OPTIMIZATION OF LQ45 INDEX STOCK PORTFOLIO ON THE INDONESIA STOCK EXCHANGE USING SINGLE INDEX MODEL

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ABSTRACT

This research aims to identify and analyze the optimization of the LQ45 Index stock portfolio on the Indonesia Stock Exchange using the Single Index Model for the period 2013-2023. The population in this study consists of the 45 companies listed in the LQ45 Index. The sample was selected using purposive sampling, resulting in 34 companies. The research began by collecting closing stock price data from January 1, 2013, to December 31, 2024, to determine the optimal portfolio. The analysis technique used is quantitative descriptive analysis through the Single Index Model approach. The results of this study indicate that the performance of the Single Index and Markowitz methods in forming optimal portfolio results in the same portfolio return. However, there is a difference in the variance and standard deviation values, with the Single Index method showing higher values compared to the Markowitz method. Furthermore, 31 out of the 34 sample stocks were included in the optimal portfolio, namely HRUM, BRPT, EMTK, TOWR, MEDC, AMRT, AKRA, INKP, ITMG, BBCA, ANTM, PTBA, ESSA, ADRO, BBNI, MAPI, ACES, CPIN, BMRI, KLBF, BBRI, GGRM, UNVR, BBTN, ICBP, EXCL, INCO, PGAS, INDF, UNTR, and TLKM. Based on the optimal portfolio, the expected return is 3.282%, with a risk of 0.267% from the investment in this portfolio.

Keywords: Single Index Model, optimal portfolio, LQ45 Index.

OPTIMALISASI PORTOFOLIO SAHAM INDEKS LQ45 DI BURSA EFEK INDONESIA MENGGUNAKAN SINGLE INDEX MODEL

ABSTRAK

Penelitian ini bertujuan untuk mengetahui dan menganalisis Optimalisasi Portofolio saham Indeks LQ45 di Bursa Efek Indonesia Menggunakan Single Index Model Pada Year 2013-2023. Populasi dalam penelitian ini adalah Perusahan yang terdaftar pada Indeks Saham LQ45 sebanyak 45 perusahaan. Pemilihan sampel data dilakukan secara purposive sampling di dapat sebanyak 34 perusahaan. Yang telah di kumpulkan dimulai dengan mengumpulkan data harga saham penutupan periode 1 Januari 2013 – 31 Desember 2024 sampai mendapatkan portofolio optimal. Teknik analisis yang digunakan adalah analisis deskriptif kuantitatif dengan tahapan Single Index Model. Hasil Penelitian ini menunjukkan terlihat antara kinerja metode Single Indeks dan Markowitz dalam membentuk portofolio optimal menghasilkan return portofolio yang sama, hanya yang menunjukan perbedaan pada variance dan standar deviasi memiliki nilai yang berbeda antara metode tersebut, dengan nilai yang di tunjukan lebih tinggi pada metode Single Indeks dari pada metode Markowitz. Kemudian terdapat 31 saham dari 34 sampel penelitian yang termasuk portofolio optimal yaitu HRUM, BRPT, EMTK, TOWR, MEDC, AMRT, AKRA, INKP, ITMG, BBCA, ANTM, PTBA, ESSA, ADRO, BBNI, MAPI, ACES, CPIN, BMRI, KLBF, BBRI, GGRM, UNVR, BBTN, ICBP, EXCL, INCO, PGAS, INDF, UNTR, dan TLKM. Berdasarkan portofolio optimal yang terbentuk maka return ekspektasinya adalah sebesar 3.282%. Dan risiko yang harus dihadapi dari hasil investasi pada portofolio tersebut adalah sebesar 0.267%.

Kata kunci: Model Indeks Tunggal, Portofolio Optimal, Indeks LQ45

INTRODUCTION

The capital market is an integral part of a country's economy and serves as a means of business funding. This is demonstrated by the numerous companies conducting IPOs, the initial public offering of shares to the public. The capital market, which serves as a means for companies to raise funds from investors, aims to expand their business and increase working capital. The Indonesian capital market has become an attractive investment alternative amidst today's increasing access to information and technology. Various investment instruments exist, one of which is stocks. Investment, which involves investing funds or other assets with the aim of generating future profits, is often a choice for investors considering stocks as a profitable investment.

A portfolio is a collection of assets owned by an individual and is usually related to how to allocate a certain amount of wealth to several stocks with the aim of obtaining maximum returns with minimal risk. To minimize risk, investments are spread out by forming a stock portfolio. One popular way to form a stock portfolio is by using Markowitz's Mean-Variance method in 1959. The Mean-Variance method proposed by Markowitz is one of the popular methods used to form an optimal portfolio. In the Mean-Variance method, the optimal solution is determined and measured through the expected value and variance return from historical data.

Financial literacy is knowledge, skills, confidence which influences attitudes, and financial behavior a person to improve the quality of decision-making and financial management in order to achieve prosperity. Financial inclusion is the availability of access for the community to utilize financial products and/or services in formal financial institutions according to the community's needs and capabilities in order to achieve prosperity.

The 2022 SNLIK results show that the Indonesian public's financial literacy index reached 49.68 percent, up from 38.03 percent in 2019. Meanwhile, the financial inclusion index this year reached 85.10 percent, an increase from 76.19 percent in the previous SNLIK period in 2019. This indicates a narrowing gap between literacy and inclusion levels, from 38.16 percent in 2019 to 35.42 percent in 2022. (Otoritas Jasa Keuangan, 2022).

The financial literacy index of the Indonesian people in 2022 was 49.68%, which means that out of every 100 residents, there are around 49 people who...well literateThese results indicate an increase from previous surveys, namely 38.03% in 2019, 29.70% in 2016, and 21.84% in 2013. Despite this increase, the data also indicates that many Indonesians are still not well-literate. Based on the 2022 financial literacy index data above, it can be concluded that out of every 100 residents, approximately 51 people lack the correct knowledge, beliefs, skills, attitudes, and behaviors regarding financial services institutions and formal financial products and services. This will impact the public's readiness to invest in stocks.

