Comparisonal Analysis of the Formation of Optimum Stock Portfolio in LQ45 Index and Development Board Index Using Single Index Model and Random Model

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Abstract. The purpose of this study is to provide empirical evidence that determining a stock portfolio using a single index model can provide optimal returns compared to determining a stock portfolio using a random model. There were 374 stocks from the Development Board Index and 45 stocks from the LQ45 index involved as samples of this study. The results showed that the determination of a stock portfolio using a single index model taken from the Development Board Index provides the most optimal return compared to the determination of other stock portfolios.

Keywords: Portfolio · Single Index Model · LQ45 Index · Development Board Index

1 Introduction

According to [1], investment can be defined as delaying current consumption to be used in efficient production for a certain period. Investment activities carried out by the community will continuously increase economic activities and job opportunities, increase national income and increase the level of community prosperity.

The types of investments are categorized based on the period (short, medium, and long), risks (low, medium, and high), involvement (direct and indirect), capital types (money, market, financial market, etc.), commodities such as precious metals, property, and the real sector).

Therefore, this study discusses investment in the capital market, especially stocks. As is well known, investing in stocks has a higher chance of return than investing in savings or time deposits, even for the level of difficulty when compared to businesses in the real sector, it is relatively easy, but when viewed from the number of investors, investment in the capital market is still much higher. Little compared to other types of investment, both in terms of amount despite the size of the investment, although recently the number of investors in the Indonesian capital market has increased sharply, especially among the millennial generation.

R. Hurriyati et al. (Eds.): GCBME 2022, AEBMR 255, pp. 148–156, 2024.
https://doi.org/10.2991/978-94-6463-234-7_15

In previous studies regarding portfolio formation on the Indonesia Stock Exchange (IDX) using the Single Index Model, the stock index samples used were different, for example in [2] study using the LQ45 index, other studies [3] using Sri Kehati index. With the differences in indices taken as samples, a research problem arises, namely confusion in determining which index to choose to form the optimum stock portfolio, after determining which index to use, people are generally still confused about how to determine which stock to choose from. The existing index and after it is formed, we do not know whether the portfolio that has been formed is better than the portfolio that we form based on intuition or randomly.

So, this study aims to determine what index will be used to form an optimal stock portfolio, find out how to form an optimal stock portfolio using the Single Index Model, find out the comparison stock portfolio performance using the Single Index Model with an arbitrary portfolio and determine the best optimal stock portfolio.

2 Methods

Before forming an optimal stock portfolio, it is necessary to determine which stock index will be sampled, while the method used is to compare all indexes on the IDX with the JCI in terms of risk & return. Data is obtained by downloading the January 2021 Index Fact Sheet from https://www.idx.co.id. Of the 38 existing indices, the best index for the January 2021 period is the DBX index (development board index). This development board index consists of 374 issuers, then purposive sampling is carried out using only issuers that have been included in the development board index for more than 1 year, then have a positive return, and 10 issuers with the largest market cap are taken.

To be more convincing, not only the development board index is used in the formation of this optimal stock portfolio, but also the optimal stock portfolio is formed using the LQ45 index as comparison material. The reason for using the LQ45 index as a comparison is because LQ45 is an index that is used as a reference by the IDX so that a summary of the performance of LQ45 companies appears on the IDX website in market data statistical reports.

After determining the type of index that will be used as a sample or basis for forming an optimal stock portfolio, followed by the formation of the optimal stock portfolio itself, in this study the calculations were carried out using Microsoft Excel, first, the formation of an optimal stock portfolio was carried out using a single index model, then evaluate the performance of the stock portfolio using the Sharpe measure, Treynor measure, and Jensen measure. The steps taken are as follows:

The first step in forming an optimal stock portfolio is to calculate the weekly stock return of the Development Board Index (according to the criteria) in period t (R_{it}) which is the calculation of the profit level of each stock. According to Eduardus Tandelilin (2001), returns can be calculated by not including dividends, so in this research, stock returns are only capital gains/losses, with the following formula:

$$R_{it} = \frac{P_t - P_{t-1}}{P_{t-1}} \tag{1}$$

This return calculation does not include dividends, this is done to provide more security to potential investors, in other words, only with capital gains/losses, it can

provide benefits, especially if the dividend element is included. Dividends will provide more profit or become a bonus for potential investors, in addition to avoiding out layers in the beta calculation.

