

# Analysis of the Formation of Optimal Portfolio in Investment Decision Making Using Single Index Model

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**Abstract:-** In fact in investing stocks, returns and risks are two things that are inseparable. A high return will contain a high risk as well. Conversely, the low risk will have a low return as well. Therefore investors are required to be able to make the right decisions in investing, so as to minimize risk. The right decision that can be used by investors in reducing the risk of investing is by diversifying. The purpose of this research is to find out and find decent stocks in the optimal portfolio as well as the proportion of funds from each of those stocks formed with the Single Index Model. This research was conducted on the LQ 45 Index on the Indonesia Stock Exchange. The population in this study is all companies listed in the LQ Index 45 for the period 2015-2019. The results showed that of the 28 stocks there are 13 stocks that can enter into the optimal portfolio of Single Index Model form with a proportion of 29.27% ADRO, AKRA of -2.11%, ASII of 3.53%, BBKA by 10.01%, BBNI by 0.75%, BBTN by 0.47%, INCO by 13.65%, INDF at 11.16%, MNCN at 4.33%, PTBA at 0.06%, TLKM at 22.32%, UNTR at 2.28% , WSKT by 4.28%.

**Keywords:-** Stocks, Return, Risk, Diversification, Optimal Portfolio, Single Index Model

## I. INTRODUCTION

Capital markets are challenged through the era of the digital economy to become more modern. With that condition, the Indonesia Stock Exchange (IDX) together with The Indonesian Securities Guarantee Clearing (KPEI) and the Indonesian Central Securities Exchange (KSEI) continue to strive to provide the best service. These efforts were made to improve infrastructure and expand the reach of capital markets throughout Indonesia. In order to answer business challenges, the Indonesia Stock Exchange (IDX) launched a new trading system called Jakarta Automated Trading Systems Next Generation (JATS NextG) which has a capacity of 1 million orders and 500 thousand transactions per day and is able to handle multi products in a single platform[1]. Jakarta Automated Trading Systems Next Generation (JATS NextG) application is able to make people's access to investing in capital markets easier and faster. Therefore, sufficient knowledge, experience and business instincts are required to analyze which stocks to buy, which stocks will be sold and which stocks will remain.

In fact in investing stocks, returns and risks are two things that are inseparable. A high return will contain a high risk as well. Conversely, the low risk will have a low return as well. Therefore investors are required to be able to make the right decisions in investing, so as to minimize risk. The right decision that can be used by investors in reducing the risk of investing is by diversifying. Diversification can be done by investing in different types of stocks, so as to form a portfolio[2]. The purpose of the formation of this stock portfolio is to get the maximum return of expectations with the minimum level of risk[3].

The Indonesia Stock Exchange (IDX) publishes a stock index containing companies with certain criteria to overcome the difficulties experienced by investors. One of these indexes is the LQ 45 Index, the stocks contained in the LQ 45 Index are liquid stocks, high market capitalization, have good growth prospects, have high trading frequency and have good financial condition[4]. Thus, when viewed in terms of risk the LQ45 stock group has the lowest risk compared to other stocks. The following in Table 1 presented the return of the stocks of companies listed in the LQ Index 45 Period 2015 – 2019 as follows:

Table 1:- Stock Return of Companies Listed in the LQ Index 45 Period 2015 – 2019

No	Stock Code	Return				
		2015	2016	2017	2018	2019
1	ADRO	-0,505	2,291	0,097	-0,347	2,251
2	AKRA	0,742	-0,164	0,058	-0,324	-0,079
3	ASII	-0,192	0,379	0,003	-0,009	-0,158
4	BBKA	0,013	0,165	0,413	0,187	0,286
5	BBNI	-0,182	0,107	0,792	-0,111	-0,108
6	BBRI	-0,019	0,022	-0,688	0,005	0,202
7	BBTN	0,075	0,344	1,052	-0,289	-0,165
8	BMRI	-0,142	0,251	-0,309	-0,078	0,041
9	BSDE	-0,003	-0,025	-0,031	-0,262	0,000
10	GGRM	-0,094	0,162	0,311	-0,002	-0,366
11	ICBP	0,029	-0,364	0,038	0,174	0,067
12	INCO	-0,549	0,725	0,025	0,128	0,117
13	INDF	-0,233	0,531	-0,038	-0,023	0,064
14	INTP	-0,107	-0,310	0,425	-0,159	0,031
15	JSMR	-0,259	-0,173	0,481	-0,331	0,209
16	KLBF	-0,279	0,148	0,116	-0,101	0,066
17	LPPF	0,173	-0,141	-0,339	-0,440	-0,248
18	MNCN	-0,270	-0,054	-0,268	-0,463	1,362
19	PGAS	-0,543	-0,016	-0,352	0,211	0,024
20	PTBA	-0,651	1,762	-0,803	0,748	-0,381

21	PTPP	0,084	-0,017	-0,307	-0,316	-0,122
22	SCMA	-0,114	-0,097	-0,114	-0,246	-0,246
23	SMGR	-0,296	-0,195	0,079	0,162	0,043
24	TLKM	0,084	0,282	0,116	-0,155	0,059
25	UNTR	-0,023	0,254	0,666	-0,227	-0,213
26	UNVR	0,146	0,049	0,441	-0,188	-0,075
27	WIKA	-0,283	-0,106	-0,343	0,068	0,202
28	WSKT	0,136	0,527	-0,133	-0,240	-0,116

Source : Processed Data (2020)

Based on Table 1 it can be seen that although the stocks of the companies listed in the LQ 45 Index are 45 companies that have high liquidity and high market capitalization and are known as blue chip stock groups but not in spite of the uncertainty of the level of return that investors will receive. It can be seen in Table 1 that the return of sample company stocks from the LQ 45 Index during the period 2015-2019 fluctuates. The highest return of stocks was in PT Adaro Energy, Tbk (ADRO) in 2016 at 2,291 while the lowest return on stocks was in PT Bukit Asam (Persero), Tbk (PTBA) in 2017 of -0.803.