This means that Indonesians are still vulnerable to being trapped by fraudulent investments that offer large profits in a short time. Therefore, proper basic knowledge of stock investing is essential.

The portfolios compiled by investment managers in mutual funds naturally also consider the performance of the stocks they select, which are then grouped into mutual fund groups. Mutual fund performance experienced stable growth from 2016 to 2020, from 1,425 to 2,219, then declined from 2021 to March 2024, from 2,120 to 1,703. Net Asset Value (NAV) also experienced steady growth, from IDR 338,749.81 billion in 2016 to IDR 2,219. 578,438.29 billion in 2021, then decreased in 2022 and 2023. The number of mutual fund units in circulation also experienced stable growth, from Rp 240,237,854,788.62 billion in 2016 to Rp 435,143,042,392.00 billion in 2020. However, the number of mutual fund units in circulation decreased from 2021 to 2023. The value of mutual fund subscriptions fluctuates from year to year. The subscription value continued to increase from 2016 from Rp 350,645.34 billion to Rp 711,217.13 billion in 2019 and then decreased in 2020 to Rp. 637,504.76 billion, and then an increase occurred in 2021 and 2022 to Rp 911,906.99 billion, then decreased in 2023 to Rp 697,518.00 billion. The highest subscription value occurred in 2022 at Rp 911,906.99 billion. The redemption value continued to increase from 2016 from Rp 302,719.79 billion to Rp 656,327.13 billion in 2019 and then decreased in 2020 to Rp 602,143.69 billion, and then an increase occurred in 2021 and 2022 to Rp 990,241.53 billion, then decreased in 2023 to Rp 688,535.15 billion.

It can be seen that the number of mutual funds and net asset value increased from 2016 until 2020, but then a decline occurred from 2021 to 2024.

. The movement of the IHSG price from 2013 to 2023 experienced an upward trend, however, the net asset value (NAB) of stock mutual funds had increased from 2013-2018 but then decreased until 2023. This is a gap that stock mutual funds should have experienced the same movement as the IHSG, but if seen from Figure 4, there is an inconsistency that occurred in 2019-2023 which actually decreased when the IHSG price increased.

Portfolio theory begins with the assumption that future returns on securities can be estimated and then defines risk by varying the distribution of returns. Under certain assumptions, portfolio theory yields a linear relationship between risk and return. In this case, the greater the risk of an investment or loan, the greater the desired rate of return to offset that risk. Investors seek to maximize the expected return on an investment with a certain acceptable level of risk. A portfolio that achieves this goal is called an efficient portfolio. To form an efficient portfolio, several assumptions must be made regarding investor behavior in making investment decisions. A reasonable assumption is that investors tend to be risk-averse. A risk-averse investor is an investor who, when faced with two investments with the same expected return and different risks, will choose the investment with the

lower risk. If an investor has several efficient portfolio options, the most optimal portfolio will be chosen (Adnyana, 2020). Furthermore, when looking at mutual funds, which are also portfolios compiled by investment managers to facilitate investors' investment, the presented data shows an inconsistency, creating a gap between the Jakarta Composite Index (JCI) price and the performance of equity mutual funds from 2013 to 2023. The JCI experienced an upward trend, while equity mutual funds experienced a downward trend, as seen from their NAV.

This research aims to delve deeper into this concept, attempting to assess the potential returns and risks associated with this stock mix. This analysis specifically relates to companies included in the LQ45 index for the 2024 period.

LITERATURE REVIEW
Capital Market
Capital markets are formed for economic and financial reasons, specifically to connect people with money (investors) with companies that need funds for production. This meeting is expected to increase prosperity for both those with funds and those in need. (Chandra et al., 2018)

The capital market in Indonesia is the Indonesia Stock Exchange (IDX). The Indonesia Stock Exchange (IDX) can be seen from the historical factors when the Dutch East Indies government opened plantations in Indonesia. On December 14, 1912, stock exchange trading was officially launched under the name Vereniging voor de Effectenhandel as a branch of the Amsterdam Stock Exchange (Amsterdamse Effectenbeurs) in the Netherlands. (www.idx.co.id)

Stocks
Stocks are one of the most popular financial market instruments. Issuing shares is one option companies choose when deciding on corporate financing. Furthermore, stocks are a popular investment instrument among investors due to their ability to offer attractive returns. (www.idx.co.id)

Return dan Risk
According to (Adnyana, 2020), for returns on an investment, there are several things that need to be considered, including: (1) There is a trade-off between risk andReturn. (2) Diversification is very crucial in investment. (3) Return The actual value is the most important thing. (4) The scale of the investment. For example, a return of 1 million from an investment of 1 million is certainly very good, but this is not the case if the return of 1 million is obtained from an investment of 1 billion. (5) The risk of an investment often depends on how long you plan to hold the investment. (6) The time period for receiving the return. For example, a return of 1 million from an investment of 1 million is extraordinary, but what if the time period is 100 years? The solution to this is the calculation of the rate of return/percentage of return which can be calculated by dividing the amount received by the amount invested. (7) The past provides insight into risk andreturn from investments, but there is no guarantee that the future will repeat the past. (8) Expected rate of return (expected return) is the expected rate of return that will be realized from an investment based on the weighted average of the probability distribution of possible outcomes. The expected rate of return is calculated by multiplying the probability of each condition occurring by the outcome of each condition. (Adnyana, 2020)

Risk is the chance that some unfavorable event will occur. The presence of risk implies the presence of more than one possible outcome. A simple prospect is an investment opportunity that puts initial wealth at risk and has only two possible outcomes. (Adnyana, 2020)

Portofolio
(Ramdani & Nazar, 2021) explain that Harry Markowitz's in 1991 portfolio theory provides many insights for students, businesspeople, and decision-makers. The theory's content is simple: "Don't put all your eggs in one basket," meaning "Don't put all your eggs in one basket, but put them in more than one basket." The theoretical concept explains that "investing capital should not be confined to a single location, but rather in multiple locations and in a non-unidirectional manner, which is called investment diversification."

