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Analysis of Optimal Portfolio on Investment Decision Using Single Index Model on LQ45 Stocks (Listed on Indonesia Stock Exchange for The Period 2022-2024)

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A B S T R A C T

This research aims to examine the construction of an ideal portfolio using a single index approach in the LQ45 sector for the years 2022-2024. This study uses a quantitative descriptive analysis methodology, utilizing secondary data and purposive sampling procedures. The research findings indicate the creation of an ideal portfolio that includes 12 equities with a single index strategy. The stocks, ranked by their allocation in the portfolio, are Indofood CBP Sukses Makmur Tbk (ICBP), Mitra Adiperkasa Tbk (MAPI), Perusahaan Indofood Sukses Makmur Tbk (INDF), Unilever Indonesia Tbk (UNVR), Sumber Alfaria Trijaya Tbk (AMRT), Bank Syariah Indonesia Tbk (BRIS), AKR Corporindo Tbk (AKRA), Bank Mandiri (Persero) Tbk (BMRI), Bank Central Asia Tbk (BBCA), United Tractors Tbk (UNTR), Jasa Marga (Persero) Tbk (JSMR), and Bukit Asam Tbk (PTBA). ICBP is the largest part of the portfolio, accounting for 18.5%. Twelve optimal portfolios are projected to yield a return of 0.020830 or 2.08%. The portfolio risk that investors must face for their investments is 0.000892, equivalent to 0.09%. This research can help investors in building an optimal portfolio. Investors can distribute their capital across various stocks to optimize returns at a certain level of risk. However, this research does not differentiate between the preference for analysis methods other than the single index model, and further research could use other indices besides LQ45 and compare the results.

KATA KUNCI

Portofolio Optimal, Keputusan Investasi, Model Indeks Tunggal, LQ45, Deskriptif Kuantitatif, Bursa Efek Indonesia

A B S T R A K

Penelitian ini bertujuan untuk meneliti konstruksi portofolio ideal dengan menggunakan pendekatan indeks tunggal di sektor LQ45 untuk tahun 2022-2024. Studi ini menggunakan metodologi analisis deskriptif kuantitatif, dengan memanfaatkan data sekunder dan prosedur pengambilan sampel purposif. Temuan penelitian menunjukkan penciptaan portofolio ideal yang mencakup 12 ekuitas dengan strategi indeks tunggal. Saham-saham, yang diurutkan berdasarkan alokasinya dalam portofolio, adalah Indofood CBP Sukses Makmur Tbk (ICBP), Mitra Adiperkasa Tbk (MAPI), Perusahaan Indofood Sukses Makmur Tbk (INDF), Unilever Indonesia Tbk (UNVR), Sumber Alfaria Trijaya Tbk (AMRT), Bank Syariah Indonesia Tbk (BRIS), AKR Corporindo Tbk (AKRA), Bank Mandiri (Persero) Tbk (BMRI), Bank Central Asia Tbk (BBCA), United Tractors Tbk (UNTR), Jasa Marga (Persero) Tbk (JSMR), dan Bukit Asam Tbk (PTBA). ICBP merupakan bagian terbesar dari portofolio, terdiri dari 18,5%. Dua belas portofolio optimal diproyeksikan menghasilkan imbal hasil sebesar 0,020830 atau 2,08%. Risiko portofolio yang harus dihadapi investor untuk investasi mereka adalah 0.000892, setara dengan 0,09%. Penelitian ini dapat membantu investor dalam membangun portofolio optimal. Investor dapat mendistribusikan modal mereka ke berbagai saham untuk mengoptimalkan keuntungan pada risiko tertentu. Namun, Penelitian ini tidak membedakan antara preferensi metode analisis selain model indeks tunggal serta penelitian lebih lanjut dapat menggunakan indeks lain selain LQ45 dan membandingkan hasil.