Furthermore, the return of stocks in 2019 from each company listed on the LQ 45 Index decreased. This indicates that there is an element of risk in the investment. Another problem often faced by investors is when having to choose which stocks to be formed into portfolios so that in the end the investor wrongly makes the right portfolio decision to choose then this impacts the return that the investor will receive. Therefore, it is necessary to analyze in stock selection and optimal portfolio determination.

Alternative stock selection and portfolio determination can be done using various analysis tools, one of which is by using a single index model. This model can be used to simplify calculations in the Markowitz Model by providing the required input parameter parameters in markowitz model calculations. The Single Index Model is based on the observation that the price of a security fluctuates in the direction of the market price index. Therefore, this research uses the Single Index Model in portfolio formation, where optimal stock selection and portfolio determination is done by collecting historical data on individual stocks that are used as inputs and analyzed to be outputs that can describe the performance of each portfolio and can determine whether the portfolio belongs to the optimal portfolio or vice versa.

This research was inspired by research conducted by Pratama (2019) [5] with the results showing that: (1) there are seven stocks included in the optimal stock portfolio according to the Single Index Model on stocks listed in the LQ45 Index namely INCO (Vale Indonesia Tbk.), SRIL (Sri Rejeki Isman Tbk.), BBRI (Bank People of Indonesia (Persero) Tbk.), BMRI (Bank Mandiri (Persero) Tbk.), BBNI (Bank Negara Indonesia (Persero) Tbk.), BBTN (State Savings Bank (Persero) Tbk.), and GGRM (Gudang Garam Tbk.). (2) The proportion of funds worth investing in the shares is INCO of 14.56%, SRIL of 11.11%, BBRI of 22.01%, BMRI of 19.05%, BBNI of 15.08%, BBTN of 7.63%, and GGRM of 10.53%. The optimal portfolio of LQ

45 shares is expected to have a return of 0.015077223 or 1.50% per month, while the risk to be borne from the optimal portfolio in accordance with the calculation result is 0.008541182 or 0.85%. Further research conducted by Milliondry (2018) [6] with the results of the study showed that by using the Single Index Model approach, the shares of LQ 45 Index members in the period January 2010 to July 2017 that can form an optimal portfolio consisting of BBKA 23%, JSMR 9.6% , INDF 9.3 % , GGRM 7.8 % , UNTR 7.5% , KLBF 6.8 % , INTP 6.7%, SMGR 6.4% , ASII 6.4%, BBNI 2.2%, BBRI 2.1% ADRO 1.9% , LSIP 1.4% , PTBA 1% , AKRA 1.2%, ICBP 0.7 % , BMRI 0.4 % , BSDE 0.1 % and optimal portfolio points are at risk 0.08 and expected return 0.0128.

Differences in research results occurred due to different research periods, namely in this study using the period 2015-2019 while the Pratama research (2019) [5] using the period 2016-2018 and Milliondry research (2018) [6] using the period 2010-2017.

This research aims to find out and find stocks that are eligible to be included in the optimal portfolio as well as the proportion of funds from each of those stocks. The theoretical usefulness of this research is expected to provide empirical evidence in investment management, especially regarding the formation of optimal portfolios using the Single Index Model in the LQ 45 Index in the period 2015-2019. For investor practitioners, this research can be used as a contribution of thought and ingredients for investors in investment decision making by looking at the optimal stock portfolio.

## II. LIBRARY REVIEW

### 1.1. Capital Markets

Companies that need funds can sell their securities in the capital market. Capital Market can be said to be an abstract market, because the traded is a long-term fund that is a fund whose association in investing more than a year[7].

### 1.2. Return

Return is the result earned from the investment. Return can be a return of realization that has already occurred or a return of expectations that has not occurred but is expected to occur in the future [3].

#### 1. Realized Return or $R_i$

This realization return is calculated based on historical data, this return is important because it is used as one of the performance gauges of the company. Return realization is important because it is used as one of the performance measurement tools of the company.

#### 2. Expected Return or $E(R_i)$

Expected Return is a return that is expected to be obtained by investors in the future. In contrast to the return of realization that has already occurred, the return of expectations of its nature has not occurred[3].

2.2. Risk

Risk is often associated with deviation or deviation from the outcome received by the expected.

In the concept of investment, in general the risk can be classified into 2 i.e.

1. Systematic risk, is a macro risk because it is related to changes that occur in the market as a whole and can result in variability of investment returns.
2. Unsystematic risk is a risk associated with changing the risk of micro-conditions of a particular company so that specifically will only affect the return on investment of the company [3].

To calculate risk, a widely used method is standard deviation that measures the absolute deviation of nlai value that has already occurred with the expected value [3].

