

## ANALYSIS OF OPTIMAL STOCK PORTFOLIO FORMATION USING THE SINGLE INDEX MODEL AS THE BASIS FOR INVESTMENT DECISIONS

Hermin Sirait<sup>1</sup>, Wanda Nur Hanifah<sup>2</sup>, Devi Anggraeni<sup>3</sup>, Shenda Aprilia Christanti<sup>4</sup>

<sup>1,2,3,4</sup> Universitas Darma Persada, Jakarta, Indonesia

Email: herminsirait01@gmail.com<sup>1</sup>, wandaa821dnh@gmail.com<sup>2</sup>,

deviagr03@gmail.com<sup>3</sup>; shendaac@gmail.com<sup>4</sup>

### ABSTRACT

*Calculation and determination the optimal portfolio by Single Index Model method, which involves several stages of calculation. These stages comprise the determination of the optimal portfolio and the identification of the optimal proportion of funds to be invested in the securities that included in the optimal portfolio. This study also presents the results of the return and risk analysis of the optimal portfolio securities. A sample of LQ45 listed, and seven optimal portfolio stocks were identified are Barito Pacific Tbk (BRTP), Medco Energi Internasional Tbk (MEDC), Indofood Sukses Makmur Tbk (INKP), Bank Mandiri (Persero) Tbk (BMRI), Mitra Pack Tbk (PTMP), Essa Industries Indonesia Tbk (ESSA), and GoTo Gojek Tokopedia Tbk (GOTO).*

### KEYWORDS

*Optimal Portfolio, Return, Risk, Securities, Investment, LQ45*



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### INTRODUCTION

Funding, investment and policy decisions are three important decisions in financial management. Investment is an activity of investing capital or funds in the form of money or other valuable assets in the present in an object, institution or other party for a certain period of time for a relatively long period of time in the hope of obtaining profits in the future Investment (Sukirno, 2020). The main hope for investors in investing is of course to obtain the greatest profit, besides that it is necessary to understand and mitigate the existing risks so that they do not significantly affect the expected profits.

Investors are exposed to many combinations of stocks in a portfolio. Investors will choose the optimal portfolio because it is a portfolio formed by optimizing one of two dimensions, namely expected *returns* or portfolio risk. One of the widely used portfolio performance measurement concepts is the result of a combination of portfolio *returns* divided by the risk of the portfolio. Therefore, in particular, the optimal portfolio is the one that provides the highest return combination with the

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lowest risk. The optimal portfolio can also be a portfolio with little risk (Hartono, 2022).

Many stocks are publicly traded so it requires investors to be able to decide on the best stock selection that provides the best returns and the lowest risk. The Indonesia Stock Exchange (IDX) issues stock indices with certain criteria with certain classifications, namely as many as 44 stock index groups such as LQ45, IDX30, IDX80, MNC36, SRI-KEHATI, JII, KOMPAS100 etc. This research will use the LQ45 index, which is 45 companies selected according to the criteria set by the Indonesia Stock Exchange that have high liquidity and large market capitalization and are supported based on fundamental analysis and company development. The existence of this stock index is very helpful for investors to be able to decide the best choice in investing or buying the best company shares in obtaining profits as expected.

This study aims to find out the LQ45 stocks that are included in the optimal portfolio category, and to find out the proportion of funds invested in each LQ45 stock as well as to find out the amount of return and risk and the optimal portfolio of LQ45 shares.

## RESEARCH METHOD

This research is a type of quantitative descriptive research. According to Sugiyono (2022), descriptive research is research to find out the value of an independent variable which does not make a comparison of the variable on other samples, and looks for the relationship between the variable and other variables. This study uses quantitative data in the form of numbers that will be analyzed by statistical methods to test the correctness of the hypothesis.

Meanwhile, the quantitative method according to Sugiyono (2016) can be interpreted as a research method based on the philosophy of positivism, used to research on certain populations or samples, data collection using research instruments, analysis and quantitative/statistical, with the aim of testing hypotheses that have been determined.

### Population and Sample

This study aims to form an optimal portfolio by using a single index model in making investment decisions in companies listed on LQ45 during the period December 2022 to May 2024. The population in this study is all companies listed on the Indonesia Stock Exchange (IDX), and the sample in this study is determined as many as 45 companies with the determination of the sample, namely companies listed in LQ45.

### Data Analysis

The data analysis in this study consists of several stages of calculation, namely:

1. Calculate the realized *return* on each stock using the formula:

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

The realized return on each stock is the current period price of the stock on the  $i$ th share minus the stock price of the past period on the first share and divided by the stock price of the past period on the  $i$ th share. (Hartono, 2022)

2. Calculate *the expected return* on each stock using the formula:

$$E(R_{t(i)}) = \frac{\sum (R_{t(i)})}{n}$$

The expected return of each share is a journal of *the*  $i$ th share realization return divided by the amount of  $i$ th share price data. (Hartono, 2022).

3. Calculate the market realization return on the JCI using the formula:

$$RM_{,t} = \frac{IHSg_t - IHSg_{t-1}}{IHSg_{t-1}}$$

The market realization return from JCI is the stock price of the current period minus the stock price of the past period and divided by the stock price of the past period. (Hartono, 2022).

4. Calculate *the expected market return* on the JCI using the formula:

$$E(= R_{M,t}) = \frac{\sum R_{M,t}}{n}$$

The expected return on JCI is the amount of JCI realized return divided by the amount of JCI stock price data. (Hartono, 2022).

5. Calculate the standard deviation on each stock, JCI, and Bank Indonesia interest rate using:

$$SD = \sqrt{\frac{\sum (R_i - E(R_i))^2}{n-1}}$$

The standard deviation of each stock, JCI, and Bank Indonesia's interest rate is the root of the amount of the  $i$ th realized return minus the *ith expected return* and divided by the amount of  $i$ th data minus one. (Hartono, 2022).

6. Calculate *the beta* on each stock using the formula:

$$\beta_i = \frac{\sigma_{iM}}{\sigma_{iM}^2}$$

Beta is a measure of the volatility between the *return-return* of a security (portfolio) and the *market return-return*. If this volatility is measured by covariance, then the covariance of *return* between the  $i$ th security and the market return is  $\sigma_{iM}$ . If this covariance is related to the relative to market risk (i.e. divided by the market *return* variant  $\sigma_M^2$ ), then this result will measure the risk of the  $i$ th security relative to the market risk or called *beta*. (Hartono, 2022)

7. Calculate *the alpha* on each stock using the formula:

$$\alpha_i = E(R_i) - \beta_i \cdot E(RM)$$

*The alpha* of each share is *the expected return* of the  $i$ th share minus the *beta* of each  $i$ th share multiplied by the *expected return* of the market.

8. Calculate the residual error variant of each stock using the formula:

$$\sigma_{ei}^2 = \beta_i^2 \cdot \sigma_M^2 - \sigma_i^2$$

The unique variant (risk) of each stock is *that the beta* of each stock is multiplied by the market risk and subtracted by the total risk of each stock. (Hartono, 2022).

9. Calculate *the excess return to beta (ERB)* on each stock using the formula:

$$ERB = \frac{E(R_i) - R_{BR}}{\beta_i}$$

Excess return to beta on each share is the expected *return* of the *i*th share minus the *return* of risk-free assets and divided by the *beta* of the *i*th share. *Excess return to beta* means measuring *excess return* relative to a single unit of non-diversifying risk as measured by *beta*. This ERB ratio also shows the relationship between two investment determinants, namely *return* and risk. (Hartono, 2022)

Sorts securities based on the largest ERB value to the smallest ERB value. The securities with the largest ERB value are candidates for inclusion in the optimal portfolio. An optimal portfolio will contain assets that have a high ERB ratio. Assets with low ERB ratios will not be included in the optimal portfolio. Thus, a *cut-off point* is needed which is the limit of how high the ERB value is. (Hartono, 2022).