A portfolio is a combination of two or more individual stocks, either real assets such as the purchase of productive assets, factory construction, mining operations, or plantations, or financial assets held in the money market, either in the form of certificates of deposit or money market securities held by investors (Hardiana et al., 2021). The portfolio selection process can be divided into two stages. The first stage begins with observation and experience and ends with beliefs about the future performance of available securities. The second stage begins with relevant beliefs about future performance and ends with portfolio selection. (Markowitz, 1952)
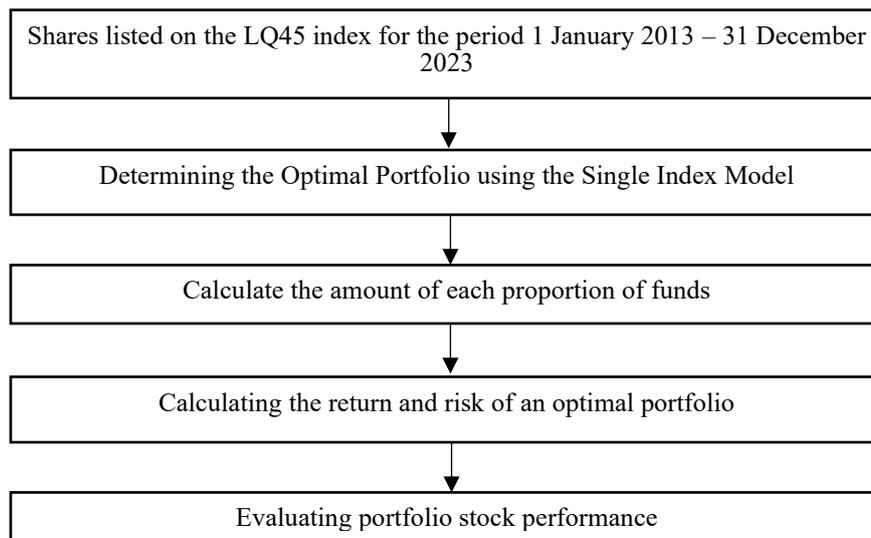
Framework


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┌─────────────────────────────────────────────────────────────────┐
│ Shares listed on the LQ45 index for the period 1 January 2013 –   │
│                    31 December 2023                               │
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┌─────────────────────────────────────────────────────────────────┐
│ Determining the Optimal Portfolio using the Single Index Model    │
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┌─────────────────────────────────────────────────────────────────┐
│ Calculate the amount of each proportion of funds                  │
└─────────────────────────────────────────────────────────────────┘
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┌─────────────────────────────────────────────────────────────────┐
│ Calculating the return and risk of an optimal portfolio           │
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│ Evaluating portfolio stock performance                            │
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Figure 1 Framework

RESEARCH METHODS

The population used in this study is 45 companies listed on the LQ45 index of the Indonesia Stock Exchange from 2013 to 2023. The sampling technique used in this study is the random sampling method Purposive Sampling. The number of samples that met the criteria was 34 company samples.

Table 1 Operasional Variables

No	Concept of Analysis	Formula	Explantion
1	Calculating the return (profit) level for each share	$R_t = \dfrac{P_t - P_{t-1}}{P_{t-1}}$	R_t = Return on day t P_t = Closing price on day t P_{t-1} = Closing price on day t-1
2	Calculating Expected Return (expected profit) from market prices	$E(R_m) = \dfrac{\sum_{t=1}^{N}(R_m)}{N}$	$E(R_m)$ = expected return market R_m = return that has occurred in the market N = Number of observation time intervals
3	Calculating Standard Deviation is a measurement to calculate the level of risk.	$\sigma i = SD = \left(\dfrac{\sum_{i=1}^{N}(Xi - EX)^2}{N-1}\right)^{1/2}$	σi = Risk per stock (standard deviation) Xi = realized return i to stock i EX = Average realized return on stock i N = Number of observations
4	Calculating market risk	$\sigma_m{}^2 = \dfrac{\sum_{i=1}^{N}[R_m - ER_m]^2}{N-1}$	σm^2 = Market return variance ER_m = Expected market return in period t R_m = Market return rate in period t N = Number of periods
5	Calculating covariance, where covariance is the average deviation of each data, is a comparison of stock return calculations with market returns.	$\sigma_{im} = \dfrac{\sum_{i=1}^{N}(R_{it} - ER_i)(R_{mt} - ER_m)}{n}$	σ_{im} = Covariance between stock i's return and market return $E(R_i)$ = Expected return on stock i R_{it} = Return on stock i $E(R_{mt})$ = Expected market return R_m = Market return n = Number of periods
6	Calculate the beta and alpha of each stock. Beta can be calculated using the equation.	$\beta_p = \dfrac{\sigma_{im}}{\sigma_m{}^2} = \dfrac{\sum_{i=1}^{N}(R_{it} - ER_i)(R_{mt} - ER_m)}{\sum_{i=1}^{N}(R_{mt} - ER_m)^2}$ $\alpha_i = E(R_i) - \beta_i \cdot E(R_m)$	β_i = Beta of share i σ_{im} = covariance between stock I returns and market returns $\sigma_m{}^2$ = market return search α_i = Alpha of share i $E(Ri)$ = expected return from stock i