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1. Introduction

Stocks are a preferred investment instrument for many investors because they offer attractive returns [1]. Generally, there are two benefits that investors can obtain when they become shareholders, namely dividends and capital gains. Dividends are profit distributions made by a company and originate from the profits generated by that company [2]. Meanwhile, capital gains are profits obtained from the difference between the purchase price and the selling price of the shares [3].

Investment is the activity of placing capital now with the hope of gaining profit in the future [4]. Stock returns are the profits obtained both in the short term and long term from an issuer/company. This is an important measure for investors because it helps in evaluating the

performance and profitability of their investments [5]. However, in the capital market, there are not only high returns but also risks that accompany them. The higher the return, the higher the risk. Conversely, the lower the return, the lower the investment risk. Return and risk are important considerations for investors, while analytical knowledge remains relatively limited [6].

Maximizing returns and minimizing risks before investing are steps those investors need to take by choosing stocks with high market liquidity. One of the best stocks to choose is the LQ45 stocks, which are an index that measures the price performance of 45 stocks with high liquidity and large market capitalization, supported by good company fundamentals [7]. Although LQ45 stocks are a collection of stocks with high liquidity, they are not free from uncertainty regarding the return levels that investors will receive. Therefore, investors still need to consider various uncertainties that may occur and anticipate them [8].

Based on Markowitz's theory, the single index model method is a simplification of the Markowitz model that reduces the input of portfolio theory analysis and the number of variables that need to be estimated. Additionally, this model can also be used to calculate the expected return and risk of a portfolio [9]. The single index model method is an analytical model in portfolio formation that explains how to form an optimal stock portfolio from several efficient portfolio choices or a technique to measure the return and risk of a stock or portfolio [10].

Diversification is a strategic approach used by business practitioners and investors to manage risk and improve performance by spreading investments or operations across various areas [11]. By diversifying, stocks will be optimized in the portfolio, resulting in several stocks being selected as the best for making investment/financial decisions. When making financial decisions, optimization is one of the most important techniques [12]. Portfolio optimization is also one of the most important issues in the financial market and has many applications in financial planning and decision-making [13]. In this case, the more realistic the assumptions and modeling conditions for portfolio optimization to the financial market, the more reliable the results will be obtained. For that reason, investors will make decisions about the components of their own investment portfolios [14].

However, creating an optimal portfolio is a challenge, especially for new investors. They need analytical tools to obtain the correct stock composition in their portfolio. One of the approaches used to obtain an optimal portfolio is the modern portfolio theory (MPT) or the mean-variance analysis established by Markowitz (1952). However, the application of the Markowitz model is very time-consuming, as it requires numerous estimates to fill the covariance matrix. This model assumes that stock returns follow a normal distribution. However, stock returns often exhibit non-normal characteristics, such as skewness and kurtosis. This can result in a less optimal portfolio when using the traditional mean-variance approach [15]. In an effort to simplify the Markowitz model, researcher introduced the single-index model which reduces the number of calculations required compared to the Markowitz model, making it more practical for real-world applications [16]. The Sharpe ratio enables strong decision-making in portfolio selection under normal market conditions. This ratio provides a clear measure of risk-adjusted returns, which is crucial for evaluating and comparing various investment portfolios [17]. In addition to the formation of an optimal portfolio, the Sharpe method with a single index model offers considerations for fund allocation, expected portfolio return, and the resulting portfolio risk. Thus, it makes it easier for investors to make investment decisions.

Based on the discussion above, the researcher intends to consider how an optimal portfolio is designed by applying the single index model analysis method to the selected stocks that are the subject of the research, namely the stocks in the LQ45 industry. The LQ45 Index consists of 45 stocks from the IDX with high liquidity and large market capitalization, which have passed various selection criteria [18]. By taking data over a period of 3 years, specifically from 2022-2024, as the basis for the research. Based on the background above, the researcher has set the title "Optimal Portfolio Analysis on Investment Decisions Using the Single Index Model on LQ45 Stocks (Listed on the Indonesia Stock Exchange for the Period of 2022-2024)."