10. Calculate the value of  $A_i$  on each stock using the formula:

$$A_i = \frac{(E(R_i) - R_{BR}) \cdot \beta_i}{\sigma_{ei}^2}$$

The value of  $A_i$  on each stock is the expected return of the *i*th share minus the return of risk-free assets, then multiplied by *the beta* of the *i*th share after which it is divided by the variant of the *i*th stock residual error. (Hartono, 2022)

11. Calculate the  $B_i$  value of each stock using the formula:

$$B_i = \frac{\beta_i^2}{\sigma_{ei}^2}$$

The value of  $B_i$  on each *beta share* of the *i*th share is divided by the variant of the *i*th security residual error. (Hartono, 2022)

12. Calculate the Cut-off point ( $C_i$ ) value using the formula:

$$C_i = \frac{\sigma M^2 \sum_{j=1}^i A_j}{1 + \sigma M^2 \sum_{j=1}^i B_j}$$

$C_i$  is the value of  $C$  for the *i*th share which is calculated from the accumulation of values  $A_i$  and  $B_{values}$  up to  $B_j$  (Hartono, 2022)

13. Determining *the Cut-off point* ( $C_i$ )

The magnitude of *the cut-off point* ( $C^*$ ) is the value of  $C_i$  where the ERB value last time is still greater than  $C_i$ . 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 a smaller ERB with a point ERB of  $C^*$  are not included in the optimal portfolio formation. (Hartono, 2022)

14. Calculate the proportion of funds in each stock for the optimal portfolio using the formula:

$$w_i = \frac{Z_i}{\sum_{j=1}^k Z_j}$$

The  $Z_i$  value is as follows:

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

In the calculation of the proportion of funds in each optimal portfolio stock, it is to calculate first the value of  $Z_i$  where the calculation is the beta of the *i*th share divided by the variant of the residual error of the *i*th share, after which it is

multiplied by the ERBi of the *i*th share minus the value of the largest cut-off point. (Hartono, 2022).

15. Calculate *the portfolio beta* on each stock using the formula:

$$\beta_p = \sum_{i=1}^n w_i \cdot \beta_i$$

The portfolio beta is the weighted average of the beta of each stock. (Hartono, 2022)

16. Calculate *the portfolio alpha* on each stock using the formula:

$$\alpha_p = \sum_{i=1}^n w_i \cdot \alpha_i$$

Portfolio alpha is a weighted average of alpha

17. Calculate *the expected return of the portfolio* on each stock using the formula:

$$E(R_p) = \alpha_p + \beta_p E(R_M)$$

*The expected return* of the portfolio is the alpha of the portfolio plus the beta of the portfolio multiplied by the expected return. (Hartono, 2022).

18. Calculating Portfolio Risk

on each stock using the formula:

$$\sigma_p^2 = \beta_p^2 \cdot \sigma_M^2 + \left( \sum w_i \cdot \sigma_{ei} \right)^2$$

The portfolio risk on each stock is the beta of the portfolio to the second power multiplied by the market variant, then added to the proportion of funds multiplied by the residual error variant after which it is multiplied by two (Hartono, 2022).

## RESULT AND DISCUSSION

### Overview of Research Objects

This research was carried out based on the shares of companies listed on the Indonesia Stock Exchange as the population and sampling based on companies listed on LQ45, namely 45 companies that meet the LQ45 category.

**Table 1. LQ45 Company List December 2022 – May 2024**

No.	Kode Saham	Perusahaan	No.	Kode Saham	Perusahaan
1	ACES	Ace Hardware Indonesia Tbk	24	INCO	Vale Indonesia Tbk
2	ADRO	Adaro Energy Indonesia Tbk	25	INDF	Indofood Sukses Makmur Tbk
3	AKRA	Akr Corporindo Tbk	26	INKP	Indah Kiat Pulp & Paper Tbk
4	AMRT	Sumber Alfaria Trijaya Tbk	27	INTP	Indocement Tunggul Prakarsa Tbk
5	ANTM	Aneka Tambang Tbk	28	ITMG	Indo Tambangraya Megah Tbk
6	ARTO	Bank Artos Indonesia Tbk	29	KLBF	Kalbe Farma Tbk
7	ASII	Astra International Tbk	30	MAPI	Mitra Adiperkasa Tbk
8	BBCA	Bank Sentral Asia Tbk	31	MBMA	Merdeka Battery Materials Tbk
9	BBNI	Bank Negara Indonesia (Persero) Tbk	32	MDKA	Merdeka Copper Gold Tbk
10	BBRI	Bank Rakyat Indonesia (Persero) Tbk	33	MEDC	Medco Energi Internasional Tbk
11	BBTN	Bank Tabungan Negara (Persero) Tbk	34	MTEL	Dayamitra Telekomunikasi Tbk
12	BMRI	Bank Mandiri (Persero) Tbk	35	PGAS	Perusahaan Gas Negara Tbk
13	BRIS	Bank Syariah Indonesia Tbk	36	PGEO	Pertamina Geothermal Energy Tbk
14	BRPT	Barito Pacific Tbk	37	PTBA	Bukit Asam Tbk
15	BUKA	Bukalapak.com Tbk	38	PTMP	Mitra Pack Tbk
16	CPIN	Charoen Pokphand Indonesia Tbk	39	SIDO	Industri Jamu dan Farmasi Sido Muncul Tbk
17	EMTK	Elang Mahkota Teknologi Tbk	40	SMGR	Semen Indonesia (Persero) Tbk
18	ESSA	Essa Industries Indonesia Tbk	41	SRTG	Saratoga Investama Sedaya Tbk
19	EXCL	XL Axiata Tbk	42	TLKM	Telkom Indonesia (Persero) Tbk
20	GGRM	Gudang Garam Tbk	43	TOWR	Sarana Menara Nusantara Tbk
21	GOTO	GoTo Gojek Tokopedia Tbk	44	UNTR	United Tractors Tbk
22	HRUM	Harum Energy Tbk	45	UNVR	Unilever Indonesia Tbk
23	ICBP	Indofood CBP Sukses Makmur Tbk			

**Source : IDX, Processed by researchers**

The data used in this study is stock data of 45 companies at the close of each month for the period December 2022 to May 2024, which is the period after the Covid19 pandemic, where Indonesia's economic conditions have begun to improve with conditions in the business world starting to increase production, business competition and stock demand and supply are increasing, so an effective and efficient stock portfolio analysis is needed. The following is a table of closing prices for stocks every month for 18 months.