No	Concept of Analysis	Formula	Explantion	
			β_i	= Beta of share i
			$E(Rm)$	= expected market return
7	Calculate investment risk.	$\sigma ei^2 = \sigma i^2 - (\sigma m^2 \cdot (\alpha i)^2)$ $$\sigma_i^2 = \beta_i^2 \cdot \sigma_m^2 + \sigma_{ei}^2$$	σei^2 σi^2 σm^2 αi^2 σ_i^2 β_i^2 σ_m^2 σ_{ei}^2	= variance ei of share i = stock variance i = market variance = alpha of share i = stock variance i = stock beta = market variance = residual error variance
8	Calculate excess return to beta (ERB), which can be used to measure excess return relative to a unit of non-diversifiable risk, as measured by beta.	$$ERB = \frac{E(R_i) - R_f}{\beta_i}$$	ERB $E(R_i)$ of stock i R_f β_i	= Excess Return to Beta i = average expected return = return on risk-free assets = beta of stock i
9	Calculate the Ai and Bi values required to calculate the cut-off point (C*).	$$A_i = \frac{[E(R_i) - Rf] \cdot \beta_i}{\sigma_{ei}^2}$$ Dan $$B_i = \frac{\beta_i^2}{\sigma_{ei}^2}$$	$E(R_i)$ Rf Risk-Free Assets β_i σ_{ei}^2 individual stocks	=Individual stock Expected Return = Average Return on = Stock Beta Individual = Variance error of
10	Calculate the candidate cut-off rate.	$$C_i = \frac{\sigma_m^2 \sum_{j=1}^i A_j}{1 + \sigma_m^2 \sum_{j=1}^i B_j}$$	C_i σ_m^2 A_j B_j	= Breakpoint =Market variance = A_i = B_i
11	Calculate the proportion of funds for each stock.	$$Wi = \frac{Zi}{\sum Zi}$$ Dimana $$Zi = \frac{\beta_i^2}{\sigma ei^2} (ERB_i - C*)$$	Wi in each stock Zi stock	= Percentage of funds invested = Scale of weights for each
12	Calculate portfolio alpha and beta to calculate the expected portfolio return.	$$\alpha_p = \sum_{i=1}^n Wi \cdot \alpha_i \ dan \ \beta_p = \sum_{i=1}^n Wi \cdot \beta_i$$	α_p = Portfolioalpha β_p = Portfolio beta Wi in each stock	= Percentage of funds invested
13	The expected portfolio return is the weighted average of the individual returns of each stock that makes up the optimal portfolio.	$$E(R_p) = \alpha_p + \beta_p \cdot E(R_m)$$	$E(R_p)$ = Expected Portfolio Return	
14	Calculate portfolio risk, which can be calculated using the equation.	$$\sigma p^2 = \beta_p^2 \cdot \sigma_m^2 + \left(\sum_{t=1}^n W_i \sigma_{ei} \right)^2$$	σp^2 = Portfolio Risk	

Source: (ELTON et al., 2014) , (Hartono M, 2010)

This research uses the Single Index Model data analysis technique or Treynor method, namely Excess Return to Beta (ERB) in order to achieve the Optimal Portfolio.

RESULTS AND DISCUSSION

Stock price fluctuations are driven by several factors, including specific events that trigger market reactions, such as sentiment, financial report releases, and macroeconomic news. On May 22, 2013, at a Federal Reserve Open Market Committee meeting, Bernanke first mentioned the possibility of reducing bond purchases, which became known as tapering. This announcement shocked financial markets, which had become accustomed to high levels of stimulus. This resulted in a spike in bond interest rates, a decline in bond prices, and significant market volatility in global financial markets (Bizhare Contributor, 2024). On June 22, 2013, at 12:00 a.m. Western Indonesian Time (WIB), the government officially raised the prices of subsidized premium and diesel fuel. The price of premium increased by Rp 2,000 to Rp 6,500 per liter, and the price of diesel increased by Rp 1,000 to Rp 5,500 per liter (Wicaksono, 2013). Bank Indonesia (BI) again raised its benchmark interest rate, or BI rate. The Bank Indonesia Board of Governors (BI) meeting on Thursday, July 11, 2013, decided to raise the BI rate by 50 basis points (bps) to 6.5 percent from the previous 6.00 percent (ekon.go.id, 2013). The United States Federal Reserve (Fed) finally made its decision to reduce its stimulus on Wednesday, December 18, 2013. The Fed decided to reduce the stimulus

(tapering off) from the original US$85 billion per month to US$75 billion per month, effective January 2014 (Amri et al., 2013).

The 2014 Presidential and Vice Presidential Election was contested by two pairs of presidential and vice presidential candidates: Prabowo Subianto and Hatta Rajasa, and Joko Widodo and Jusuf Kalla. On May 31, 2014, the General Elections Commission (KPU) announced the two presidential and vice-presidential candidate pairs and held a drawing for ballot numbers on June 1, 2014. The voting process took place on July 9, 2014 (www.kpu.go.id, 2014). The presidential and vice-presidential election was ultimately won by the Joko Widodo-Jusuf Kalla ticket, winning 53.15% of the vote, defeating the Prabowo Subianto-Hatta Rajasa ticket, which received 46.85% of the vote, according to the KPU's decision on July 22, 2014. The President and Vice President-elect were inaugurated on October 20, 2014, replacing Susilo Bambang Yudhoyono (www.kpu.go.id, 2014). The first fuel price increase during the Jokowi era occurred on November 17, 2014. At that time, Jokowi and Vice President Jusuf Kalla had not even been in office for a month. Two types of subsidized fuel prices increased. First, premium gasoline rose from Rp 6,500 per liter to Rp 8,500 per liter. Then, diesel fuel rose from Rp 5,500 per liter to Rp 7,500 per liter (Farisa, 2022).