2.3. Portfolio

Portfolios are investments in various types of securities, stocks, bonds, money markets and derivative products. As a combination of different types of securities with different investment weight compositions each type of securities are in one portfolio package [7]. A rational investor will invest by diversifying to form a portfolio so as to minimize risk without having to reduce the expected return.

2.4. Efficient Portfolio and Optimal Portfolio

An efficient portfolio is a good portfolio but not the best. An efficient portfolio can be defined as a portfolio that provides the greatest return on expectations with certain risks or provides the smallest risk with a certain expected return[3]. Rational investors will choose an efficient portfolio because it is a portfolio formed by optimizing one of two dimensions, namely the return of expectations or portfolio risk.

An optimal portfolio is a portfolio with the best combination of return expectations and risks[3]. An optimal portfolio is also an efficient portfolio, but an efficient portfolio is not necessarily an optimal portfolio.

2.5. Single Index Model

William Sharpe developed the Markowitz model by introducing the Single Index Model. "Single Index Model is based on the observation that the price of a security fluctuates in the direction of the market index" [3]. In particular it can be observed that most stocks tend to experience price increases if the stock price index rises. The opposite is also true, which is that if the stock price index falls, most stocks experience a price drop. This suggests that the return of the security is correlated due to a common response to changes in market value. Single Index Model Equation as follows :

$$R_i = \alpha_i + \beta_i \cdot R_M + e_i \dots\dots\dots(1)$$

Source : [3]

Description :

- $R_i$  = Return of securities to -i;
- $\alpha_i$  = The expected value of an independent return of securities to the return of the market
- $\beta_i$  = Beta which is a coefficient that measures  $R_i$  changes as a result of  $R_M$  changes
- $R_M$  = The return rate of the market index, is also a random variable
- $e_i$  = Residual error which is a random variable with an expected value equal to zero or  $E(e_i) = 0$

2.6. Optimal Portfolio based on Single Index Model

An optimal portfolio of investors is a portfolio chosen by investors from the many options available in an efficient portfolio. Calculations to determine the optimal portfolio will be very easy if based solely on a number that can determine whether a security can be incorporated into that optimal portfolio. This is the ratio of excess return to beta (ERB).

$$ERB_i = \frac{E(R_i) - R_{br}}{\beta_i} \dots\dots\dots(2)$$

Source : [3]

Description :

- $ERB_i$  = Excess Return to Beta (ERB) stock i
- $E(R_i)$  = Expected Return stock i
- $R_{br}$  = Return on risk-free assets
- $\beta_i$  = Beta stock i

The optimal portfolio will contain asset assets that have a high ERB ratio value. Asset assets with a low ERB ratio will not be included in the optimal portfolio. Thus, a Cut off Rate (Ci) is required that can determine what erb value limit is said to be high. The size of this delimiter point can be determined by the following steps :

1. Sort securities by the largest ERB value to the smallest value. Securities with the largest ERB value are candidates for inclusion in the optimal portfolio.
2. Calculate the value of  $A_i$  and  $B_i$  for each security to - i as follows:

$$A_i = \frac{[E(R_i) - R_{br}] \beta_i}{\sigma_{ei}^2} \dots\dots\dots(3)$$

And

$$B_i = \frac{\beta_i^2}{\sigma_{ei}^2} \dots\dots\dots(4)$$

Source : [3]

Description :

- $E(R_i)$  = Expected Return stock i
- $R_{br}$  = Return on risk-free assets
- $\beta_i$  = Beta stock i

$\sigma_{e_i}^2$  = variance of residual error

3. Calculate Ci value with formula as follows :

$$C_i = \frac{\sigma_m^2 \sum_{j=1}^i A_j}{1 + \sigma_m^2 \sum_{j=1}^i B_j} \dots\dots(5)$$

Source : [3]

Description:

- $C_i$  = Cut Off Rate
- $\sigma_m^2$  = Variance of Return Market Index
- $\beta_i$  = Beta stock i

4. The size of the cut-off point ( $C^*$ ) is the  $C_i$  value where the ERB value was last time still greater than the  $C_i$  value
5. Securities that make up the optimal portfolio are securities that have an ERB value greater than or equal to the ERB value at point  $C^*$ . Securities that have a smaller ERB with ERB point  $C^*$  are not included in the formation of optimal portfolios.
6. Once the securities that make up the optimal portfolio have been determined, the next step is to calculate the large proportion of each of those securities in the optimal portfolio. The proportion for securities to i is as follows:

$$W_i = \frac{Z_i}{\sum_{j=1}^k Z_j} \dots\dots\dots(6)$$

With  $Z_i$  :

$$Z_i = \frac{\beta_i}{\sigma_{e_i}^2} (ERB_i - C^*) \dots\dots\dots(7)$$

Source : [3]

Description :

- $W_i$  = Proportion of securities to i
- k = Optimal number of securities in the portfolio
- $\beta_i$  = Beta stock i
- $\sigma_{e_i}^2$  = variance of residual error
- ERB<sub>i</sub> = Excess Return to Beta (ERB) stocks i
- $C^*$  = Cut Off point value which is the largest  $C_i$  value

### III. RESEARCH METHODS

#### 3.1. Types of research

This research is a descriptive study that is conducted to find out self-variable either one variable or more (independent) tapa make comparisons or connect with other variables.