2. Research Method

This research uses a quantitative descriptive analysis method by providing important basic information that can guide further and more detailed investigations. The sample was taken using the purposive sampling method from the LQ45 index stock population. These stocks were diversified into an optimal portfolio using the single index model. Statistical calculations were performed using Ms. Excel and SPSS programs. A sample is a part of the population selected for observation and analysis. A sample is used to draw conclusions about the entire population [19].

The purposive sampling method is the sampling technique used in this research. Purposive sampling is a non-probability sampling technique where the researcher selects participants based on specific criteria aligned with the research objectives [20]. The criteria in this study are stocks listed on the IDX, companies that report financial statements, companies that use the rupiah currency, and companies that generate profit. The research sample, resulting from the selection of stocks in the LQ45, consists of 28 stocks that meet the criteria as seen on Table 1.

Table 1. Sample of LQ45 Index Stock Research

Number	Code	Emit
1	AKRA	AKR Corporindo Tbk
2	AMRT	Sumber Alfaria Trijaya Tbk
3	ANTM	Sumber Alfaria Trijaya Tbk
4	ARTO	Bank Jago Tbk
5	ASII	Astra International Tb
6	BBCA	Bank Central Asia Tbk
7	BBNI	Bank Negara Indonesia (Persero) Tbk
8	BBRI	Bank Rakyat Indonesia (Persero) Tbk
9	BBTN	Bank Tabungan Negara (Persero) Tbk
10	BMRI	Bank Mandiri (Persero) Tbk
11	BRIS	Bank Syariah Indonesia Tbk
12	CPIN	Charoen Pokphand Indonesia Tbk
13	EXCL	XL Axiata Tbk Gudang Garam Tbk
14	GGRM	Gudang Garam Tbk
15	ICBP	Indofood CBP Sukses Makmur Tbk
16	INDF	Indofood Sukses Makmur Tbk
17	INTP	Indocement Tunggal Prakarsa Tbk
18	ISAT	Indosat Tbk
19	JSMR	Jasa Marga (Persero) Tbk
20	KLBF	Kalbe Farma Tbk
21	MAPI	Mitra Adiperkasa Tbk
22	PTBA	Bukit Asam Tbk
23	SIDO	Industri Jamu dan Farmasi Sido Muncul Tbk
24	SMGR	Semen Indonesia (Persero) Tbk
25	TLKM	Telkom Indonesia (Persero) Tbk
26	TOWR	Sarana Menara Nusantara Tbk
27	UNTR	United Tractors Tbk
28	UNVR	Unilever Indonesia Tbk

Analysis of optimal portfolio formation using the single index method by calculating the formula can be done with the following steps [21]:

2.1. Calculating Stock Return on Equation (1)

$$Ri = ((P\_(t) - P\_(t-1)))/P\_(t-1) \quad (1)$$

Where Ri is the return of stock i. Pt is the closing price of stock i on day t. Pt-1 is the closing price of stock i on day t – 1.

2.2. Calculating Expected Return

The expected return or expected return for each individual stock is the average percentage return of realized stock i divided by the total realized return of stock i. The formula used is on Equation (2)

$$E(Ri) = (\sum Ri)/n \quad (2)$$

Where E(Ri) is the expected return. Ri is the realized return of stock I and n is the number of periods of the realized return of stock i.

2.3. Calculating Market Return on Equation (3)

$$Rm = \frac{(IHSG_t - IHSG_{t-1})}{IHSG_{t-1}} \quad (3)$$

Where Rm is the market return. IHSGt is the composite market index on day t. IHSGt-1 is the composite market index on day t-1.

2.4. Calculating Market Return Expectations on Equation (4)

$$E(Rm) = (\sum Rm)/n \quad (4)$$

Where E(Rm) is the expected market return. Rm is the market return and n is the number of periods of realized market return.

2.5. Calculating Alpha (α) and beta (β) with regression in data analysis using the SPSS program

2.6. Calculating Market Risk on Equation (5)

$$\sigma_m^2 = \frac{(R_m - ER_m)^2}{N} \quad (5)$$

Where σm2 is market risk. Rm is market return and Erm is expected market return.