One and a half months later, on January 1, 2015, Jokowi lowered the prices of premium and diesel fuel. Premium gasoline dropped from Rp 8,500 per liter to Rp 7,600 per liter. Meanwhile, diesel fuel dropped from Rp 7,600 to Rp 7,250 per liter. Shortly thereafter, on January 19, 2015, Jokowi further lowered the prices of premium and diesel fuel. Premium gasoline dropped from Rp 7,600 per liter to Rp 6,600 per liter. Then, the price of diesel fuel rose from Rp 7,250 per liter to Rp 6,400 per liter. However, these prices did not last long. On March 1, 2015, Jokowi announced a Rp 200 price increase for Premium gasoline, to Rp 6,800 per liter. On March 28, 2015, Jokowi further increased the prices of Premium gasoline and diesel fuel by Rp 500 per liter each. With these increases, the price of Premium gasoline rose from Rp 6,800 to Rp 7,300 per liter. The price of diesel fuel then increased from Rp 6,400 to Rp 6,900 per liter. The price of Premium gasoline fell from Rp 7,300 to Rp 7,150 per liter. Meanwhile, the price of diesel fuel fell from Rp 6,700 to Rp 5,950 per liter (Farisa, 2022). On August 11, 2015, the People's Bank of China (PBOC), the People's Bank of China (PBOC), implemented a new policy, devaluing the Chinese New Year by 1.9%. This was done as an effort to increase export competitiveness and stimulate long-term economic growth. This devaluation decision triggered stock sales and currency depreciation globally, starting in Asia, followed by Europe and the United States (US) (Apriyani, 2015). The first simultaneous regional elections were held on December 9, 2015, for regions whose regional heads' terms ended in 2016. Participants in these simultaneous elections were at the provincial and district/city levels. These simultaneous elections took place in 269 regions, encompassing nine provinces, 224 districts, and 36 cities in Indonesia (Setyaningrum, 2022).

On June 23, 2016, a majority of British voters in a referendum approved their country leaving the European Union (EU), a move known as Brexit. On January 31, 2020, the UK officially left the EU (Welle, 2023). To open 2016, on January 5, the government again lowered the prices of premium gasoline and diesel. Premium gasoline fell from Rp 7,300 to Rp 6,950 per liter. Meanwhile, diesel gasoline fell from Rp 6,700 to Rp 5,650 per liter. Three months later, on April 1, 2016, the prices of premium gasoline and diesel fuel were lowered again. Premium gasoline fell from Rp 6,950 to Rp 6,450. Then, diesel gasoline fell from Rp 5,650 to Rp 5,150 per liter (Farisa, 2022). The 2016 United States presidential election, held on November 8, 2016, saw Republican Donald Trump lose the popular vote to Democrat Hillary Clinton by over 2.8 million votes but win 30 states and the decisive electoral college with 304 votes (Beckwith, 2024).

On January 20, 2017, Donald Trump and Mike Pence will be sworn in as President and Vice President of the United States on Friday, around 11:30 a.m. to 12:30 p.m. local time. However, Trump supporters and Americans eager to witness this historic inauguration have begun filling the National Mall, the center of the crowd. Strict and multi-layered screening is in place for everyone wishing to witness the inauguration in Washington, D.C. (Christiastuti, 2017). Simultaneous regional elections will be held again on February 15, 2017, to elect regional leaders at the provincial and district/city levels, whose terms expire in 2018. The 2017 regional head elections were held simultaneously in 7 provinces, 76 districts, and 18 cities (Setyaningrum, 2022). On Wednesday, December 21, 2017, US President Donald Trump touted his legislative achievements, including a major overhaul of US taxation, which he called a fulfillment of a campaign promise. Trump spoke shortly after the US Congress approved a tax reform bill that passed the Republican-dominated House of Representatives. (Hoke, 2017)

During 2018, the price of Pertalite (a type of gasoline) increased twice. On January 20, 2018, Jokowi raised the price of Pertalite to Rp 7,600 per liter. Then, on March 24, 2018, the price of Pertalite rose again to Rp 7,800 per liter (Farisa, 2022). Trump decided to raise import duties on solar panels and washing machines to 30 percent and 20 percent, respectively. From then on, on January 22, 2018, the trade war began (CNN Indonesia, 2020). Simultaneous regional elections were held again on June 27, 2018, to elect regional leaders at the provincial and district/city levels. The 2018 regional head elections were held simultaneously in 171 regions, comprising 17 provinces, 115 regencies, and 39 cities (Setyaningrum, 2022).

Entering President Jokowi's second term, the price of Pertalite (gasoline) was lowered on January 5, 2019. At that time, Jokowi, accompanied by Vice President Ma'ruf Amin, lowered the price of Pertalite to Rp 7,650 per

liter (Farisa, 2022). One day earlier than the previously scheduled date of May 22, the Indonesian General Elections Commission (KPU) finally announced the results of the 2019 General Election. Held at the KPU RI Building on Jalan Imam Bonjol, Central Jakarta, and led by KPU RI Chairman Arief Budiman, the Joko Widodo-Ma'ruf Amin ticket was declared the winner of the 2019 Presidential Election. The number 01 ticket outperformed the Prabowo-Sandi ticket, securing 55.50% of the vote compared to 44.50% from 34 provinces and 130 PPLN (National Elections Commission) (www.dw.com, 2019). Abqaiq, managed by Saudi state oil company Aramco, and the Khurais oil field were hit by drones and missiles early Saturday (September 14). Houthi rebels have repeatedly launched rockets, missiles, and drones at populated areas in Saudi Arabia (BBC News Indonesia, 2019). President Joko Widodo and K.H. Ma'ruf Amin officially assumed office as President and Vice President of the Republic of Indonesia for the 2019-2024 term. The two were inaugurated at a Plenary Session of the People's Consultative Assembly (MPR) of the Republic of Indonesia held at the Nusantara Building, Parliament Complex, Senayan, Jakarta, on Sunday, October 20, 2019. At 3:30 p.m. Western Indonesian Time (WIB), the presidential and vice presidential inauguration ceremony began with the playing of the national anthem, Indonesia Raya. (www.presidenri.go.id, 2019)