The approach taken in this study is by way of quantitative approach, because the main data used in this study is in the form of numbers. Quantitative Data is data in the form of numbers or qualitative data that is thought. This research uses data in the form of stock price list (closing price), LQ45 data; and BI interest rates for the period 2015-2019

#### 3.2. Population and Sample

The population in this study is all companies registered in LQ 45 from the period 2015 – 2019 which is 68 population. The sampling technique used in this study is purposive sampling. Purposive sampling is a sampling of data based on specific criteria. The criteria of purposive sampling are listed companies and never exit the LQ 45 Index from the period 2015–2019. Of these criteria, 28 companies listed in the LQ Index of 45 will be sampled in this study. The companies sampled in this study are as follows: ADRO, AKRA, ASII, BBCA, BBNI, BBRI, BBTN, BMRI, BSDE, GGRM, ICBP, INCO, INDF, INTP, JSMR, KLBF, LPPF, MNCN, PGAS, PTBA, PTPP, SCMA, SMGR, TLKM, UNTR, UNVR, WIKA, WSKT.

#### 3.3. Variables and Measurements

The data analysis in this study will be conducted in the following ways :

1. Calculating the Return and Expectation of Return of each stock as well as the market return
- 2.

$$R_i = \frac{(P_t - P_{t-1})}{P_{t-1}} \dots\dots\dots(8)$$

Source : [3]

Description :

- $R_i$  = Return of stock i
  - $P_t$  = Stock price in the t period
  - $P_{t-1}$  = Stock price in previous period
- Stock Return Expectation Formula

$$E(R_i) = \frac{\sum_{t=1}^n R_{it}}{n} \dots\dots\dots(9)$$

Source : [3]

Description :

$E(R_i)$  = Expected Return of stock i  
 $R_{it}$  = Return of stock i  
 n = Number of Observations

3. Calculate Market Return and Return Expectations with LQ 45 data base using formula

$$R_m = \frac{(I_t - I_{t-1})}{I_{t-1}} \dots\dots\dots(10)$$

Description :

$R_m$  = Market Return  
 $I_t$  = Market index observation period  
 $I_{t-1}$  = Market index in the previous period

Market Expected Return is

$$E(R_m) = \frac{\sum_{t=1}^n R_{mt}}{n} \dots\dots\dots(11)$$

Description :

$E(R_m)$  = Market Expected Return  
 $R_{it}$  = Market return in the t period  
 n = Number of Observations

4. Calculate Market Risk  
 Market Risk

$$\sigma_m^2 = \sum_{t=1}^n \frac{[R_{mt} - E(R_m)]^2}{n-1} \dots\dots\dots(12)$$

Source : [3]

Description :

$\sigma_m^2$  = Variance Market Return  
 $R_{mt}$  = Market Return fort period  
 $E(R_m)$  = Expected Market Return  
 n = Number of Observations

5. Calculate Beta and Alpha per stock  
 Beta

$$\sigma_{im} = \sum_{i=1}^m [R_i - E(R_i)] [R_m - E(R_m)] \dots\dots(13)$$

Description :

$\sigma_{im}$  = Covarian between Stock Return i and Market Return  
 $R_i$  = Stock Return i  
 $E(R_i)$  = Expected Stock Return i  
 $R_m$  = Market Return  
 $E(R_m)$  = Expected Market Return

Next beta can be calculated with formula

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2} \dots\dots\dots(14)$$

Source : [3]

Description :

$\beta_i$  = Beta of stock i  
 $\sigma_{im}$  = Covarian between Stock Return i and Market Return  
 $\sigma_m^2$  = Variance Market Return

Alpha

$$\alpha_i = E(R_i) - \beta_i E(R_m) \dots\dots\dots(15)$$

Description:

$\alpha_i$  = Alpha of stock i  
 $E(R_i)$  = Expected Stock Return i  
 $E(R_m)$  = Expected Market Return

3.4. Data Collection Techniques

The data collection techniques used in this study are with documentation. This technique is done by looking at secondary data that has been provided by the Indonesia Stock Exchange including records, report reports, and form forms in accordance with the research.

3.5. Data Analysis Techniques

The sequential stage of data analysis can be explained as follows :

1. Calculate the total return of realization of each stock
2. Calculate the return expectation ( $E(R_i)$ ) of each stock
3. Calculating market return ( $R_M$ ) and return of market expectations ( $E(R_M)$ )
4. Determine the return value of risk-free assets
5. Calculate the total risk of each stock
6. Determining Excess Return to Beta (ERB)
7. Sort stocks by largest ERB value to smallest
8. Calculate  $A_i$  and  $B_i$  Values and Cut Off Points
9. Match optimal portfolio candidates with criteria if  $ERB > C^*$
10. Determine the proposi of the funds of each selected stock
11. Calculates beta and alpha portfolios
12. Requires expected return and portfolio risk

**IV. RESULTS AND DISCUSSIONS**

4.1. Calculation of Expected Return of Stocks and Deviation Standards

After searching for the return of stocks then carried out the calculation of expected return of stocks in the sample of companies listed in LQ 45 period 2015-2019. Expected Return is the level of profit or return expected by the investor, where the expected return ( $E(R_i)$ ) is of positive value indicating that the stock will give the investor a profit as well as vice versa if the expected return ( $E(R_i)$ ) is of negatif value then the investment will be a loss for the investor[3].

Risk is always attached to investment returns. Risk and retun are uni-directional. The greater the risk of an investment then the return will also be greater and vice versa

if the smaller the risk of an investment then the return (rate of return) will also be smaller[8]. In this study the researchers only took the data of expected return that had a positive value, the following presented picture Expected Return and Standard Deviation of companies registered in LQ 45 Period 2015 – 2019.