2.7. Calculating unsystematic risk (σei2) on Equation (6)

$$\sigma_{ei}^2 = \frac{1}{t}\sum_{t=1}^{t}[R_{it} - (\alpha_i + \beta_i R_m)]^2 \quad (6)$$

2.8. Calculating Excess Return to Beta (ERB)

ERB is used to measure the excess return relative to one unit of non-diversifiable risk measured by beta. Then, determine the excess return to beta (ERB) for each stock. The ERB ratio shows the relationship between two investment determinants, namely return and risk, with the formula on Equation (7)

$$ERB_i = \frac{E(Ri) - R_{BR}}{\beta_i} \quad (7)$$

Where ERBi is the excess return to beta of security i. E(Ri) is the expected return based on the single index model for security i. RBR is the risk-free asset return and βi is the beta of security i.

2.9. Calculating the stock limit or cut-off point (Ci). The values Ai and Bi are calculated to determine Ci, which can be seen on Equation (8) and (9)

$$Ai = ([E(Ri) - R\_BR\ ].\beta i)/(\sigma\_ei\text{^}2\ ) \quad (8)$$

$$Bi = (\beta\_i\text{^}e)/(\sigma\_ei\text{^}2\ ) \quad (9)$$

Where E(Ri) is the expected return. RBR is the risk-free return. Bi is the beta of security i. σei2 is the variance of the residual error of security i, which is also known as unique risk or unsystematic risk.

2.10. Determining the cut-off rate (Ci)

The boundary point (Ci) is the ratio of market variance and stock return premium to stock error variance with market variance and individual stock sensitivity to error variance. The formula used is on Equaton (10).

$$Ci = \frac{\sigma_m^2 \sum_{j=i}^{i} Ai}{1+\sigma_m^2 \sum_{j=i}^{i} Bi} \quad (10)$$

2.11. Determining the optimal portfolio

If the ERB Ratio >= Ci, then the stocks are included in the optimal portfolio.

If the ERB Ratio < Ci, then those stocks are excluded from the optimal portfolio.

2.12. Calculating the Worthiest Stock Value on Equation (11)

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2}(ERB_i - C^*) \quad (11)$$

Where Zi is the number of securities in the optimal portfolio. is the Beta of security i. σei2 is the variance of the residual error of security i. ERBi is the excess return to beta of security i. C∗ is the cutoff point value, which is the largest Ci value.

2.13. Calculating the Proportion of Invested Funds on Equation (12)

$$\text{Wi} = \frac{Z_i}{\sum_{j-1}^{k} z_i} \quad (12)$$

Where Wi is the proportion of the i-th security and Zi is the number of securities in the optimal portfolio.

2.14. Calculating portfolio alpha (α_p) and portfolio beta (βp^2) on Equation (13) and (14)

$$\alpha_p = \sum_{i=1}^{n} Wi\ \alpha i \quad (13)$$

$$\beta_p{}^2 = \sum_{i=1}^{n} Wi.\beta i \quad (14)$$

2.15. Calculating the expected return of the portfolio E(Rp) on Equation (15).

Rp = E (Ri).Wi

$$\text{E(Rp)} = \alpha_p + \beta_p\ \text{E(Ri)} \quad (15)$$

2.16. Calculating portfolio risk on Equation (16)

$$\sigma_p{}^2 = \beta_p{}^2.\sigma_m{}^2 + \sum_{i=1}^{n} Wi^2.\sigma_{ei}{}^2 \quad (16)$$

Where $\sigma_p{}^2$ is the portfolio variance. $\beta_p{}^2.\sigma_m{}^2$ is the market-related risk. $Wi^2.\sigma_{ei}{}^2$ is the weighted average of the unsystematic risk of each company.