**Table 2. Closing Price of Shares Dec 2022 – May 2024**

Kode Saham	Des-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24
ACES	496	490	505	478	450	630	675	720	730	750	800	755	720	850	835	880	935	820
ADRO	3.850	2.960	2.990	2.900	3.130	2.040	2.230	2.410	2.670	2.850	2.560	2.620	2.380	2.400	2.420	2.700	2.710	2.690
AKRA	1.400	1.310	1.385	1.550	1.620	1.365	1.420	1.385	1.400	1.545	1.490	1.435	1.475	1.620	1.700	1.720	1.675	1.620
AMRT	2.650	2.830	2.900	2.880	2.900	2.640	2.580	2.700	2.900	2.960	2.890	2.870	2.930	2.650	2.750	2.910	2.930	2.800
ANIM	1.985	2.310	1.990	2.090	2.100	1.895	1.950	1.985	1.990	1.815	1.705	1.740	1.705	1.550	1.460	1.600	1.640	1.515
ARTO	3.720	3.210	2.510	2.420	2.070	2.380	3.180	2.910	2.330	2.020	1.575	3.200	2.900	3.210	2.710	2.670	2.150	2.350
ASII	5.700	6.000	6.100	6.000	6.750	6.450	6.775	6.850	6.450	6.225	5.775	5.400	5.650	5.125	5.225	5.150	5.150	4.430
BBCA	8.550	8.475	8.750	8.750	9.050	9.050	9.150	9.125	9.175	8.825	8.750	8.975	9.400	9.550	9.875	10.075	9.800	9.225
BBNI	9.225	9.150	8.775	9.350	9.425	9.050	9.150	8.875	9.175	10.325	4.790	5.275	5.375	5.750	6.000	5.900	5.250	4.530
BBRI	4.940	4.580	4.670	4.730	5.100	5.575	5.425	5.650	5.550	5.225	4.960	5.275	5.725	5.700	6.125	6.090	4.940	4.430
BBTN	1.350	1.360	1.325	1.225	1.245	1.280	1.320	1.315	1.255	1.220	1.225	1.295	1.250	1.305	1.430	1.555	1.320	1.240
BMRU	4.963	4.975	5.000	5.163	5.175	5.050	5.200	5.725	6.025	6.025	5.675	5.850	6.050	6.650	7.000	7.250	6.900	5.725
BRIS	1.290	1.335	1.520	1.680	1.730	1.730	1.690	1.655	1.710	1.625	1.500	1.655	1.740	2.330	2.470	2.710	2.640	2.220
BRPT	755	825	935	825	835	760	745	775	1.070	1.300	1.125	1.045	1.330	1.060	975	945	1.020	1.110
BUKA	262	290	262	248	236	212	212	216	232	218	210	208	216	192	157	152	130	130
CPIN	5.650	5.825	5.375	4.990	4.590	4.950	5.275	5.175	5.175	5.425	5.800	5.200	5.025	4.480	4.840	5.250	4.950	5.200
EMTK	1.030	1.080	950	790	705	595	710	650	570	585	500	645	590	464	470	436	386	432
ESSA	915	990	1.070	945	700	488	580	590	605	795	600	555	530	492	515	675	780	800
EXCL	2.140	2.300	2.090	1.980	1.750	1.985	1.955	2.270	2.500	2.380	2.270	2.120	2.000	2.320	2.380	2.260	2.470	2.420
GGRM	18.000	23.000	25.000	26.000	28.450	27.000	27.625	27.925	24.050	24.600	23.275	21.125	20.325	19.700	20.325	19.900	18.225	19.150
GOTO	91	112	118	109	104	147	110	113	96	85	60	97	86	88	71	69	63	71
HRUM	1.620	1.730	1.630	1.460	1.510	1.410	1.420	1.660	1.560	1.885	1.615	1.385	1.335	1.175	1.250	1.350	1.410	1.375
ICBP	10.000	10.100	10.125	9.975	10.575	11.700	11.325	11.200	11.075	10.350	11.550	10.575	11.775	11.550	11.600	10.875	10.400	10.400
INCO	7.100	7.425	6.825	6.650	6.975	6.300	6.300	6.875	5.900	5.650	4.950	4.500	4.310	3.870	4.050	4.070	4.250	5.075
INDF	6.725	6.725	6.475	6.200	6.450	7.100	7.350	7.325	7.100	6.625	6.650	6.425	6.450	6.375	6.625	6.375	6.250	6.075
INKP	8.725	8.325	7.925	7.500	7.775	6.900	8.500	9.150	9.100	11.100	9.600	8.775	8.325	7.825	8.725	9.575	9.375	9.500
INTP	9.900	10.000	11.125	10.525	10.850	9.900	9.925	10.425	10.700	9.950	9.275	10.200	9.400	9.025	9.075	8.750	7.750	6.625
ITMG	39.025	36.200	37.200	39.400	33.300	22.125	24.125	27.200	28.925	28.975	26.525	24.550	25.650	27.050	26.200	26.700	25.225	24.350
KLBF	2.090	2.060	2.110	2.100	2.120	2.030	2.050	1.915	1.815	1.755	1.690	1.615	1.610	1.510	1.490	1.475	1.455	1.520
MAPI	1.445	1.300	1.510	1.510	1.370	1.775	1.690	1.980	1.935	1.820	1.735	1.745	1.790	1.955	1.920	1.820	1.575	1.305
MBMA						755	810	745	810	805	670	635	560	660	610	492	550	660
MDKA	4.120	4.720	4.540	4.190	3.940	3.000	3.060	3.510	3.380	2.880	2.230	2.530	2.700	2.700	2.260	2.280	2.630	2.870
MEDC	1.015	1.395	1.150	1.010	1.010	905	890	1.130	1.070	1.610	1.275	1.155	1.155	1.220	1.310	1.430	1.350	1.410
MTEL	800	675	690	705	700	655	665	655	750	680	620	720	705	680	635	615	570	605
PGAS	1.760	1.545	1.565	1.380	1.430	1.430	1.305	1.365	1.375	1.375	1.255	1.115	1.130	1.165	1.090	1.360	1.470	1.610
PGEO				695	755	910	875	850	1.380	1.445	1.415	1.055	1.170	1.310	1.210	1.175	1.220	1.255
PTBA	3.690	3.400	3.860	3.990	4.140	3.060	2.680	2.770	2.860	2.800	2.480	2.420	2.440	2.610	2.560	2.970	3.030	2.490
PTMP				165	98	101	151	121	175	194	141	202	212	212	292	156	124	128
SIDO	755	755	880	870	790	725	730	640	620	590	510	500	525	510	615	620	730	705
SMGR	6.575	7.400	7.225	6.300	5.950	5.800	6.075	6.975	6.800	6.425	6.100	6.500	6.400	6.200	6.100	5.900	4.670	3.750
SRTG	2.530	2.430	2.360	1.985	1.895	1.550	1.670	1.610	1.665	1.760	1.430	1.635	1.640	1.510	1.575	1.445	1.410	1.480
TLKM	3.750	3.850	3.880	4.060	4.250	4.040	4.000	3.720	3.730	3.750	3.490	3.760	3.950	3.960	4.000	3.470	3.170	2.840
TOWR	1.100	1.120	1.050	925	1.025	990	1.055	1.015	1.030	960	890	1.000	990	890	920	860	805	715
UNTR	26.075	24.550	27.900	29.100	28.900	22.225	23.275	27.525	26.000	28.250	25.125	21.900	22.625	22.950	23.525	24.175	24.825	22.300
UNVR	4.700	4.660	4.180	4.350	4.400	4.530	4.260	3.850	3.670	3.740	3.620	3.650	3.530	3.100	2.730	2.700	2.620	3.080

Source : IDX, Processed by researchers, 2024

The process of forming an optimal portfolio of stocks using the Single Index model consists of several stages of calculation, namely determining the company's shares that fall into the optimal portfolio category, calculating the amount of funds to be invested in each stock, and calculating the amount of *return and* optimal portfolio risk.

### Calculation and Determination of Optimal Portfolio

The process of calculating and determining stocks in the optimal portfolio category is based on *the ERB (Excess Return to Beta)* value. If *the ERB value is*  $\geq C_i$ , the stock is in accordance with the optimal portfolio criteria. On the other hand, stocks with *an ERB value of*  $< C_i$  do not meet the optimal portfolio criteria of stocks.