Table 2:- Expected Return and Standard Deviation of Companies listed in LQ Index 45 Period 2015-2019

No	Stock Code	Expected Return (E(R <sub>i</sub> ))	Standard Deviation (σ <sub>i</sub> )
1	ADRO	0,758	2,799
2	AKRA	0,046	0,825
3	ASII	0,005	0,439
4	BBCA	0,213	0,543
5	BBNI	0,100	1,293
6	BBRI	-0,096	0,837
7	BBTN	0,203	2,201
8	BMRI	-0,047	0,498
9	BSDE	-0,064	0,223
10	GGRM	0,002	0,512
11	ICBP	-0,011	0,416
12	INCO	0,089	0,734
13	INDF	0,060	0,570
14	INTP	-0,024	0,559
15	JSMR	-0,015	0,751
16	KLBF	-0,010	0,325
17	LPPF	-0,199	1,076
18	MNCN	0,062	1,284
19	PGAS	-0,135	0,593
20	PTBA	0,135	14,945
21	PTPP	-0,136	0,637
22	SCMA	-0,163	0,151
23	SMGR	-0,041	0,389
24	TLKM	0,077	0,313
25	UNTR	0,091	0,751
26	UNVR	0,074	0,481
27	WIKA	-0,092	0,460
28	WSKT	0,035	0,616

Source : Processed Data (2020)

Based on table 2 above, it can be explained that of the 28 stocks included in the LQ Index 45 for the period 2015-2019 there are only 15 stocks that have a positive value expected return (E(R<sub>i</sub>)). Of the fifteen companies, the company with the highest expected return on shares is PT Adaro Energy, Tbk (ADRO) at 0.758 or 75.8% while the company with the lowest expected return on shares is PT Gudang Garam Tbk (GGRM) at 0.002 or 0.2%. Furthermore, the company with the highest risk is PT Bukit Asam, Tbk (PTBA) of 14,945 or 1494.5% and followed by PT Adaro Energy, Tbk (ADRO) of 2,799 or 279.9% while the company with the lowest risk is PT Telekomunikasi Indonesia (Persero), Tbk (TLKM) which is 0.313 or 31.3%.

After the calculation of expected return and risk of the company's stocks can be concluded that PT Adaro Energy, Tbk is able to provide a high return rate follow also with a higher level of risk, while at PT Gudang Garam, Tbk is only

able to provide a small return compared to the sample company registered in LQ 45. This is because cigarette companies are under pressure due to the increase in customs tax every year and other government policies that affect stock price fluctuations. Therefore, it takes a little patience for investors to wait for the shares of this cigarette issuer to come out of its lethargy and return to its fair price.

Furthermore, for PT Telekomunikasi Indonesia (Persero), Tbk provides low risk compared to sample companies registered in LQ 45 because PT Telekomunikasi Indonesia (Persero), Tbk made changes in business policy by focusing on business lines that have higher profitability that are recurring, especially in enterprise solutions services such as enterprise connectivity, data centers and cloud, and selectively reducing and not prioritizing business solutions that have relatively low margin levels and non-recurring[9].

4.2. Excess Return to Beta (ERB) Calculation

The next step is to perform beta calculations, variant alpha and residual errors and Excess Return to Beta (ERB). The determination of Excess Return to Beta (ERB) is done by reducing the expected return of each stock with a risk-free return rate, and the result is divided by the beta of the stocks in question. The calculation results can be seen in Table 3 below:

Table 3:- Beta, Alpha, Variants of Residual Errors, and Excess Return to Beta (ERB) in companies registered with LQ 45 for the period 2015-2019

No	Stock Code	β	α <sub>i</sub>	σ <sub>ie2</sub>	ERB
1	ADRO	-39,416	3,852	1,557	0,760
2	AKRA	5,661	-0,398	0,136	0,033
3	ASII	-3,453	0,276	0,039	0,026
4	BBCA	-1,455	0,327	0,059	0,264
5	BBNI	-0,895	0,170	0,335	0,183
6	BBTN	-1,083	0,288	0,969	0,273
7	GGRM	0,974	-0,074	0,052	-0,075
8	INCO	-9,967	0,871	0,107	0,097
9	INDF	-6,646	0,582	0,065	0,071
10	MNCN	-14,002	1,161	0,329	0,067
11	PTBA	-13,368	1,185	44,670	0,141
12	TLKM	-2,746	0,292	0,020	0,104
13	UNTR	-1,022	0,171	0,113	0,165
14	UNVR	0,824	0,010	0,046	-0,017
15	WSKT	-3,998	0,349	0,076	0,054

Source : Processed Data (2020)

Based on Table 3 above, it can be seen that beta securities that have the highest beta are found in the stocks of PT AKR Corporindo, Tbk (AKRA) of 5,661. The value indicates that the company's market return of 1% will result in a change in the return of stocks of PT AKR Corporindo, Tbk (AKRA) in the same direction of 5,661 or 566,1%. This indicates that the greater the beta value, the greater the influence of the market profit level as well as the risk of stocks also higher[10] or it can be said that the stocks of PT AKR Corporindo, Tbk (AKRA) as aggressive stocks.