3. Result and Discussion

3.1. Realized Return, Expected Return, Standard Deviation dan Variance

To calculate realized return, expected return, standard deviation, and variance for each individual stock using the excel program. Realized return is obtained from the percentage change in the closing price of stock i on day t-1 minus the closing price of stock i on day t, then the result is divided by the closing price of stock i on month (t-1). Expected return is calculated based on the sum of the realized returns of a stock, which is then divided by the research period. Or in excel, expected return is calculated using the Average formula, standard deviation is calculated with the STDEV.S formula or the ½ power of the variance, and variance is calculated by squaring the standard deviation or the Average result from the subtraction of daily return and expected return, then squaring it. By entering the stock returns into the calculation formula, the results for expected return, standard deviation, and variance for each individual stock are obtained, as shown in Table 2.

Table 2. E(Ri), STDEV, and Variance of Individual Stocks

Code	E(Ri)	STDEV	Variance
AKRA	0.000626	0.635423	0.403763
AMRT	0.001427	0.615606	0.378971
ANTM	-0.000295	0.659859	0.435414
ARTO	-0.001853	1.136564	1.291777
ASII	-0.000074	0.452662	0.204903
BBCA	0.000473	0.354503	0.125673
BBNI	-0.000205	0.668366	0.446713
BBRI	0.000096	0.432759	0.187281
BBTN	-0.000416	0.493368	0.243412
BMRI	0.000816	0.463706	0.215023
BRIS	0.000942	0.679522	0.461750
CPIN	-0.000128	0.512302	0.262453
EXCL	-0.000221	0.601972	0.362371
GGRM	-0.000958	0.543268	0.295140
ICBP	0.000516	0.436477	0.190512
INDF	0.000371	0.342758	0.117483
INTP	-0.000465	0.495544	0.245564
ISAT	-0.000133	0.992061	0.984185
JSMR	0.000295	0.509100	0.259182
KLBF	-0.000078	0.488319	0.238456
MAPI	0.001371	0.762302	0.581105
PTBA	0.000291	0.596302	0.355576
SIDO	-0.000373	0.487764	0.237914
SMGR	-0.000887	0.550397	0.302937
SMRA	-0.000446	0.643747	0.414410
TLKM	-0.000467	0.427361	0.182637
TOWR	-0.000585	0.505208	0.255235
UNTR	0.000482	0.534592	0.285789
UNVR	-0.000888	0.579752	0.336112

Based on Table 2, it shows that the company with the highest expected return value is Sumber Alfaria Trijaya Tbk (AMRT) at 0.001427, while the company with the lowest expected return value is Bank Jago Tbk (ARTO) at -0.001853. The result of the largest standard deviation calculation is shown in the company Bank Jago Tbk (ARTO) at 1.136564. Next, the calculation of stock variance aims to determine the risk of the expected return on the stock. Based on the results of the individual stock variance calculation, the stock with the highest variance is Bank Jago Tbk (ARTO) with a value of 1.291777.

3.2. Market Return (Rm) and Expected Market Return E(Rm)

Market return (Rm) can be calculated using the Composite Stock Price Index (IHSG) data as the object of research. The calculation of the Market Expected Return E(Rm) in Excel uses the Average formula, the standard deviation is calculated using the STDEV.S formula, and the variance is calculated by squaring the standard deviation or by using the formula for the average of the daily stock returns minus the expected return raised to the power of ½. The results of the calculation of the expected return, standard deviation, and variance of the Composite Stock Price Index

(IHSG) for the period 2022-2024 are shown in the following Table 3.

Table 3. E(Ri), STDEV, and Market Variance R(m)

	R(m)
ER(m)	0.000112
STDEV	0.203057
Variance	0.041232

3.3. Determining Beta, Alpha, and Variance Error

To calculate alpha and beta using the SPSS program, while the variance error of each stock is calculated using the Excel program. Alpha and beta are calculated using the linear regression analysis method, which is a comparison of the realized return of a stock with the market return over a certain period. Variance error represents the unsystematic risk of a stock obtained from the average product of beta and the market return of a specific stock [22]. The results of the calculations of alpha, beta, and variance error or unique risk of each individual stock are shown in the following Table 4.