ERB calculation is based on *the Expected Return on Asset* of the portfolio.  $C_i$  is a component of *returns* that is associated with the unique risk of a portfolio that is part of the *return* that cannot be explained by the systematic factors that affect the market as a whole.

The stage of calculating *the ERB* and  $C_i$  values is to calculate the realized return, *expected return*, and standard deviation of each stock. Calculation of

realized return by calculating the change in stock price in one period compared to the previous period.

**Table 3. Return on Realization of Company Shares LQ45 Dec 2022 – May 2024**

Bulan/ Tahun	Des-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24
ACES		-0.01	0.03	-0.05	-0.06	0.40	0.07	0.07	0.01	0.03	0.07	-0.06	-0.05	0.18	-0.02	0.05	0.05	-0.12
ADRO		-0.23	0.01	-0.03	0.08	-0.35	0.09	0.08	0.11	0.07	-0.10	0.02	-0.09	0.01	0.01	0.12	0.02	-0.01
AKRA		-0.06	0.06	0.12	0.05	-0.16	0.04	-0.02	0.01	0.10	-0.04	-0.04	0.03	0.10	0.05	0.01	-0.03	-0.03
AMRT		0.07	0.02	-0.01	0.01	-0.09	-0.02	0.05	0.07	0.02	-0.02	-0.01	0.02	-0.10	0.04	0.06	0.01	-0.04
ANTM		0.16	-0.14	0.05	0.00	-0.10	0.03	0.02	0.00	-0.09	-0.06	0.02	-0.02	-0.09	-0.05	0.10	0.03	-0.08
ARTO		-0.14	-0.22	-0.04	-0.14	0.15	0.34	-0.08	-0.20	-0.13	-0.22	1.03	-0.09	0.11	-0.16	-0.01	-0.19	0.09
ASII		0.05	0.02	-0.02	0.13	-0.04	0.05	0.01	-0.06	-0.03	-0.07	-0.06	0.05	-0.09	0.02	-0.01	0.02	-0.14
BBCA		-0.01	0.03	0.00	0.03	0.00	0.01	0.00	0.01	-0.04	-0.01	0.03	0.05	0.02	0.03	0.02	-0.03	-0.06
BBNI		-0.01	-0.04	0.07	0.01	-0.04	0.01	-0.03	0.03	0.13	-0.54	0.10	0.02	0.07	0.04	-0.02	-0.11	-0.14
BBRI		-0.07	0.02	0.01	0.08	0.09	-0.03	0.04	-0.02	-0.06	-0.05	0.06	0.09	0.00	0.07	-0.01	-0.18	-0.10
BBTN		0.01	-0.03	-0.08	0.02	0.03	0.03	0.00	-0.05	-0.03	0.00	0.06	-0.03	0.04	0.10	0.09	-0.15	-0.06
BMRI		0.00	0.01	0.03	0.00	-0.02	0.03	0.10	0.05	0.00	-0.06	0.03	0.03	0.10	0.05	0.04	-0.05	-0.17
BRIS		0.03	0.14	0.11	0.03	0.00	-0.02	-0.02	0.03	-0.05	-0.08	0.10	0.05	0.34	0.05	0.10	-0.03	-0.16
BRPT		0.09	0.13	-0.12	0.01	-0.09	-0.02	0.04	0.38	0.21	-0.13	-0.07	0.27	-0.20	-0.08	-0.03	0.08	0.09
BUKA		0.11	-0.10	-0.05	-0.05	-0.10	0.00	0.02	0.07	-0.06	-0.04	-0.01	0.04	-0.11	-0.18	-0.03	-0.14	0.00
CPIN		0.03	-0.08	-0.07	-0.08	0.08	0.07	-0.02	0.00	0.05	0.07	-0.10	-0.03	-0.11	0.08	0.08	-0.05	0.05
EMTK		0.05	-0.12	-0.17	-0.11	-0.16	0.19	-0.08	-0.12	0.03	-0.15	0.29	-0.09	-0.21	0.01	-0.07	-0.11	0.12
ESSA		0.08	0.08	-0.12	-0.26	-0.30	0.19	0.02	0.03	0.31	-0.25	-0.08	-0.05	-0.07	0.05	0.31	0.16	0.03
EXCL		0.07	-0.09	-0.05	-0.12	0.13	-0.02	0.16	0.10	-0.05	-0.05	-0.07	-0.05	0.16	0.03	-0.05	0.09	-0.02
GGRM		0.28	0.09	0.04	0.09	-0.05	0.02	0.01	-0.14	0.02	-0.05	-0.09	-0.04	-0.03	0.03	-0.02	-0.08	0.05
GOTO		0.23	0.05	-0.08	-0.05	0.41	-0.25	0.03	-0.15	-0.11	-0.25	0.62	-0.11	0.02	-0.19	-0.03	-0.09	0.13
HRUM		0.07	-0.06	-0.10	0.03	-0.07	0.01	0.17	-0.06	0.21	-0.14	-0.14	-0.04	-0.12	0.05	0.08	0.04	-0.02
ICBP		0.01	0.00	-0.01	0.06	0.11	-0.03	-0.01	0.00	-0.01	-0.07	0.12	-0.08	0.11	-0.02	0.00	-0.06	-0.04
INCO		0.05	-0.08	-0.03	0.05	-0.10	0.00	0.09	-0.14	-0.04	-0.12	-0.09	-0.04	-0.10	0.05	0.00	0.04	0.19
INDF		0.00	-0.04	-0.04	0.04	0.10	0.04	0.00	-0.03	-0.07	0.00	-0.03	0.00	-0.01	0.04	-0.04	-0.02	-0.03
INKP		-0.05	-0.05	-0.05	0.04	-0.11	0.23	0.08	-0.01	0.22	-0.14	-0.09	-0.05	-0.06	0.12	0.10	-0.02	0.01
INTP		0.01	0.11	-0.05	0.03	-0.09	0.00	0.05	0.03	-0.07	-0.07	0.10	-0.08	-0.04	0.01	-0.04	-0.11	-0.15
ITMG		-0.07	0.03	0.06	-0.15	-0.34	0.09	0.13	0.06	0.00	-0.08	-0.07	0.04	0.05	-0.03	0.02	-0.06	-0.03
KLBF		-0.01	0.02	0.00	0.01	-0.04	0.01	-0.07	-0.05	-0.03	-0.04	-0.04	0.00	-0.05	-0.01	-0.01	-0.01	0.04
MAPI		-0.10	0.16	0.00	-0.09	0.30	-0.05	0.17	-0.02	-0.06	-0.05	0.01	0.03	0.09	-0.02	-0.05	-0.13	-0.17
MBMA							0.07	-0.08	0.09	-0.01	-0.17	-0.05	-0.12	0.18	-0.08	-0.19	0.12	0.20
MDKA		0.15	-0.04	-0.08	-0.06	-0.24	0.02	0.15	-0.04	-0.15	-0.23	0.13	0.07	0.00	-0.16	0.01	0.15	0.09
MEDC		0.37	-0.18	-0.12	0.00	-0.10	-0.02	0.27	-0.05	0.50	-0.21	-0.09	0.00	0.05	0.07	0.09	-0.06	0.04
MTEL		-0.15	0.02	0.02	-0.01	-0.05	0.02	-0.02	0.15	-0.09	-0.09	0.15	-0.02	-0.04	-0.07	-0.03	-0.07	0.06
PGAS		-0.12	0.01	-0.12	0.04	0.00	-0.09	0.05	0.01	0.00	-0.09	-0.11	0.01	0.03	-0.05	0.25	0.08	0.10
PGeo					0.09	0.21	-0.04	-0.03	0.52	0.05	-0.02	-0.25	0.11	0.12	-0.08	-0.03	0.04	0.03
PTBA		-0.08	0.14	0.03	0.04	-0.25	-0.12	0.03	0.03	-0.02	-0.11	-0.02	0.01	0.07	-0.02	0.15	0.02	-0.18
PTMP					-0.41	0.03	0.50	-0.20	0.45	0.11	-0.27	0.43	0.05	0.38	-0.47	-0.21	0.03	
SIDO		0.00	0.17	-0.01	-0.09	-0.08	0.01	-0.12	-0.03	-0.05	-0.14	-0.02	0.05	-0.03	0.21	0.01	0.18	-0.03
SMGR		0.13	-0.02	-0.13	-0.05	-0.03	0.05	0.15	-0.03	-0.05	-0.05	0.07	-0.02	-0.03	-0.02	-0.03	-0.21	-0.20
SRTG		-0.04	-0.03	-0.16	-0.05	-0.18	0.08	-0.04	0.03	0.05	-0.19	0.14	0.00	-0.08	0.04	-0.08	-0.02	0.05
TUMR		0.03	0.01	0.05	0.05	-0.05	-0.01	-0.07	0.00	0.01	-0.07	0.08	0.05	0.00	0.01	-0.13	-0.05	-0.10
TOWR		0.02	-0.05	-0.12	0.11	-0.03	0.07	-0.04	0.01	-0.07	0.12	-0.01	-0.10	0.03	-0.07	-0.05	-0.11	
UNTR		-0.06	0.14	0.04	-0.01	-0.23	0.05	0.18	-0.05	0.09	-0.11	-0.13	0.03	0.01	0.03	0.03	0.03	-0.10
UNVR		-0.01	-0.10	0.04	0.01	0.03	-0.06	-0.10	-0.05	0.02	-0.03	0.01	-0.03	-0.12	-0.12	-0.01	-0.03	0.18