Beta securities that have the lowest beta are found in the stocks of PT Adaro Energy, Tbk(ADRO) which is -39,416. The value indicates that if the market return increases by 1% then the change in the return of stocks of PT Adaro Energy, Tbk(ADRO) will decrease by 39,416 or 3941,6% or it can be said that the stocks of PT Adaro Energy, Tbk(ADRO) as defensive stocks. Knowing the beta of each security is also useful for the consideration of incorporating such securities into the portfolio to be formed.

From Table 3 above, it is also possible to know that the highest Alpha value is found in the stocks of PT Adaro Energy, Tbk(ADRO) at 3,852 and the lowest alpha is in the stocks of PT AKR Corporindo, Tbk (AKRA) of -0,398. Furthermore, based on the results  $\sigma_{ie}^2$  results show that the entire sample company has a positive value. This indicates that each stock has an un systematic risk that may affect the company individually. With the highest  $\sigma_{ie}^2$  value is in PT Bukti Asam, Tbk (PTBA) company of 44,670 while the

lowest  $\sigma_{ie}^2$  is in PT Telekomunikasi Indonesia (Persero), Tbk (TLKM) company which is 0.020.

Excess Return to Beta (ERB) is used as a measure of excess return relative to one un diversified risk unit measured by beta[8]. The highest ERB value is in PT Bukit Asam, Tbk (PTBA) at 4,575 while the stocks that have the lowest ERB are in the stocks of PT Gudang Garam, Tbk (GGRM) of -0,075.

4.3. Cut Off Rate Calculation

At the stage of determining the stock rating based on Excess return to Beta (ERB) and Cut Off Point is done the separation of the same stocks that enter into the optimal portfolio, using the existing formula can then be determined the value of  $C_i$  for each stock. Furthermore, the value of  $C_i$  obtained will be determined Cut off Point ( $C^*$ ) which is the largest  $C_i$  value.

Table 4:- LQ 45 Index Cut Off Rate Determination

No	Stock Code	ERB	Aj	Bj	Ci	C*
1	ADRO	0,75951	-17,27652	997,60939	-0,00042	
2	AKRA	0,03323	-1,18644	235,49724	-0,00012	
3	ASII	0,02636	6,30262	309,25294	0,00049	
4	BBCA	0,26445	-3,40078	35,87780	-0,00227	
5	BBNI	0,18337	-0,06587	2,39677	-0,00066	
6	BBTN	0,27251	-0,14328	1,20972	-0,00284	
7	INCO	0,09657	-1,30385	925,32421	-0,00003	
8	INDF	0,07149	1,51890	682,27646	0,00005	
9	MNCN	0,06693	0,57123	595,86549	0,00002	
10	PTBA	0,14066	-0,01797	4,00061	-0,00011	
11	TLKM	0,10420	-0,26486	386,28621	-0,00002	
12	UNTR	0,16459	-0,14715	9,27003	-0,00038	
13	WSKT	0,05351	2,12538	211,15277	0,00024	C*
14	GGRM	-0,07480	-1,35165	18,08333	-0,00179	
15	UNVR	-0,01664	-0,01014	14,68159	-0,00002	

Source : Processed Data (2020)

Based on Table 4 above it can be seen that the value of Cut Off Point ( $C^*$ ) of 15stocks is located in stocks of PT Waskita Karya (Persero), Tbk of 0,00024 which is the last limit where the value of ERB is greater than or equal to the value of  $C_i$ . Meanwhile, stocks that have a smaller ERB with ERB at cut off point ( $C^*$ ) are not included in the optimal portfolio formation. Thus after  $C^*$  is determined, a selection of stocks that can be included in the optimal portfolio candidate by comparing the ERB value of each stock with the value of  $C^*$ .

Stocks of companies that have an ERB value greater than or equal to the value of  $C^*$  can be seen in Table 5 below:

Table 5:- Optimal Portfolio Candidates in LQ 45 Index

No	Stock Code	ERB	Ci	Description
1	ADRO	0,75951	-0,00042	Candidate
2	AKRA	0,03323	-0,00012	Candidate
3	ASII	0,02636	0,00049	Candidate
4	BBCA	0,26445	-0,00227	Candidate
5	BBNI	0,18337	-0,00066	Candidate
6	BBTN	0,27251	-0,00284	Candidate
7	INCO	0,09657	-0,00003	Candidate
8	INDF	0,07149	0,00005	Candidate
9	MNCN	0,06693	0,00002	Candidate
10	PTBA	0,14066	-0,00011	Candidate
11	TLKM	0,10420	-0,00002	Candidate
12	UNTR	0,16459	-0,00038	Candidate
13	WSKT	0,05351	0,00024	Candidate

Source : Processed Data (2020)

The establishment of an optimal portfolio aims to assist investors in choosing the right investment, thus getting the maximum return with a minimum level of risk[11]. Based on Table 5 there are 13 companies that are included in the stock candidate so that the stock is able to form the optimal portfolio, because the 13 (thirteen) stocks have an Excess Return to Beta (ERB) value higher than the Cut off Rate. Stocks that have a higher Excess Return to Beta (ERB) value mean they are able to generate a higher return than the systematic risk. This means that the stock is able to face market risks that affect the overall market change, so that the stock can be said to be a stable stock and stable for investing[10].