Table 4. Beta, Alpha, and Stock Variance Error

Code	Ai	Bi	σ_{ei}^2
AKRA	0.000574	0.455169	0.000051
AMRT	0.001363	0.587825	0.000066
ANTM	-0.000372	0.681331	0.000077
ARTO	-0.002021	1.521221	0.000171
ASII	-0.000134	0.534520	0.000060
BBCA	0.000410	0.578038	0.000065
BBNI	-0.000259	0.491487	0.000055
BBRI	0.000020	0.689466	0.000077
BBTN	-0.000479	0.577365	0.000065
BMRI	0.000739	0.694288	0.000078
BRIS	0.000875	0.602190	0.000068
CPIN	-0.000170	0.361384	0.000041
EXCL	-0.000306	0.779419	0.000088
GGRM	-0.000981	0.204626	0.000023
ICBP	0.000505	0.109217	0.000012
INDF	0.000358	0.100550	0.000011
INTP	-0.000495	0.274094	0.000031
ISAT	-0.000199	0.592590	0.000067
JSMR	0.000246	0.448775	0.000050
KLBF	-0.000122	0.398755	0.000045
MAPI	0.001327	0.391328	0.000044
PTBA	0.000225	0.589055	0.000066
SIDO	-0.000391	0.162771	0.000018
SMGR	-0.000959	0.664262	0.000075
TLKM	-0.000509	0.384811	0.000043
TOWR	-0.000649	0.579083	0.000065
UNTR	0.000408	0.661517	0.000074
UNVR	-0.000925	0.337678	0.000038

Based on the Table 4, the company with the highest alpha value is Sumber Alfaria Trijaya Tbk (AMRT) at 0.001363. Meanwhile, the company with the lowest alpha value is Bank Jago Tbk (ARTO) at -0.002021. Alpha is a part of the individual stock return that is not influenced by market changes. Alpha is used to calculate the variance of the stock's residual error. Based on Table 5 above, it shows that alpha and beta vary, with some companies having negative or positive alpha and beta values. The stock with the highest beta value is Bank Jago Tbk (ARTO) at 1.521221. Beta reflects the volatility of a stock's return relative to the market return, measuring the systematic risk of a stock relative to market risk. This means that Bank Jago Tbk has the highest risk calculated based on realized return and market realized return (IHSG). Meanwhile, the company with the smallest beta value is Indofood Sukses Makmur Tbk (INDF) with a value of 0.100550.

3.4. Determining the Value of Excess Return to Beta (ERB) and Value of Ci

Excess return to beta means measuring the excess return relative to beta, where to calculate ERB, a risk-free asset return (RBR) is needed. In this study, the risk-free asset return is measured from the risk-free asset on Bank Indonesia Certificates (SBI), which have low or near-zero risk and certain returns. RBR in this study uses the BI rate for the period 2022-2024. RBR is calculated based on the processed data using the formula, resulting in an RBR of 0.000147. Based on the calculation results, the excess return to beta (ERB) and the Ci value for each stock are then calculated. The obtained ERB values are sorted or ranked from the largest ERB value to the smallest ERB value. The value of Ci is the ratio of market variance and return premium to the stock's variance error with market variance in the sensitivity of the individual stock to the stock's variance error.

3.5. Determining the cut-off point (C*)

The optimal portfolio contains stocks with a high ERB ratio. Stocks with a low ERB ratio will not be included in the optimal portfolio, so a cutoff point is needed to determine the threshold value of the ERB ratio that is considered high. The magnitude of the cutoff point can be determined with the following steps: (1). Sort the securities from the largest ERB value to the smallest ERB value. The security with the largest ERB value is a candidate to be included in the optimal portfolio. (2). Calculate the values of Ai and Bi for each security i. The cut-off point (C*) is the maximum value of Ci from a series of Ci stock values. The cut-off point value is used as a boundary to determine which stocks are candidates for the portfolio and which are not. The stocks that form the optimal portfolio are those with an ERB value greater than or equal to 100 ERB at point C*, while those with an ERB value less than the ERB at point C* are not included as candidates in the optimal portfolio. The result of the cut-off point calculation in this study is C* equal to -0.000183.