Source : Processed by researchers, 2024

Expected return is a profit that is expected in the future (has not yet happened). Expected return calculation is based on the expected stock profit rate on a particular day (future) and the market profit rate in that period. After calculating the Expected return, the next calculation is to calculate the Standard Deviation by measuring the level of volatility or risk of the entire investment portfolio. The Deviation Standard shows how far or how close the realized results or returns of the portfolio are. The standard deviation shows how much the portfolio returns fluctuate or vary relative to its historical average. The higher the standard deviation, the greater the variability of investment returns from the average value or expected return. The following is a table of Expected return calculations and standard deviations in table 3.

**Table 3. Expected Return and Standard Deviation of LQ45 Companies**



K o d e S a h a m	E ( R )	
	E x p e c t e d	S t a n d a r D e v i a s i
ACES	0.04	0.11
ADRO	-0.01	0.12
AKRA	0.01	0.07
AMRT	0.00	0.05
ANTM	-0.01	0.08
ARTO	0.01	0.30
ASII	-0.01	0.06
BBCA	0.00	0.03
BBNI	-0.03	0.14
BBRI	0.00	0.07
BBTN	0.00	0.06
BMRI	0.01	0.06
BRIS	0.04	0.10
BRPT	0.03	0.15
BUKA	-0.04	0.07
CPIN	0.00	0.07
EMTK	-0.04	0.13
ESSA	0.01	0.17
EXCL	0.01	0.09
GGRM	0.01	0.09
GOTO	0.01	0.23
HRUM	0.00	0.10
ICBP	0.00	0.06
INCO	-0.02	0.09
INDF	-0.01	0.04
INKP	0.01	0.10
INTP	-0.02	0.07
ITMG	-0.02	0.11
KLBF	-0.02	0.03
MAPI	0.00	0.12
MBMA	0.00	0.13
MDKA	-0.01	0.12
MEDC	0.03	0.18
MTEL	-0.01	0.08
PGAS	0.00	0.09
PGEO	0.06	0.19
PTBA	-0.02	0.10
PTMP	0.03	0.32
SIDO	0.00	0.10
SMGR	-0.03	0.09
SRTG	-0.03	0.09
TLKM	-0.01	0.06
TOWR	-0.02	0.07
UNTR	0.00	0.10
UNVR	-0.02	0.07

Source : Processed by researchers, 2024

Investors will prioritize stocks with a positive expected return (ER) value (above 0). Based on table 4.3 Stocks with values above 0 are 14 company stocks with the highest ER value are PGEO at 0.06, BRIS and ACES with an ER value of 0.04, MEDC, BRPT, PTMP with an ER value of 0.03, EXCL. AKRA, BMRI, INKP, GOTO, ESSA, GGRM, ARTO with an ER value of 0.01.

Standard deviation to determine the risk of expected stock returns. Investors will certainly consider stocks with the lowest standard deviation. Based on table 3, stocks with positive ER values have varying Standard Deviation values. Table 4 shows 14 stocks with a positive ER value and standard deviation of each stock.

Table 4. Expected Return with Positive Value and LQ45 Company Deviation Standard

Kode Saham	E (R ) Expected Return	Standar Deviasi
PGEO	0.06	0.19
BRIS	0.04	0.10
ACES	0.04	0.11
MEDC	0.03	0.18
BRPT	0.03	0.15
PTMP	0.03	0.32
EXCL	0.01	0.09
AKRA	0.01	0.07
BMRI	0.01	0.06
INKP	0.01	0.10
GOTO	0.01	0.23
ESSA	0.01	0.17
GGRM	0.01	0.09
ARTO	0.01	0.30

**Source : Processed by researchers, 2024**

Based on the table above, PGEO with the highest ER value of 0.06 has a standard deviation value of 0.19, BRIS and ACES with an ER value of 0.04 have different standard deviation values, namely BRIS 0.10 and ACES of 0.11, MEDC, BRPT, PTMP with an ER value of 0.03 also have different standard deviation values, namely the PTMP standard deviation of 0.32, MDEC 0.18 and BRPT 0.15. EXCL. AKRA, BMRI, INKP, GOTO, ESSA, GGRM, ARTO with an ER value of 0.01 also have different deviation standards, namely AKRA 0.07, BMRI 0.06, INKP 0.10, GOTO 0.23, ESSA 0.17, GGRM 0.09, ARTO 0.30. This indicates that the stocks with the highest ER value do not have the lowest deviation. In the calculation of the LQ45 company's Standard Deviation, the stock with the lowest standard deviation of 0.06 is BMRI with an ER of 0.01. Investors certainly take into account the balance between the expected return and the level of risk of each investment. However, it must also consider the ER and JCI and SBI Deviation Standards in calculating the optimal portfolio.

The calculation of the JCI and SBI Deviation Standards and Expected Return  $E(R_M)$  based on the closing data of JCI and SBI every month in the period Dec 2022 to May 2024 is shown in table 4.5 and table 4.6.

**Table 5. Closing Prices of JCI and SBI for the Period Dec 2022 to May 2024**

Bulan/Tahun	Harga Penutupan dan SBI	
	IHSG	SBI
Des-22	6,850.62	5.50%
Jan-23	6,839.34	5.75%
Feb-23	6,843.24	5.75%
Mar-23	6,805.28	5.75%
Apr-23	6,915.72	5.75%
May-23	6,633.26	5.75%
Jun-23	6,661.88	5.75%
Jul-23	6,931.36	5.75%
Aug-23	6,953.26	5.75%
Sep-23	6,939.89	5.75%
Oct-23	6,752.21	5.75%
Nov-23	7,080.74	6.00%
Dec-23	7,272.80	6.00%
Jan-24	7,207.94	6.00%
Feb-24	7,316.11	6.00%
Mar-24	7,288.81	6.00%
Apr-24	7,257.12	6.00%
May-24	7,132.61	6.00%

Source : IDX, Processed by researchers, 2024

Table 6. Deviation Standards and E(R<sub>M</sub>) JCI and SBI

	IHSG	SBI
E (RM)	0.26%	0.49%
Standar Deviasi	2.17%	0.01%

Source : IDX, Processed by researchers, 2024

Based on table 6, the JCI Expected Return is 0.26% per month with a standard deviation of 2.17% per month. Meanwhile, the calculation of SBI's expected return is 0.49% per month and the standard deviation is 0.01% per month. This shows that the expected return on investment in the IDX is smaller than that of investment in SBI, and the risk of investment in the IDX is greater than that of SBI. The value of the expected return of JCI and SBI proves that investing in the Indonesia Stock Exchange provides greater returns compared to investing in SBI.