The novel coronavirus began to attract global attention after, on January 20, 2020, health authorities in Wuhan City, Hubei Province, China, announced that three people had died in Wuhan after suffering from pneumonia caused by the virus.(Sudarmadi, 2020) In Indonesia, on Monday, March 2, 2020, the President announced the first two cases of Covid-19. The two cases were a 64-year-old mother and her 31-year-old daughter. (Retaduari, 2022) The World Health Organization (WHO) officially declared the Covid-19 outbreak a global pandemic. This announcement was made on Wednesday evening (March 11, 2020). In less than three months, Covid-19 has infected more than 126,000 people in 123 countries, from Asia, Europe, the US, and South Africa. (Putri, 2020) Simultaneous regional elections were held again on December 9, 2020, to elect regional leaders at the provincial and district/city levels. The 2020 regional head elections were held simultaneously in 270 regions, comprising 9 provinces, 224 districts, and 37 cities. The 2020 regional elections are different due to their implementation during a pandemic. (Setyaningrum, 2022)

President Joko Widoso kicked off the National Covid-19 Vaccination Program, which was first implemented on Wednesday, January 13, 2021, at the Merdeka Palace, Jakarta. President Joko Widodo was the first person to receive the Covid-19 vaccination. This marked the start of a free mass vaccination program throughout Indonesia and served as an effort to address the Covid-19 pandemic. (www.setneg.go.id, 2021) Joe Biden and Kamala Harris will be inaugurated on January 20, 2021. The new president and vice president will take the oath of office, which will be read by the chief justice of the Supreme Court. (BBC News Indonesia, 2020)

On February 24, 2022, Russia invaded neighboring Ukraine, triggering Europe's worst conflict since World War II. Previously, for weeks, there had been much speculation about Russian President Vladimir Putin's intentions, as he massed troops on the border. Shortly before 6:00 a.m. on February 24, 2022, Russia announced a military operation in Ukraine. (Reditya, 2023) Recently, on April 1, 2022, Jokowi raised the price of non-subsidized fuel, Pertamax. The price increase was significant, ranging from Rp 3,000 to Rp 12,500-13,000 per liter, from Rp 9,000 per liter to Rp 12,500-13,000 per liter. Most recently, on September 3, 2022, Jokowi raised the prices of three types of fuel: Pertalite, diesel, and Pertamax. The price breakdown is as follows: Pertalite increased from Rp 7,650 per liter to Rp 10,000 per liter; diesel increased from Rp 5,150 per liter to Rp 6,800 per liter; and Pertamax increased from Rp 12,500 to Rp 14,500 per liter. Jokowi explained that this increase was due to rising global oil prices and the swelling budget for fuel subsidies and compensation. (Farisa, 2022)

The United States (US) Federal Reserve (The Fed) again raised its benchmark interest rate by 25 basis points (bps) at its Open Market Committee (FOMC) meeting on February 1, 2023, or early Thursday (February 2, 2023) Indonesian time. (Uly & Sukmana, 2023)

Optimal Portfolio Formation Using the Single Index Model
Expected Return and Portfolio Risk
Table 2. Return and Optimal Portfolio Risk of LQ45 Stocks for the 2013 Period

Stock Code	Z_i	W_i	α	β 2013	σ_{ei}^2	$E(R_P)$	σ_P^2
EMTK	2.40384	30.09%	0.00176	0.06491	0.00064		
TOWR	1.71281	21.44%	0.00093	0.08427	0.00041		
INKP	1.60844	20.13%	0.00361	1.21371	0.00163		
MEDC	1.42728	17.87%	0.00129	0.39903	0.00059		
ICBP	0.75879	9.50%	0.00131	1.22030	0.00042		
INCO	0.02501	0.31%	0.00072	0.76206	0.00098		
TLKM	0.03568	0.45%	0.00102	1.23827	0.00031		
UNVR	0.01007	0.13%	0.00106	1.30774	0.00046		
KLBF	0.00650	0.08%	0.00107	1.32269	0.00037		
TOTAL	7.98841	100.00%	0.01277	7.61297	0.00579	0.00183	0.00020

Source: Processed Data (2026)

Optimization of Lq45 Index Stock Portfolio on the Indonesia Stock Exchange Using Single Index Model (Wily Andresen, Teddy Chandra, Evelyn Wijaya, Yusnita Octafilia Th. A. Y. I, and Mimelientesa Irman)

Based on table 2 it can be seen that the calculation results forreturn and the risk of each share in the optimal portfolio for the 2013 period. Once the proportion of each share in the optimal portfolio is known, it can be calculatedreturn and the risks. It can be seen that the stocks that make up the optimal portfolio havereturn is 0.00183. And the optimal portfolio risk is 0.00020. It can be concluded that the optimal portfolio that has been analyzed hasreturn which is greater than the possible risks faced.