The next step is to calculate the expected return, which is the value calculated by dividing the number of a series of numbers or data by the number of available data. According to Zalmi Zubir (2011), the expected return formula is:

$$E(R_i) = \frac{\sum_{t=1}^{N} R_{it}}{N} \tag{2}$$

Return expectation is a measure of the central tendency of a return distribution during a certain period.

Next to calculating market returns, the selection of market indexes does not depend on a theory, but rather depends on empirical results. The market index that can be chosen for the IDX market, for example, is the JCI or the LQ45 Index, if the JCI is used, the market return for the t-the time is the JCI. According to [1], the market return formula is as follows:

$$R_{mt} = \frac{JCI_t - JCI_{t-1}}{JCI_{t-1}} \tag{3}$$

Calculating the expected market return E(Rm), the market expected return is the average of the total market returns for each period during the research period, according to Zalmi Zubir (2011), the market expected return can be calculated by the formula:

$$E(R_m) = \frac{\sum_{t=1}^{N} R_{mt}}{N} \tag{4}$$

Calculating the average return on risk-free assets in a certain period, obtained from the average monthly interest rate data for Bank Indonesia Certificates, with the formula:

$$R_f = \frac{\frac{\sum SBIinterest}{N}}{12} \tag{5}$$

According to [1], the calculation aims to determine the optimal portfolio that will be greatly facilitated based on influential numbers. This figure is the ratio between excess return to beta or excess return to beta ratio, with the formula:

$$ERB_i = \frac{E(R_i) - R_f}{\beta_i} \tag{6}$$

To calculate ERBi, you must first calculate Beta, by definition Beta is a measure of the volatility between the return of security (portfolio) and the market return. If this volatility is measured by covariance, then the covariance of the return between the *i-th* security and the market return is in. If this covariance is related relative to market risk, then this result will measure the risk of the *i-th* security relative to market risk, according to [1], Beta can be calculated by the formula:

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2} \tag{7}$$

or it can be described by calculating the covariance of security returns with market returns ($\int_{im}$), with the formula:

$$_{im} = \frac{\sum_{t=1}^{N}(R_i - E(R_i)).(R_m - E(R_m))}{N} \tag{8}$$

Calculating market risk/systematic risk ($\sigma^2{}_m$), as a risk that cannot be reduced by diversification and this risk is related to changes in the market as a whole, with the formula:

$$^{2}_{m} = \sum_{t=1}^{N} \frac{(R_{mt} - E(R_m))^2}{N} \tag{9}$$

According to [1], the optimal portfolio will contain stocks that have a high ERB ratio value. Stocks with a low ERB ratio will not be included in the optimal portfolio. Thus, a cut-off point or C* is needed which determines the limit of what ERB values are said to be high and how many are said to be low. The magnitude of this limiting point can be determined by the following steps:

First, sort the securities from the largest ERB value to the smallest ERB value. Then calculate the values of Ai and Bi with the formula:

$$A_i = \frac{(E(R_i) - R_f).\beta_i}{\sigma^2_{ei}} \tag{10}$$

$$B_i = \frac{\beta_i^2}{^{2}_{ei}} \tag{11}$$

Next calculate the value of C_i with the formula:

$$C_i = \frac{\sigma_m^2 \sum_{t=1}^{i} A_1}{1 + ^{2}_{m} \sum_{t=1}^{i} B_1} \tag{12}$$

$$C_i = \frac{\sigma_m^2 \sum_{t=1}^{i} \frac{(E(R_i) - R_f).i}{^{2}_{ei}}}{1 + ^{2}_{m} \sum_{t=1}^{i} \frac{^{2}_{i}}{^{2}_{ei}}} \tag{13}$$

According to [1], to calculate C_i, you must first calculate the variance of the i-th security residual error which is also an unsystematic risk, with the formula:

$$^{2}_{ei} = \frac{\sum_{i=1}^{N} ei^2}{N} \tag{14}$$

While ei is the residual error which is a random variable with the expected value equal to zero which can be calculated by the formula:

$$e_i = R_i - {}_i - ({}_i.R_m) \tag{15}$$

To calculate ei, you must first calculate the security's alpha which is the expected value of stock returns that is independent of market returns, which can be calculated by the formula:

$${}_i = E(R_i) - {}_i.E(R_m) \tag{16}$$

The cut-off point (C*) is the value of Ci. The securities that make up the optimal portfolio are those that have an ERB value greater than or equal to the ERB value at point C*. Securities that have an ERB value less than point C* are not included in the formation of the optimal portfolio.