The optimal portfolio calculation process by calculating Beta, Alpha, Unique Risk, and ERB. Beta calculates the sensitivity/volatility between the return-return of a security and the market return-return. If volatility is measured by covariance, then the covariance of return between the *i*th security and the market return is  $\sigma_{iM}$ . If this covariance is correlated with relative to market risk (i.e. divided by the market return variant  $\sigma_M^2$ ), then this result will measure the risk of the *i*th security relative to market risk.  $\beta_i$  is the sensitivity of a portfolio to the movement of the market index and the regression coefficient that measures how strong the relationship between the price movement of an asset or portfolio and the movement of the market index is.

Alpha is the difference between the yield of each stock return and the market return compared. The alpha calculation of each stock is the expected return of the

ith share minus the beta of each ith share multiplied by the expected return of the market. The  $\alpha$  value is the expected return of an investment or portfolio and describes how much return is expected from the portfolio when the market performs as much as the market index.

Variance Error or Unique Risk is a variant of stocks. The calculation of the unique variant (risk) of each stock is the beta of each stock multiplied by the market risk and subtracted by the total risk of each stock

Excess Return to Beta (ERB) is the difference between expected return and free assets. The calculation of excess return to beta on each stock is the expected return of the ith share minus the return of risk-free assets and divided by the beta of the ith share. Excess return to beta means measuring excess return relative to one unit of non-diversifying risk as measured by beta. The ERB ratio also shows the relationship between two factors that determine investment, namely return and risk

**Tabel 7. Beta, Alpha, Variance Error Residual dan ERB**

No.	Emiten	Beta	Alpha	Varian Error	ERB	No.	Emiten	Beta	Alpha	Varian Error	ERB
1	MEDC	1.6491	0.0301	0.0342	0.0179	24	BBNI	3.0177	-0.0339	0.0206	-0.0102
2	BRPT	1.4697	0.0295	0.0225	0.0194	25	EMTK	2.6008	-0.0480	0.0178	-0.0177
3	PTMP	6.0481	0.0168	0.1011	0.0033	26	ANTM	0.9911	-0.0155	0.0056	-0.0180
4	INKP	1.0753	0.0073	0.0107	0.0049	27	BUKA	0.8502	-0.0398	0.0054	-0.0499
5	BMRI	1.4603	0.0066	0.0038	0.0038	28	BRIS	0.7989	0.0354	0.0110	0.0408
6	ESSA	1.2769	0.0044	0.0304	0.0022	29	AKRA	0.6998	0.0091	0.0045	0.0086
7	GOTO	1.4937	0.0042	0.0515	0.0021	30	INCO	0.5821	-0.0174	0.0073	-0.0357
8	AMRT	1.0395	0.0017	0.0023	-0.0005	31	BBCA	0.5743	0.0034	0.0007	0.0000
9	BBRI	1.2339	-0.0068	0.0053	-0.0069	32	SIDO	0.5314	-0.0010	0.0093	-0.0084
10	HRUM	1.0152	-0.0074	0.0100	-0.0094	33	BBTN	0.4611	-0.0043	0.0036	-0.0174
11	ARTO	4.8701	-0.0077	0.0878	0.0000	34	ICBP	0.0982	0.0038	0.0035	-0.0086
12	UNTR	2.0170	-0.0094	0.0097	-0.0044	35	GGRM	-0.1302	0.0079	0.0084	-0.0207
13	ASII	1.0766	-0.0156	0.0039	-0.0164	36	KLBF	-0.1908	-0.0176	0.0009	0.1204
14	MTEL	1.4672	-0.0170	0.0063	-0.0123	37	MAPI	-0.2115	0.0009	0.0135	0.0212
15	TLKM	1.2575	-0.0177	0.0034	-0.0154	38	INDF	-0.4027	-0.0041	0.0016	0.0250
16	ADRO	2.7092	-0.0195	0.0143	-0.0064	39	PGAS	-0.4814	0.0001	0.0084	0.0126
17	MDKA	3.1907	-0.0212	0.0155	-0.0056	40	EXCL	-0.6619	0.0128	0.0078	-0.0093
18	PTBA	2.0799	-0.0225	0.0109	-0.0105	41	UNVR	-0.9784	-0.0196	0.0049	0.0276
19	INTP	1.9709	-0.0260	0.0049	-0.0131	42	CPIN	-1.4082	0.0012	0.0047	0.0052
20	ITMG	2.1735	-0.0265	0.0112	-0.0118	43	MBMA	-1.6983	0.0013	0.0161	0.0042
21	TOWR	1.9073	-0.0275	0.0051	-0.0144	44	ACES	-2.7020	0.0427	0.0096	-0.0114
22	SMGR	2.0884	-0.0335	0.0084	-0.0158	45	PGEO	-3.1938	0.0662	0.0355	-0.0134
23	SRTG	2.5979	-0.0336	0.0080	-0.0122						

Source : Processed by researchers, 2024

It is known that the beta measurement parameter on a portfolio with a value of more than 1 indicates that the portfolio tends to move more strongly or is more sensitive to market changes. Based on the Beta calculation in table 4.7, out of 45 issuers, there are 25 issuers with a Beta value of < 1 and 20 issuers with a Beta

value of  $> 1$ . The highest beta value is PTMP stock with a beta value of 6.0481, which means that if there is a change in market return of X amount, there will also be a change in PTMP share return of 6.0481. Next is ARTO with a Beta value of 4.8701, MDKA with a Beta value of 3.1907, BBNI with a Beta value of 3.0177 and ADRO with a Beta value of 2.7092, as well as 20 other issuers with a Beta value exceeding 1, according to Table 8.

**Table 8. Issuers with a Beta value of  $> 1$**

No.	Emiten	Beta	Alpha	Varian Error	ERB
1	PTMP	6.0481	0.0168	0.1011	0.0033
2	ARTO	4.8701	-0.0077	0.0878	0.0000
3	MDKA	3.1907	-0.0212	0.0155	-0.0056
4	BBNI	3.0177	-0.0339	0.0206	-0.0102
5	ADRO	2.7092	-0.0195	0.0143	-0.0064
6	EMTK	2.6008	-0.0480	0.0178	-0.0177
7	SRTG	2.5979	-0.0336	0.0080	-0.0122
8	ITMG	2.1735	-0.0265	0.0112	-0.0118
9	SMGR	2.0884	-0.0335	0.0084	-0.0158
10	PTBA	2.0799	-0.0225	0.0109	-0.0105
11	UNTR	2.0170	-0.0094	0.0097	-0.0044
12	INTP	1.9709	-0.0260	0.0049	-0.0131
13	TOWR	1.9073	-0.0275	0.0051	-0.0144
14	MEDC	1.6491	0.0301	0.0342	0.0179
15	GOTO	1.4937	0.0042	0.0515	0.0021
16	BRPT	1.4697	0.0295	0.0225	0.0194
17	MTEL	1.4672	-0.0170	0.0063	-0.0123
18	BMRI	1.4603	0.0066	0.0038	0.0038
19	ESSA	1.2769	0.0044	0.0304	0.0022
20	TLKM	1.2575	-0.0177	0.0034	-0.0154
21	BBRI	1.2339	-0.0068	0.0053	-0.0069
22	ASII	1.0766	-0.0156	0.0039	-0.0164
23	INKP	1.0753	0.0073	0.0107	0.0049
24	AMRT	1.0395	0.0017	0.0023	-0.0005
25	HRUM	1.0152	-0.0074	0.0100	-0.0094