The highest Excess Return to Beta (ERB) value is in stocks of PT Adaro Energy, Tbk at 0.75951; PT Bank Tabungan Negara, Tbk amounted to 0.27251; PT Bank Central Asia, Tbk amounted to 0.26445; PT Bank Negara Indonesia, Tbk amounted to 0.18337; PT United Tractor

amounted to 0.16459; PT Bukit Asam, Tbk amounted to 0.14066; PT Telekomunikasi Indonesia amounted to 0.10420; PT Vale Indonesia, Tbk amounted to 0.09657; PT Indofarma, Tbk amounted to 0.07149; PT Media Nusantara Citra, Tbk amounted to 0.06693; PT Waskita Karya (Persero), Tbk amounted to 0.05351; PT AKR Corporindo, Tbk amounted to 0.03323 and PT Astra International, Tbk by 0.02636. This indicates that the return that will be received by investors will increase when the market return increases.

1. Proportion of Each Selected Stock

After determining which stocks are candidates for the portfolio the next step is to determine the proportion of the allocation of funds (Wi) invested by investors in each stock that enters the optimal portfolio[3]. Here is presented data on the proportion of funds allocation portofollio optimal stock Index LQ 45 Period 2015 – 2019.

Table 6:- Proportion of Optimal Portfolio Fund Allocation of LQ-45 Index Stocks For Period 2015-2019

No	Stock Code	$\beta$	ERB	$\sigma e2$	C*	Zi	Wi	Proportion
1	ADRO	-39,416	0,760	1,557	0,000	-19,233	0,2927	29,27%
2	AKRA	5,661	0,033	0,136	0,000	1,388	-0,0211	-2,11%
3	ASII	-3,453	0,026	0,039	0,000	-2,317	0,0353	3,53%
4	BBCA	-1,455	0,264	0,059	-0,002	-6,578	0,1001	10,01%
5	BBNI	-0,895	0,183	0,335	-0,001	-0,493	0,0075	0,75%
6	BBTN	-1,083	0,273	0,969	-0,003	-0,308	0,0047	0,47%
7	INCO	-9,967	0,097	0,107	0,000	-8,969	0,1365	13,65%
8	INDF	-6,646	0,071	0,065	0,000	-7,333	0,1116	11,16%
9	MNCN	-14,002	0,067	0,329	0,000	-2,847	0,0433	4,33%
10	PTBA	-13,368	0,141	44,670	0,000	-0,042	0,0006	0,01%
11	TLKM	-2,746	0,104	0,020	0,000	-14,663	0,2232	22,32%
12	UNTR	-1,022	0,165	0,113	0,000	-1,496	0,0228	2,28%
13	WSKT	-3,998	0,054	0,076	0,000	-2,813	0,0428	4,28%
Total						-65,7051		100,00%

Source : Processed Data (2020)

Based on Table 6 above can be described in the form of a chart.

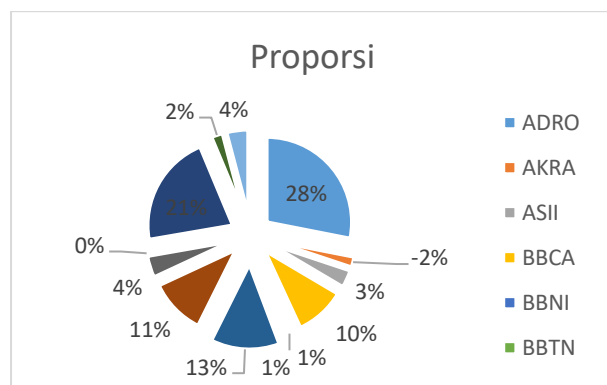


Figure 1:- Proportion of Optimal Portfolio Fund Allocation of LQ-45 Index Stocks Period 2015-2019

In Table 6 and figure 1 shows that the proportion of each selected stock in the company listed in the LQ 45 Index for the period 2015-2019. In Table 6 and figure 1 it explains that the company PT Adaro Energy, Tbk (ADRO) needs sufficient funds of 0.293 representing that of the 100% of the funds held by investors as much as 29.3% will be invested in stocks of PT Adaro Energy, Tbk (ADRO) and the rest invested in other stocks, namely stocks of PT Bank Tabungan Negara, Tbk (BBTN); PT Bank Central Asia, Tbk (BBCA); PT Bank Negara Indonesia, Tbk (BBNI); PT United Tractor (UNTR); PT Bukit Asam, Tbk (PTBA); PT Telekomunikasi Indonesia (TLKM); PT Vale Indonesia, Tbk (INCO); PT Indofarma, Tbk (INDF); PT Media Nusantara Citra, Tbk (MNCN); PT Waskita Karya (Persero), Tbk (WSKT); PT AKR Corporindo, Tbk (AKRA) and PT Astra International, Tbk (ASII).



The results of this study are different from research conducted by Pratama (2019) [5] with the results of research showing that: (1) there are seven stocks included in the optimal stock portfolio according to the Single Index Model on stocks listed in the LQ45 Index namely INCO (Vale Indonesia Tbk.), SRIL (Sri Rejeki Isman Tbk.), BBRI (Bank Rakyat Indonesia (Persero) Tbk.), BMRI (Bank Mandiri (Persero) Tbk.), BBNI (Bank Negara Indonesia (Persero) Tbk.), BBTN (State Savings Bank (Persero) Tbk.), and GGRM (Gudang Garam Tbk.). (2) The proportion of funds worth investing in the shares is INCO of 14.56%, SRIL of 11.11%, BBRI of 22.01%, BMRI of 19.05%, BBNI of 15.08%, BBTN of 7.63%, and GGRM of 10.53%. Furthermore, the results of this study are also different from research conducted by Milliondry (2018)[6] with the results of research showing that by using the Single Index Model approach, the shares of LQ 45 Index members in the period January 2010 to July 2017 can form an optimal portfolio consisting of BBCA 23%, JSMR 9.6% , INDF 9.3 % , GGRM 7.8 % ,UNTR 7.5% , KLBF 6.8 % , INTP 6.7%, SMGR 6.4 % , ASII 6.4 % , BBNI 2.2%, BBRI 2.1 % ADRO 1.9 % , LSIP 1.4 % , PTBA 1 % , AKRA 1.2%, ICBP 0.7 % , BMRI 0.4 % , BSDE 0.1 %.