After the securities that make up the optimal stock portfolio can be determined, the next question is what is the proportion of each of these securities in the optimal portfolio? The size of the proportion for the i-th security can be calculated by the formula Ci.

After the value of Ci is known, Zi and Wi are calculated to determine the structure or weight of each stock in the portfolio, using the formula:

$$w_i = \frac{Z_i}{\sum_{i=1}^{N} Z_i} \tag{17}$$

$$Z_i = \frac{\beta_i}{\frac{2}{ei}}(ERB_i - C^*) \tag{18}$$

At this stage, the formation of the optimal stock portfolio using the single index model can already be known (using historical data from August 2020 to January 2021).

After the formation of the optimal stock, the portfolio has been completed, and an evaluation of the performance of the stock portfolio that has been formed using the data for the period February 2021 to July 2021 is carried out. To evaluate the performance of the stock portfolio, the expected return of the portfolio is calculated beforehand, which is the average weighted average of the realized returns of every single security in the portfolio, according to [1], the formula used is:

$$E(R_p) = \sum\nolimits_{i=1}^{N} (w_i.E(R_i)) \tag{19}$$

Or it can also be calculated using the formula:

$$E(R_p) = \alpha_p + \beta_p.E(R_m) \tag{20}$$

The calculation of portfolio risk is also carried out, to get the portfolio risk value, it is necessary to first calculate the portfolio beta and portfolio alpha, each of which is calculated using the formula:

$$\beta_p = \sum\nolimits_{i=1}^{N} w_i.\beta_i \tag{21}$$

$$\alpha_p = \sum\nolimits_{i=1}^{N} w_i.\alpha_i \tag{22}$$

$$\frac{2}{p} = \beta_p^2 \frac{2}{.m} + (\sum\nolimits_{i=1}^{N} w_i.ei)^2 \tag{23}$$

After all values are known, then measurements are taken to determine or evaluate the performance of the stock portfolio using the reward to variability or Sharpe measure and reward to volatility or Treynor measure. Portfolio performance calculated by the Sharpe measure is done by dividing the return more by the variability of the portfolio return, according to [1], the formula used is

$$RVAR = \frac{E(R_p) - R_f}{p} \tag{24}$$

Meanwhile, the Treynor measure is carried out by dividing more returns by portfolio volatility, according to [1], the formula used is:

$$RVOL = \frac{E(R_p) - R_f}{\beta_P} \tag{25}$$

After evaluating the performance of forming an optimal stock portfolio using a single index model, it is continued with the formation of an optimal portfolio using any method. The arbitrary method is carried out in 3 ways, the first way is to change the weight of the shares that have been formed using a single index model to be evenly distributed, the second way is to reverse the weight from the original largest weight changed to the smallest weight and vice versa and the third way is the formation of an optimal stock portfolio using the excel rand formula (to obtain random weights). So that the number of portfolios formed is 5 portfolios, namely using a single index model for the LQ45 index, a single index model for the development board index, random equally, random as opposed to a single index, and using the excel rand formula.

Next, an evaluation of the performance of the five stock portfolios is carried out, and then a comparison is made, which one has better performance or has the highest RVAR and RVOL values, then compares the formation of a stock portfolio that has the highest and lowest returns, highest and lowest risk, lastly. Compare the difference in value between the return and risk of the five portfolios.

3 Results and Discussion

Based on the calculation results, 5 portfolios were generated. In the formation of a stock portfolio using the single index model on LQ45, 7 stocks are included in the optimal stock portfolio, with ERAA of 40.1%, SCMA of 21.8%, TKIM of 11.5%, BSDE of 8.5%, ITMG of 6.5%, INKP of 6.4%, and ANTM of 5.2%.

The shares entered in an arbitrary stock portfolio with equal weight are the same as the shares entered in a single index model, namely ERAA, SCMA, TKIM, MSDE, ITMG, INKP, and ANTM, but the weights are changed to be equal so that each weights 14.29%.

As for the stock portfolio in contrast to the single index model, the proportions are the opposite, namely ERAA 5.2%, SCMA 6.4%, TKIM 6.5%, MSDE 8.5%, ITMG 11.5%, INKP 21.8%, and ANTM 40.1%.