Source : Processed by researchers, 2024

Furthermore, in the alpha calculation, if the alpha value is positive, it describes the company's profit level in good condition. On the other hand, if the alpha value is negative, it indicates that the profit level of the company is not in good condition. Based on table 8 out of 25 companies with a Beta value above 1, there are 8 stocks with alpha with a positive value, there are 8 companies with the following data:

**Table 9. Issuers with positive alpha scores**

No.	Emiten	Beta	Alpha	Varian Error	ERB
1	MEDC	1.6491	0.0301	0.0342	0.0179
2	BRPT	1.4697	0.0295	0.0225	0.0194
3	PTMP	6.0481	0.0168	0.1011	0.0033
4	INKP	1.0753	0.0073	0.0107	0.0049
5	BMRI	1.4603	0.0066	0.0038	0.0038
6	ESSA	1.2769	0.0044	0.0304	0.0022
7	GOTO	1.4937	0.0042	0.0515	0.0021
8	AMRT	1.0395	0.0017	0.0023	-0.0005

Source : Processed by researchers, 2024

Stocks with a Beta value above 1 and a positive alpha consist of 8, namely MEDC, BRPT, PTMP, INKP, BMRI, ESSA, GOTO and AMRT. Residual error variance of a stock is a unique risk that can be eliminated by diversification. This unique risk exists only with the Company concerned, so this risk can be diversified. A good diversification strategy can help reduce its impact on the overall portfolio. Focusing on systematic risk (the risk associated with overall market movements) and reducing unique risks can help in building a more balanced portfolio between risk and expected return.

The next stage in the process of forming the optimal portfolio candidate of LQ45 company shares, with the calculation of excess return to beta (ERB). Stocks that are included in the optimal portfolio are stocks that have a high ERB value. So Based on table 10, the ERB calculation will be sorted based on the highest ERB value. The following is the order of LQ45 Company ERB values from highest to lowest:

**Table 10. Issuers in order of ERB value from highest to smallest**

No.	Emiten	Beta	Alpha	Varian Error	ERB
1	<b>BRPT</b>	1.4697	0.0295	0.0225	0.0194
2	<b>MEDC</b>	1.6491	0.0301	0.0342	0.0179
3	<b>INKP</b>	1.0753	0.0073	0.0107	0.0049
4	<b>BMRI</b>	1.4603	0.0066	0.0038	0.0038
5	<b>PTMP</b>	6.0481	0.0168	0.1011	0.0033
6	<b>ESSA</b>	1.2769	0.0044	0.0304	0.0022
7	<b>GOTO</b>	1.4937	0.0042	0.0515	0.0021
8	<b>AMRT</b>	1.0395	0.0017	0.0023	-0.0005

**Source : Processed by researchers, 2024**

The optimal portfolio is determined with the highest ERB value as well as positive Beta and alpha values. Based on table 10, the issuer with the highest score is KLBF with an ERB value of 0.1204, but KLBF has a negative Beta and alpha value, so KLBF does not meet the optimal portfolio criteria.

To determine an issuer by meeting the optimal portfolio criteria, a cut-off point (C\*) is required, which is a value limit that states the number of times the highest ERB value is above it. An ERB value below the cut-off point (C\*) value will be excluded or not included in the optimal portfolio criteria. The cut-off point (C\*) value is calculated by calculating the Ci value of each share. Ci in a portfolio usually refers to the correlation coefficient between the returns of two assets in a portfolio. The largest Ci value is the value limit or cut-off point (C\*). The following is the result of the calculation of the Company's Ci Shares LQ45.

**Table 11. Ci Values**

No.	Emiten	Beta	Alpha	Varian Error	ERB	Ci
1	<b>BRPT</b>	1.4697	0.0295	0.0225	0.0194	0.0131
2	<b>MEDC</b>	1.6491	0.0301	0.0342	0.0179	0.0113
3	<b>INKP</b>	1.0753	0.0073	0.0107	0.0049	0.0034
4	<b>BMRI</b>	1.4603	0.0066	0.0038	0.0038	0.0035
5	<b>PTMP</b>	6.0481	0.0168	0.1011	0.0033	0.0029
6	<b>ESSA</b>	1.2769	0.0044	0.0304	0.0022	0.0012
7	<b>GOTO</b>	1.4937	0.0042	0.0515	0.0021	0.0010
8	<b>AMRT</b>	1.0395	0.0017	0.0023	-0.0005	-0.0004

Source : Processed by researchers, 2024

Based on table 11 Ci Value of LQ45 Company Shares, the highest Ci is 0.568 which means the cut-off point (C8) is 0.568. Stocks that are included in the optimal portfolio are stocks that have an ERB value greater than or equal to the ERB value of Ci. on the other hand, stocks with an ERB value less than Ci are not included in the optimal portfolio, or can be written as follows:

If  $ERB > Ci$ , then the stock is included in the optimal portfolio.

If  $ERB < Ci$ , then the stock is not included in the optimal portfolio.

The following is a table of results of the comparison of ERB and Ci values of each stock:

**Table 12. Comparison of ERB and Ci Values**

No.	Emiten	Beta	Alpha	Varian Error	ERB	Ci	Optimal/Tidak Optimal
1	<b>BRPT</b>	1.4697	0.0295	0.0225	0.0194	0.0131	Optimal
2	<b>MEDC</b>	1.6491	0.0301	0.0342	0.0179	0.0113	Optimal
3	<b>INKP</b>	1.0753	0.0073	0.0107	0.0049	0.0034	Optimal
4	<b>BMRI</b>	1.4603	0.0066	0.0038	0.0038	0.0035	Optimal
5	<b>PTMP</b>	6.0481	0.0168	0.1011	0.0033	0.0029	Optimal
6	<b>ESSA</b>	1.2769	0.0044	0.0304	0.0022	0.0012	Optimal
7	<b>GOTO</b>	1.4937	0.0042	0.0515	0.0021	0.0010	Optimal
8	<b>AMRT</b>	1.0395	0.0017	0.0023	-0.0005	-0.0004	Tidak optimal

Source : Data Processed by Researchers, 2024

Stocks with an ERB value higher than Ci are included in the optimal portfolio. Based on Table 12 above, there are 7 stocks included in the optimal portfolio, namely Barito Pacific Tbk. (BRPT), Medco Energi Internasional Tbk. (MEDC), Indofood Sukses Makmur Tbk (INKP), Bank Mandiri (Persero) Tbk. (BMRI), Mitra Pack Tbk (PTMP), Essa Industries Indonesia Tbk (ESSA), GoTo Gojek Tokopedia Tbk (GOTO).

### Determination of the Proportion of Investment Funds

Investors also need information about the appropriate proportion of funds to invest in stocks that are included in the optimal portfolio. Calculation of the proportion of funds (Wi) that are suitable for investment in each stock. The calculation of the proportion of funds (Wi), previously calculated the weighted scale on each stock (Zi). Zi is calculated by dividing beta by unique risk and then

times (ERB result minus Ci). Calculate Wi by the total Zi divided by Zi. The following is a table of the calculation results of the weighted scale and the proportion of funds for each share.