Differences in research results occurred due to different research periods, namely in this study using the period 2015-2019 while the Primary research (2019) [5] using the period 2016-2018 and milliondry research (2018) [6] using the period 2010-2017

2. *Return and Risk Levels Of Optimal Portfolio*

The final stage in calculating the optimal portfolio is calculating the expected return and risk of the established portfolio. Before calculating the expected return and portfolio risk that is first calculated are beta and alpha portfolios. The following are presented the results of the calculation of expected return and return of the portfolio in Table 7 as follows:

Table 7:- Calculation Results of Expected Return and Portfolio Return

No	Optimal Portfolio	
1	$\alpha_p$	1,50013
2	$\beta_p$	-19,2241
3	$E(R_p)$	-0,0091
4	$\sigma_p^2$	9,0821

Source : Processed Data (2020)

Based on Table 7 it can be seen that the portfolio has a beta value of -19.2241. This indicates that the movement of the stock price is inversely proportional to the movement of IHSG as opposed to the stock market. If the market returns increase by 10% then the return of the portfolio will decrease by 1922.41%. Based on the calculation result obtained the alpha value of the portfolio of 1.50013 which means that the value indicates that the return of the portfolio is affected by the market of 150.013 %.

Based on Table 7 shows that the optimal portfolio formed provides an expected return of -0.0091 or -0.91%. Such expected returns can influence an investor's decision to

invest in stocks that are included in the optimal portfolio because they have a low expected return compared to the expected return market. Based on the calculation of the risk value of the portfolio can be smaller than the risk of each portfolio forming stock. The optimal portfolio formed has a risk of 9.0821 or 90.821 %.

The results of this study are different from the research conducted by Pratama (2019) [5] with the results of the research is the optimal portfolio of LQ 45 shares is expected to have a return of 0.015077223 or 1.50% per month, while the risk to be borne from the optimal portfolio in accordance with the calculation results is 0.008541182 or 0.85%. Furthermore, research conducted by Milliondry (2018) [6] with the results of the study obtained optimal portfolio points are at risk of 0.08 and expected return 0.0128.

Differences in research results occurred due to different research periods, namely in this study using the period 2015-2019 while the Primary research (2019) [5] using the period 2016-2018 and milliondry research (2018) [6] using the period 2010-2017.

V. CONCLUSIONS AND SUGGESTIONS

5.1. Conclusion

Based on calculations from 28 samples of companies obtained 15 companies that had positive return expectations. At the calculation stage ERB selected 13 stocks with a positive ERB value. The next stage of 9 stocks is selected with a cut off point so that 13 stocks are selected that are included in the optimal portfolio. Optimal portfolio formation stocks consist of ADRO, AKRA, ASII, BBCA, BBNI, BBTN, INCO, INDF, MNCN, PTBA, TLKM, UNTR, WSKT.

Based on the calculation of 13 stocks selected into the optimal portfolio, the amount of funds of each stock is ADRO of 29.27 % , TLKM by 22.32 % , INCO by 13.65% , INDF by 11.16% , BBCA of 10.01% , MNCN of 4.33 % , WSKT of 4.28% , ASII of 3.53% , UNTR of 2.28% , BBNI of 0.75% , BBTN of 0.47 % , PTBA of 0.06% , AKRA of -2.11 % .. Stocks of PT Adaro Energy, Tbk (ADR) received the largest proportion of funds at 29.27%. While the lowest proportion of funds occupied by stocks of PT AKR Corporindo, Tbk (AKRA) is -5.3%. This means that stocks with the smallest individual risk levels get the largest proportion of funds in the optimal portfolio.

The optimal portfolio formed provides a portfolio return of -19.2241 or -1922.41 % while for risk from the optimal portfolio of 9.0821 or approximately 908.21%. Next for portfolio return expectations of -0.0091 or about -0.91 % . This indicates that the portfolio return is smaller than the portfolio return expectations. The beta of the acquired portfolio is also lower than the individual beta where the beta value of the portfolio is 1,746. This indicates that market influence has little impact on the performance of selected stocks in optimal portfolios.

## 5.2 Suggestions

### 1. Investor

Investment decisions in portfolios should take into account fundamental aspects other than technical aspects. The method used in portfolio formation should be the Single Index Model method because it can obtain a certain return of expectations at the lowest risk. This research can also be a reference for investors to invest based on the Single Index Model method where 13 (thirteen) optimal portfolio-forming stocks have been selected consisting of ADRO, AKRA, ASII, BBKA, BBNI, BBTN, INCO, INDF, MNCN, PTBA, TLKM, UNTR, WSKT.

### 2. Further research

It is recommended to increase the observation period and research samples and can also use several methods of stock investment analysis. Data and literature must also be prepared in order to facilitate the next research process.

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