Table 3. Return and Optimal Portfolio Risk of LQ45 Stocks for the 2014 Period

Stock Code	Zi	Wi	α	β	σei²	E(Rᴘ)	σᴘ²
				2014			
MEDC	4.84166	26.68%	0.00197	0.89633	0.00032		
TOWR	3.81963	21.05%	0.00152	0.52649	0.00031		
GGRM	2.60528	14.36%	0.00094	0.78741	0.00022		
KLBF	2.35947	13.00%	0.00075	0.85949	0.00015		
INCO	1.21357	6.69%	0.00109	0.93070	0.00056		
ESSA	0.97341	5.36%	0.00093	0.53728	0.00063		
EMTK	0.89249	4.92%	0.00221	0.34071	0.00216		
BBNI	0.62383	3.44%	0.00064	1.62023	0.00014		
PGAS	0.43246	2.38%	0.00048	0.90578	0.00018		
BBRI	0.20235	1.12%	0.00063	1.84300	0.00017		
ICBP	0.18071	1.00%	0.00042	0.79237	0.00021		
TOTAL	18.14486	100.00%	0.01158	10.03979	0.00506	0.00200	0.00009

Source: Processed Data (2026)

Based on table 3 it can be seen that the calculation results forreturn and the risk of each share in the optimal portfolio for the 2014 period. Once the proportion of each share in the optimal portfolio is known, it can be calculated return and the risks. It can be seen that the stocks that make up the optimal portfolio havereturn is 0.00200. And the optimal portfolio risk is 0.00009. It can be concluded that the optimal portfolio that has been analyzed hasreturn which is greater than the possible risks faced.

Table 4. Return and Optimal Portfolio Risk of LQ45 Stocks for the 2015 Period

Stock Code	Zi	Wi	α	β	σei²	E(Rᴘ)	σᴘ²
				2015			
AKRA	3.91178	41.42%	0.00238	0.45089	0.00046		
TOWR	2.71282	28.72%	0.00083	0.05086	0.00021		
AMRT	1.02855	10.89%	0.00103	0.03815	0.00076		
EMTK	0.99997	10.59%	0.00187	0.03175	0.00164		
UNVR	0.54581	5.78%	0.00132	1.16521	0.00028		
ACES	0.24638	2.61%	0.00094	0.67144	0.00072		
TOTAL	9.44531	100.00%	0.00836	2.40831	0.00409	0.00149	0.00014

Source: Processed Data (2026)

Based on table 4 it can be seen that the calculation results forreturn and the risk of each share in the optimal portfolio for the 2015 period. Once the proportion of each share in the optimal portfolio is known, it can be calculatedreturn and the risks. It can be seen that the stocks that make up the optimal portfolio havereturn is 0.00149. And the optimal portfolio risk is 0.00014. It can be concluded that the optimal portfolio that has been analyzed hasreturn which is greater than the possible risks faced.

Table 5. Return and Optimal Portfolio Risk of LQ45 Stocks for the 2016 Period

Stock Code	Zi	Wi	α	β	σei²	E(Rᴘ)	σᴘ²
				2016			
BRPT	4.82342	22.19%	0.01045	0.65512	0.00200		
ANTM	4.18923	19.27%	0.00437	0.82619	0.00081		
ITMG	3.27372	15.06%	0.00425	0.98542	0.00095		
ADRO	3.23927	14.90%	0.00483	1.17563	0.00109		
PTBA	2.42208	11.14%	0.00394	1.40221	0.00099		
HRUM	2.30308	10.60%	0.00449	1.30296	0.00133		
MEDC	0.85165	3.92%	0.00237	0.84565	0.00161		
INCO	0.50049	2.30%	0.00205	1.44912	0.00094		
AMRT	0.13423	0.62%	0.00043	0.20104	0.00053		
TOTAL	21.73717	100.00%	0.03719	8.84335	0.01025	0.00625	0.00043

Source: Processed Data (2026)

Based on table 5 it can be seen that the calculation results forreturn and the risk of each share in the optimal portfolio for the 2016 period. Once the proportion of each share in the optimal portfolio is known, it can be calculated return and the risks. It can be seen that the stocks that make up the optimal portfolio havereturn of 0.00625. And the optimal portfolio risk is 0.00043. It can be concluded that the optimal portfolio that has been analyzed hasreturn which is greater than the possible risks faced.

Table 6. Return and Optimal Portfolio Risk of LQ45 Stocks for the 2017 Period

Stock Code	Zi	Wi	α	β	σei^2	$E(R_P)$	σP^2
				2017			
BBNI	7.07632	16.92%	0.00166	1.18042	0.00018		
BBTN	6.71458	16.06%	0.00263	0.84870	0.00034		
BRPT	5.73070	13.70%	0.00433	0.84062	0.00070		
INKP	5.63441	13.47%	0.00730	0.71291	0.00124		
UNVR	4.12527	9.87%	0.00075	1.06108	0.00009		
MEDC	2.90703	6.95%	0.00509	0.30532	0.00168		
BBRI	2.66999	6.39%	0.00078	1.36956	0.00013		
ACES	1.88404	4.51%	0.00126	0.62719	0.00052		
ESSA	1.54816	3.70%	0.00206	0.17952	0.00122		
BBCA	1.31387	3.14%	0.00054	1.14426	0.00011		
UNTR	0.85813	2.05%	0.00093	1.90948	0.00041		
TOWR	0.78358	1.87%	0.00054	0.19771	0.00047		
BMRI	0.54729	1.31%	0.00050	1.31118	0.00012		
EXCL	0.02298	0.05%	0.00043	1.21399	0.00056		
TOTAL	**41.81634**	**100.00%**	**0.02879**	**12.90195**	**0.00777**	**0.00365**	**0.00010**

Source: Processed Data (2026)

Based on table 6 it can be seen that the calculation results forreturn and the risk of each share in the optimal portfolio for the 2017 period. Once the proportion of each share in the optimal portfolio is known, it can be calculated return and the risks. It can be seen that the stocks that make up the optimal portfolio havereturn of 0.00365. And the optimal portfolio risk is 0.00010. It can be concluded that the optimal portfolio that has been analyzed hasreturn which is greater than the possible risks faced.

