio Model for the Covid-19 Period

No	Stock code	Investment Weight	E(Rp)	
1	TBIG	16%		
2	ADRO	21%		
3	ITMG	19%		
4	TOWR	9%		
5	KLBF	14%	0.027596057	0.062300269
6	PTBA	7%		
7	INCO	9%		
8	ANTM	5%		
9	UNTR	0%		
total		100%		

Based on table 6, it can be observed that during the Covid-19 period the single index model produced 9 shares that were suitable to be used as optimal portfolio candidates with an expected portfolio return of 0.027596057 and a portfolio risk of 0.062300269. The shares with the largest proportion in the single index model for the 2020-2022 Covid-19 period are shares of PT Adaro Energy Indonesia Tbk (ADRO) with a fund proportion of 21%. This figure has been identified as providing greater profit potential compared to other stocks. Apart from that, the smallest proportion of funds is shares of PT United Tractors Tbk (UNTR) with a proportion of funds of 0%.

4.4 Capital Asset Pricing Model

Table 7. Optimal Portfolio Capital Asset Pricing Model for the Period Before Covid-19

No	Stock code	Investment Weight	E(Rp)	
1	BBCA	24%		
2	BBNI	11%		
3	BBRI	21%		
4	BBTN	3%	0.00702601	0.269923152
5	BMRI	14%		
6	EXCL	1%		
7	ICBP	4%		

8	INCO	3%
9	INTP	5%
10	JSMR	5%
11	PTBA	3%
12	SMGR	6%
13	SRIL	1%
total		100%

Based on table 7, it can be observed that in the period before Covid-19 the capital asset pricing model produced 13 shares that were suitable to be used as optimal portfolio candidates with an expected portfolio return of 0.00702601 and a portfolio risk of 0.269923152. The shares with the largest proportion in the capital asset pricing model for the pre-Covid-19 period 2017-2019 were PT Bank Central Asia Tbk (BBCA) shares with a fund proportion of 24%. This figure has been identified as providing greater profit potential compared to other stocks. Apart from that, the smallest proportion of funds is PT XL Axiata Tbk (EXCL) shares with a fund proportion of 1%.

Table 8. Optimal Capital Asset Pricing Model Portfolio for the Covid-19 Period

No	**Stock code**	**Investment Weight**	**E(Rp)**	
1	ADRO	2%		
2	ANTM	5%		
3	BBCA	18%		
4	BBNI	12%		
5	BBRI	19%		
6	BMRI	9%		
7	ERAA	6%		
8	INCO	6%	0.004194825	0.11984691
9	INKP	5%		
10	ITMG	3%		
11	KLBF	4%		
12	PTBA	3%		
13	TBIG	2%		
14	TOWR	2%		
15	UNTR	4%		
total		100%		

Based on table 8, it can be observed that during the Covid-19 period the capital asset pricing model produced 15 shares that were suitable to be used as optimal portfolio candidates with an expected portfolio return of 0.004194825 and a portfolio risk of 0.11984691. The shares with the largest proportion in the capital asset pricing model for the pre-Covid-19 period 2017-2019 were PT Bank Central Asia Tbk (BBCA) shares with a fund proportion of 24%. This figure has been identified as providing greater profit potential compared to other stocks. Apart from that, the smallest proportion of funds is PT XL Axiata Tbk (EXCL) shares with a fund proportion of 1%. in the capital asset pricing model for the 2020-2022 covid-19 period, it is shares of PT Bank Rakyat Indonesia Tbk (BBRI) with a fund proportion of 19%. This figure has been identified as providing greater profit potential compared to other stocks.

4.5 Portofolio Performance

Measuring portfolio performance by Mean Absolute Deviation, Single Index Model , and Capital Asset Pricing Model is measured using the Risk Adjusted Return method (Sharpe, Treynor, and Jensen). The performance measurement results of the three models can be observed in the following table:

Table 9. Comparison of Optimal Portfolio Performance

MODEL	Period Before Covid-19			Covid-19 period		
	Sharpe	**Treynor**	**Jensen**	**Sharpe**	**Treynor**	**Jensen**
Mean Absolute Deviation	0.3491	0.0136	0.0105	0.1514	0.0418	0.0268
Single Index Model	0.5509	0.0201	0.0151	0.4325	0.042	0.028
Capital Asset Pricing Model	0.0232	0.0046	0.0002	0.0296	0.0038	0

The results of these measurements are used to assess optimal portfolio performance using standard deviation as a relevant risk measure. This equation is in accordance with portfolio theory which states that risk and return must both be considered assuming a formal framework is available to measure both in forming a portfolio. The assumptions used in the model show the difference between the ratio of portfolio returns and portfolio risk to market returns and risk-free assets. So the greater the resulting performance value can be interpreted as a measure of how much the portfolio can beat the market and risk-free assets. The greater the resulting performance value, the better the portfolio performance. A high positive performance ratio indicates that the investment has added value in relation to its risk. A negative ratio indicates that investment performance is poor.