3.6. Determining Portfolio Candidate Stocks

The stocks that are candidates for the portfolio are those with an excess return to beta value greater than or equal to the cut-off point value [23]. The cut-off point value is calculated using an Excel program, resulting in a cut-off point (C*) value of -0.000183, leading to 12 stocks being identified as optimal portfolio candidates. Table 5 shows the list of 12 optimal portfolio candidates with

positive values, ordered by the largest ERB value, and each optimal portfolio candidate stock shows a value greater than the cut-off point (C*). Table 6 shows 16 portfolios with negative values and ERB values that are classified as non-optimal portfolio candidates.

Table 5. Candidate Stocks for the Optimal Portfolio (ERB>C*)

Number	Code	ERBi	C*
1	ICBP	0.003379	-0.000183
2	MAPI	0.003128	-0.000183
3	INDF	0.002228	-0.000183
4	UNVR	0.002194	-0.000183
5	AMRT	0.002178	-0.000183
6	BRIS	0.001320	-0.000183
7	AKRA	0.001052	-0.000183
8	BMRI	0.000964	-0.000183
9	BBCA	0.000564	-0.000183
10	UNTR	0.000506	-0.000183
11	JSMR	0.000330	-0.000183
12	PTBA	0.000244	-0.000183

Table 6. Non-Candidate Stocks of the Optimal Portfolio (ERB)

Number	Code	ERBi	C*
1	BBRI	-0.000074	-0.000183
2	ASII	-0.000413	-0.000183
3	EXCL	-0.000472	-0.000183
4	ISAT	-0.000473	-0.000183
5	KLBF	-0.000564	-0.000183
6	ANTM	-0.000649	-0.000183
7	BBNI	-0.000716	-0.000183
8	CPIN	-0.000761	-0.000183
9	BBTN	-0.000975	-0.000183
10	TOWR	-0.001264	-0.000183
11	ARTO	-0.001315	-0.000183
12	SMGR	-0.001557	-0.000183
13	TLKM	-0.001596	-0.000183
14	INTP	-0.002233	-0.000183
15	SIDO	-0.003195	-0.000183
16	GGRM	-0.005400	-0.000183

Based on the criteria for selecting an optimal portfolio using the single index model, it can be seen in Table 6 that out of 28 candidate portfolio stocks, 12 stocks were selected as candidates for the optimal portfolio by comparing the excess return to beta values of each candidate portfolio stock with a Cut-off Point value of -0.000183. Among these 12 stocks, three had the highest excess return to beta values, namely Indofood CBP Sukses Makmur Tbk (ICBP), Mitra Adiperkasa Tbk (MAPI), and Indofood Sukses Makmur Tbk (INDF). The ERB values for each stock are ERB ICBP = 0.003379, ERB MAPI = 0.003128, and ERB INDF = 0.002228. The use of the single index method to determine the optimal portfolio based on the cut-off point value and excess return to beta has the advantage of also considering the systematic risk of the stock measured by beta. Since investing in stocks always involves a certain level of risk, investors need to know how to reduce that risk. Unsystematic risk can be eliminated through diversification, namely by forming an optimal portfolio. Portfolio analysis using a single index by comparing the excess return to beta value with the cut-off point value can be used as a basis for making investment decisions in stocks.

3.7. Proportions of Each Optimal Portfolio

Before calculating the proportion (Wi), we first determine the weighted scale of each optimal stock (Zi). Subsequently, we can determine the proportion of each stock in the optimal portfolio. The results of the calculations to determine the proportion of funds allocated to each asset in the optimal portfolio can be seen in Table 7.