In the formation of a stock portfolio using the single index model on the DBX (development board index), 6 stocks are included in the optimal stock portfolio with the proportion of TCPI of 39.3%, TPIA 31.7%, SRTG 11.5%, MDKA 8.9%, MPRO 8.5%, and CASA 0.03%.

For the formation of a portfolio in an arbitrary way using the Excel Rand formula, samples were taken from the development board index that met the criteria, namely 8 stocks and obtained the proportion of ARTO 19.3%, MKPI 16.9%, SRTG 14.8%, TCPI 12.7%, MPRO 10.5%, TPIA 9.3%, MDKA 9.0% and CASA 7.6%.

Next, after the five portfolios are formed, an assessment of the performance of each portfolio will be carried out and compared, the first step is to assess and compare the formation of the portfolio with the LQ45 sample consisting of 3 portfolios, namely

Table 1. Results

Portofolio	Total Risk	Sharpe Measure	Beta Portofolio	Treynor Measure	Jensen Measure
SIM	0.0083	−0.3238	1.3293	−0.0020	0.0023
SIM equally	0.0091	−0.9057	1.5707	−0.0053	−0.0023
SIM inverse	0.0091	−0.9057	15707	−0.0053	−0.0025

Source: processed data

using a single index model, any equal and any inverse of a single index. Model, with the following results (Table 1).

Then also compare the portfolio return to total risk so that the difference between return and risk is obtained, as Table 2.

Furthermore, it is carried out and compared between the formation of a portfolio with a sample development board index consisting of 2 portfolios, namely using a single index model and in any way using the Excel Rand formula, with Table 3 results.

Then also compare the portfolio return to total risk so that the difference between return and risk is obtained, as Table 4.

Table 2. Results

Portofolio	Return Portofolio	Risk Total	Deviation
Single Index Model	0.0002	0.0083	−0.0081
SIM Equally	−0.0053	0.0091	−0.0144
SIM Inverse	−0.0053	0.0091	−0.0144

Source: processed data

Table 3. Results

Portofolio	Risk Total	Sharpe Measure	Beta Portofolio	Treynor Measure	Jensen Measure
Random	0.0075	0.9795	0.8430	0.0087	0.0105
Single Index Model	0.0038	3.8544	0.5011	0.0289	0.0164

Source: processed data

Table 4. Results

Portofolio	Return Portfolio	Risk Total	Deviation
Random	0.0103	0.0075	0.0028
Single Index Model	0.0174	0.0038	0.0136

Source: processed data

4 Conclusions

4.1 Conclusions

The results of optimal stock portfolio formation from LQ45 are ERAA 40.1%, SCMA 21.8%, TKIM 11.5%, BDSE 8.5%, ITMG 6.5%, INKP 6.4% & ANTM 5.2%. For LQ45, when compared to arbitrarily forming a portfolio (with equal weights and the opposite weight of the Single Index Model), the results with the Single Index Model are better, judging from the results of all performance evaluation methods (Sharpe, Treynor, Jensen and the difference between returns and risks).

The results of optimal stock portfolio formation from DBX are TCPI 39.3%, TPIA 31.7%, SRTG 11.5%, MDKA 8.9%, MPRO 8.5%, CASA 0.03%. For DBX, when compared to portfolio formation using intuition, the results with the Single Index Model are better, judging from the results of all performance evaluation methods (Sharpe, Treynor, Jensen and the difference between return and risk).

Of the 5 ways to form an optimal stock portfolio, the best result is to use the Single Index Model taken from the DBX index, so that before forming a stock portfolio it must be determined which index will be used to form an optimal stock portfolio, one way is to compare risk and return of the 38 existing indices, compared to the JCI.

4.2 Suggestion

The formation of a stock portfolio using a single index model, can be used as a reference in investing in the capital market, in order to obtain optimal returns with certain risks, especially when considering other factors such as fundamental analysis including global economic conditions, financial investment capabilities, attitudes in decision making in investing and others. The results of the research carried out can be applied to passive strategies (investment for the medium to long term), but should still carry out periodic evaluations, so that the portfolio that is used as the basis for investing remains relevant to current conditions.

In subsequent studies, the portfolio formation method can be compared with other methods, so that the conclusions from the research results can be generalized. The formation of an optimal stock portfolio using a single index model can be compared with other arbitrary portfolios, for example with portfolios on different indices such as the Kompas 100 Index, Jakarta Islamic Index, Sectoral Index, or with certain commodities such as stocks of banking companies, agricultural products, and others. etc.

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