Based on table 9, it can be seen that the optimal portfolio formation model that has the best performance or with the highest value is the Single Index Model which is good for the period before Covid-19 with a Sharpe index result of 0.5509, a Treynor index of 0.0201 and a Jensen index of 0 .0151, while for the period during Covid-19 the Sharpe index was 0.4325, the Treynor index was 0.042 and the Jensen index was 0.028

5. Conclusion

5.1 Conclusion

Based on the results of data analysis and discussions that have been carried out, the following conclusions can be drawn:

1) The optimal portfolio formed based on the *Mean Absolute Deviation* (MAD) model consists of 10 shares in the period before Covid-19 with an expected return of 1.64% and a risk of 4.47%, while in the Covid-19 period it consists of 5 shares with a return expectation of 3.01% and risk of 19.46%.
2) The optimal portfolio formed based on *the Single Index Model* (SIM) consists of 5 shares in the pre-Covid-19 period with an expected return of 2.02% and a risk of 3.52%, while in the Covid-19 period it consists of 9 shares with an expected return of 2.76% and risk 6.23%.
3) The optimal portfolio formed based on *the Capital Asset Pricing Model* (CAPM) consists of 15 shares in the pre-Covid-19 period with an expected return of 0.42% and a risk of 11.98%, while in the Covid-19 period it consists of 9 shares with an expected return. of 2.76% and risk of 6.23%.
4) The optimal portfolio formed using *the Single Index Model* (SIM) performs better than using the *Mean Absolute Deviation* (MAD) model and *the Capital Asset Pricing Model* (CAPM) based on the Sharpe Index, Treynor Index and Jensen Index. For the research period before Covid-19, the Sharpe SIM Index (0.5509) was greater than MAD (0.3491) and CAPM (0.0232). The SIM Treynor Index (0.0201) is greater than MAD (0.0136) and CAPM (0.0046). The Jensen SIM index (0.0151) is greater than MAD (0.0105) and CAPM (0.0002). Meanwhile, for the Covid-19 period, the Sharpe SIM Index (0.4325) was greater than MAD (0.1514) and CAPM (0.0296). The SIM Treynor Index (0.042) is greater than MAD (0.0418) and CAPM (0.0038). The Jensen SIM index (0.028) is greater than MAD (0.0268) and CAPM (0).

5.2 Implications

The results of this research are important for all stakeholders because in this research it is explained that investors must be careful in choosing their portfolio, so that a stock diversification strategy with the formation of an optimal portfolio is very important for an investor to take into consideration in making investment decisions to observe the expected level of return. the level of risk to be faced, and optimal portfolio performance. The results of this research can also be a reference for various different stock investment options for investors who tend to still have doubts about choosing stocks and the optimal portfolio formation model that will be selected for the LQ45 index, managers, policy makers and LQ45 issuers in conditions before and when conditions occur. Covid-19 pandemic in Indonesia.

5.3 Limitations

This research only focuses on one stock index in Indonesia, namely LQ45, so further research should provide comparisons between other stock indices. Apart from that, measuring the performance of the Risk Adjusted Return method (Sharpe Index, Treynor Index, Jensen Index) in this research only focuses on three optimal portfolio formation models, namely *Mean Absolute Deviation, Single Index Model,* and *Capital Asset Pricing Model* , so further research should try apply the *Risk Adjusted Return method* to other optimal portfolio formation models.

5.4 Suggestion

Furthermore, based on the research results, investors are expected to form an optimal portfolio so that they can observe the combination of shares, returns and risks that are suitable for their investment decisions by choosing the optimal portfolio formation model between the mean absolute deviation model, single index model and capital asset pricing model in the research results. This is so that you can invest shares in LQ45 based on your individual preferences. Apart from that, investors must also evaluate the performance of the portfolio that has been formed, one of which is by using the *Risk Adjusted Return method* (Sharpe Index, Treynor Index, Jensen Index).

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