Table 7. Proportion of Each Stock in the Portfolio

Number	Code	Zi	Wi (%)
1	ICBP	31.452902	18.5
2	MAPI	28.505051	16.7
3	INDF	21.069591	12.4
4	UNVR	20.186285	11.8
5	AMRT	20.081783	11.8
6	BRIS	12.375105	7.3
7	AKRA	10.081425	5.9
8	BMRI	9.264357	5.4
9	BBCA	5.702183	3.3
10	UNTR	5.217418	3.1
11	JSMR	3.653177	2.1
12	PTBA	2.871101	1.7
	Total	170.460378	100

In Table 7, it can be seen that the proportions for each of the 12 companies selected as the optimal portfolio. The results show that the largest proportion in the fund allocation for the formed optimal portfolio is the company Indofood CBP Sukses Makmur Tbk (ICBP) at 18.5%, while the smallest proportion is for the company Bukit Asam Tbk (PTBA) at 1.7%.

3.8. Alpha Portfolio Value and Beta Portfolio Value

Calculating market movements with portfolio alpha and portfolio beta. A positive portfolio alpha value indicates that the portfolio is performing better than expected, while a negative alpha value indicates underperformance [24]. The portfolio beta value measures its sensitivity to market movements, indicating the level of systematic risk relative to the market [25]. Beta > 1: Indicates that the portfolio is more volatile than the market. Beta < 1: Indicates that the portfolio is less volatile than the market. Beta = 1: Implies that the portfolio's volatility matches the market's volatility. The alpha and beta values of the portfolio can be seen in Table 8.

Table 8. Portfolio Alpha Value and Portfolio Beta Value

Number	Code	(α_p)	(β_p)
1	ICBP	0.000090	0.019371
2	MAPI	0.000214	0.063047
3	INDF	0.000043	0.012123
4	UNVR	-0.000107	0.039031
5	AMRT	0.000157	0.067615
6	BRIS	0.000064	0.043854
7	AKRA	0.000035	0.027453
8	BMRI	0.000041	0.038761
9	BBCA	0.000015	0.021001
10	UNTR	0.000014	0.022297
11	JSMR	0.000006	0.011294
12	PTBA	0.000005	0.012286

Based on Table 8, it is known that there are 11 stocks with positive alpha values, indicating that the portfolio has the ability to generate higher returns than expected for a certain level of risk. Meanwhile, stocks with negative values indicate that the portfolio has performance worse than expected. Then, in Table 10, it is also known that all portfolio beta values (βp) < 1, indicating that the beta is less volatile than the market. Additionally, a positive beta value indicates that the beta moves in the same direction as the market.

3.9. Expected portfolio return and portfolio risk

The expected return of a portfolio is the weighted average of the individual returns of each stock forming the portfolio. The expected return of this portfolio can be calculated by adding the portfolio's alpha to the portfolio's beta multiplied by the market return, resulting in 0.020830 or 2.08%. The portfolio's risk is obtained at 0.000892 or 0.09%.

4. Conclusion

This research highlights the difficulties faced by new investors in creating an optimal portfolio. One of the well-known portfolio models that can be used is the single index model. This model offers investors the ability to create a portfolio with maximum returns at the desired level of risk, or minimum risk with the desired level of return. The optimal portfolio using the single index model consists of 12 stocks. The stocks, ranked by their proportion in the portfolio, are Indofood CBP Sukses Makmur Tbk (ICBP), Mitra Adiperkasa Tbk (MAPI), and Perusahaan Indofood Sukses Makmur Tbk (INDF), Unilever Indonesia Tbk (UNVR), Sumber Alfaria Trijaya Tbk (AMRT), Bank Syariah Indonesia Tbk (BRIS), AKR Corporindo Tbk (AKRA), Bank Mandiri (Persero) Tbk (BMRI), Bank Central Asia Tbk (BBCA), United Tractors Tbk (UNTR), Jasa Marga (Persero) Tbk (JSMR), and Bukit Asam Tbk (PTBA). ICBP is the stock with the highest proportion in the portfolio, at 18.5%. The twelve optimal portfolios are expected to have a return of 0.020830 or 2.08%. The portfolio risk that investors must face for their investment is 0.000892 or 0.09%.

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