**Table 13. Optimal Proportion of Stock Funds**

No.	Emiten	Beta	Alpha	Varian Error	ERB	Ci	Optimal/Tidak Optimal	Zi	Wi	Wi (%)
1	<b>BMRI</b>	1.4603	0.0066	0.0038	0.0038	0.0047	Optimal	0.110873	0.102406	10%
2	<b>BRPT</b>	1.4697	0.0295	0.0225	0.0194	0.0113	Optimal	0.411115	0.379721	38%
3	<b>ESSA</b>	1.2769	0.0044	0.0304	0.0022	0.0033	Optimal	0.042748	0.039483	4%
4	<b>GOTO</b>	1.4937	0.0042	0.0515	0.0021	0.0035	Optimal	0.032025	0.029579	3%
5	<b>INKP</b>	1.0753	0.0073	0.0107	0.0049	0.0035	Optimal	0.145931	0.134787	13%
6	<b>MEDC</b>	1.6491	0.0301	0.0342	0.0179	0.0034	Optimal	0.317576	0.293324	29%
7	<b>PTMP</b>	6.0481	0.0168	0.1011	0.0033	0.0010	Optimal	0.02241	0.020699	2%

Source : Data Processed by Researchers, 2024

Based on the calculation of the proportion of investment funds in optimal stocks according to table 13, the proportion of optimal portfolio stocks, investors can make decisions in investing in optimal stocks with a proportion, namely Barito Pacific Tbk (BRTP) shares with the highest proportion of 38%. In addition, other optimal stocks are Medco Energi Internasional Tbk (MEDC) with a proportion of 29%, Indah Kiat Pulp & Paper Tbk with a proportion of 13%, Bank Mandiri (Persero) Tbk with a proportion of 10%, Essa Industries Indonesia Tbk (ESSA) with a proportion of 4%, GoTo Gojek Tokopedia Tbk (GOTO) with a proportion of 3%, and Mitra Pack Tbk (PTMP) with a proportion of 2%. With the calculation of this proportion, investors can make the right diversification decisions in investing by considering all aspects such as risk management, financial objectives and reconciliation with risk tolerance which is the proportion of funds in the portfolio must be in line with the investor's risk tolerance.

**Return and Risk of Optimal Stock Portfolio**

Next, calculate the amount of return and risk from the optimal portfolio of stocks. Expected Return The optimal stock portfolio is calculated by calculating the portfolio alpha and portfolio beta multiplied by the proportion (Wi). The following is a table for calculating the optimal portfolio return.

**Table 14. Optimal Portfolio Beta and alpha Calculations**

No.	Emiten	Beta ( $\beta_i$ )	Alpha ( $\alpha_i$ )	Wi	$\beta_p$	$\alpha_p$
1	<b>BMRI</b>	1.4603	0.0066	0.1024	0.150	0.001
2	<b>BRPT</b>	1.4697	0.0295	0.3797	0.558	0.011
3	<b>ESSA</b>	1.2769	0.0044	0.0395	0.050	0.000
4	<b>GOTO</b>	1.4937	0.0042	0.0296	0.044	0.000
5	<b>INKP</b>	1.0753	0.0073	0.1348	0.145	0.001
6	<b>MEDC</b>	1.6491	0.0301	0.2933	0.484	0.009
7	<b>PTMP</b>	6.0481	0.0168	0.0207	0.125	0.000
					1.5561	0.0224

Source : Data Processed by Researchers, 2024



Based on table 4.13 above, the optimal *Expected Return* of stocks can be calculated as follows:

$$E() = + E()R_p \alpha_p \beta_p R_M$$

$$E() = 0.0224 + 1.5561 \cdot 0,0026R_p$$

$$E() = 0.0224 + 0.004061R_p$$

$$E() = 0.0264R_p$$

The results of the calculation of Expected Return E (Rp) on the optimal stock portfolio show that the expected return on the seven optimal stocks is 0.0264 or 2.64%. This expected return value is higher than the expected market value of 0.0026 (0.26%) or expected return risk free of 0.0049. A high expected return will influence investors' decision to invest in the stocks of companies that fall into the optimal portfolio.

After knowing the optimal portfolio return of stocks, the next thing to do is to take into account the risks of the optimal portfolio of stocks. In the calculation of stock portfolio risk, it begins with the beta value squared, market risk and unique risk of the portfolio. Below is a table of calculation of the optimal portfolio risk of stocks.

**Table 15. Optimal Portfolio Risk Calculation**

No.	Emiten	Beta (b)	Alpha (a)	Varian Error ( $\sigma^2_{ei}$ )	proporsional (wi)	$\sigma^2_{ei} \cdot w_i$	$b_p$
1	BMRI	1.4603	0.0066	0.0038	0.1024	0.0004	0.14955
2	BRPT	1.4697	0.0295	0.0225	0.3797	0.0086	0.55807
3	ESSA	1.2769	0.0044	0.0304	0.0395	0.0012	0.05042
4	GOTO	1.4937	0.0042	0.0515	0.0296	0.0015	0.04418
5	INKP	1.0753	0.0073	0.0107	0.1348	0.0014	0.14493
6	MEDC	1.6491	0.0301	0.0342	0.2933	0.0100	0.48371
7	PTMP	6.0481	0.0168	0.1011	0.0207	0.0021	0.12519
				<b>0.2542</b>	<b>1.0000</b>	<b>0.0252</b>	<b>1.5561</b>

Source : Data Processed by Researchers, 2024

$$\sigma_p^2 = \beta_p^2 \cdot \sigma_M^2 + (\sum_{i=1}^n w_i \cdot \sigma_{ei})^2$$

$$\sigma_p^2 = [(1,5561)]^2 \cdot (0,00261) + ([0,0252])^2$$

$$\sigma_p^2 = 2.421447 \cdot 0.00261 + 0.00063504$$

$$\sigma_p^2 = 0.00632 + 0.00063504$$

$$\sigma_p^2 = 0.00695502$$

$$\sigma_p^2 = 0.69\%$$

The calculation results from the table above show that the portfolio risk calculated from the three LQ45 stocks that are included in the optimal portfolio is 0.006955 or 0.69%. Compared to a portfolio return of 2.64% greater than the optimal portfolio risk.

## CONCLUSION

Based on the results of the analysis of the formation of the optimal portfolio of LQ45 companies using a single index model for the 2020-2022 period, the optimal portfolio of stocks consists of 7 optimal portfolio stocks, namely Barito Pacific Tbk. (BRTP), Medco Energi Internasional Tbk. (MEDC), Indofood Sukses Makmur Tbk (INKP), Bank Mandiri (Persero) Tbk. (BMRI), Mitra Pack Tbk (PTMP), Essa Industries Indonesia Tbk (ESSA), GoTo Gojek Tokopedia Tbk (GOTO). The highest proportion is Barito Pacific Tbk (BRTP) with 38%, Medco Energi Internasional Tbk (MEDC) with a proportion of 29%, Indah Kiat Pulp & Paper Tbk with 13%, Bank Mandiri (Persero) Tbk with 10%, Essa Industries Indonesia Tbk (ESSA) with a proportion of 4%, GoTo Gojek Tokopedia Tbk (GOTO) and Mitra Pack Tbk (PTMP) with a proportion of 3% and 2% respectively. In seven stocks, the optimal Portfolio Expected Return E (Rp) is 0.0264 or 2.64% and the optimal portfolio risk is 0.69%.

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