Table 7. Return and Optimal Portfolio Risk of LQ45 Stocks for the 2018 Period

Stock Code	Zi	Wi	α	β	σei^2	$E(R_P)$	σP^2
				2018			
CPIN	3.14239	29.48%	0.00379	1.16124	0.00074		
PTBA	2.61290	24.51%	0.00267	0.63461	0.00069		
INKP	1.57740	14.80%	0.00395	1.58884	0.00127		
AMRT	1.44353	13.54%	0.00217	0.66449	0.00088		
ESSA	1.21979	11.44%	0.00379	1.03353	0.00203		
ACES	0.66242	6.21%	0.00134	0.74130	0.00054		
TOTAL	**10.65842**	**100.00%**	**0.01771**	**5.82401**	**0.00615**	**0.00312**	**0.00028**

Source: Processed Data (2026)

Based on table 7 it can be seen that the calculation results forreturn and the risk of each share in the optimal portfolio for the 2018 period. Once the proportion of each share in the optimal portfolio is known, it can be calculated return and the risks. It can be seen that the stocks that make up the optimal portfolio havereturn is 0.00312. And the optimal portfolio risk is 0.00028. It can be concluded that the optimal portfolio that has been analyzed hasreturn which is greater than the possible risks faced.

Table 8. Return and Optimal Portfolio Risk of LQ45 Stocks for the 2019 Period

Stock Code	Zi	Wi	α	β	σei^2	$E(R_P)$	σP^2
				2019			
BBCA	5.60264	37.96%	0.00096	0.83641	0.00006		
BRPT	5.20127	35.24%	0.00508	0.59255	0.00088		
EXCL	2.09815	14.22%	0.00207	1.45344	0.00052		
MAPI	0.97765	6.62%	0.00136	1.16466	0.00056		
ADRO	0.35972	2.44%	0.00119	1.44038	0.00062		
MEDC	0.28277	1.92%	0.00101	1.16352	0.00070		
TOWR	0.23625	1.60%	0.00091	1.13776	0.00048		
TOTAL	**14.75844**	**100.00%**	**0.01258**	**7.78872**	**0.00383**	**0.00270**	**0.00017**

Source: Processed Data (2026)

Based on table 8 it can be seen that the calculation results forreturn and the risk of each stock in the optimal portfolio for the 2019 period. Once the proportion of each stock in the optimal portfolio is known, it can be calculated return and the risks. It can be seen that the stocks that make up the optimal portfolio havereturn of 0.00270. And the optimal portfolio risk is 0.00017. It can be concluded that the optimal portfolio that has been analyzed hasreturn which is greater than the possible risks faced.

Table 9. Return and Optimal Portfolio Risk of LQ45 Stocks for the 2020 Period

Stock Code	Zi	Wi	α	β	σei²	E(Rₚ)	σₚ²
				2020			
HRUM	4.35424	53.14%	0.00376	0.43861	0.00068		
EMTK	2.06942	25.26%	0.00489	0.14396	0.00220		
ANTM	1.77020	21.60%	0.00443	1.63855	0.00101		
TOTAL	8.19386	100.00%	0.01308	2.22113	0.00390	0.00415	0.00052

Source: Processed Data (2026)

Based on table 9 it can be seen that the calculation results forreturn and the risk of each stock in the optimal portfolio for the 2020 period. Once the proportion of each stock in the optimal portfolio is known, it can be calculated return and the risks. It can be seen that the stocks that make up the optimal portfolio havereturn of 0.00415. And the optimal portfolio risk is 0.00052. It can be concluded that the optimal portfolio that has been analyzed hasreturn which is greater than the possible risks faced.

Table 10. Return and Optimal Portfolio Risk of LQ45 Stocks for the 2021 Period

Stock Code	Zi	Wi	α	β	σei²	E(Rₚ)	σₚ²
				2021			
HRUM	2.27904	25.54%	0.00530	1.90656	0.00180		
AMRT	1.47758	16.56%	0.00192	0.75171	0.00093		
ADRO	1.39627	15.65%	0.00168	1.30019	0.00059		
ESSA	1.29473	14.51%	0.00417	1.97936	0.00226		
ITMG	1.13604	12.73%	0.00165	1.18672	0.00076		
EMTK	0.88715	9.94%	0.00172	1.24585	0.00102		
TOWR	0.23065	2.58%	0.00062	0.69746	0.00049		
AKRA	0.22240	2.49%	0.00083	1.08456	0.00047		
TOTAL	8.92386	100.00%	0.01789	10.15241	0.00832	0.00344	0.00043

Source: Processed Data (2026)

Table 10 shows the calculation results for the return and risk of each stock in the optimal portfolio for the 2021 period. Once the proportion of each stock in the optimal portfolio is known, the return and risk can be calculated. The stocks that make up the optimal portfolio have a return of 0.00344, and the risk of the optimal portfolio is 0.00043. It can be concluded that the analyzed optimal portfolio has a return greater than the potential risks. It can be concluded that the analyzed optimal portfolio has a return that is greater than the possible risks faced.

Table 11. Return and Optimal Portfolio Risk of LQ45 Stocks for the 2022 Period

Stock Code	Zi	Wi	α	β	σei²	E(Rₚ)	σₚ²
				2022			
ITMG	3.75042	18.31%	0.00310	0.39970	0.00069		
MAPI	3.00306	14.66%	0.00327	0.76233	0.00080		
AMRT	2.62266	12.81%	0.00340	1.21553	0.00080		
MEDC	2.25718	11.02%	0.00371	0.85253	0.00123		
AKRA	1.53774	7.51%	0.00224	0.87878	0.00083		
KLBF	1.45311	7.10%	0.00112	0.58451	0.00030		
ADRO	1.10280	5.39%	0.00219	1.33784	0.00070		
PTBA	1.00927	4.93%	0.00145	0.88592	0.00047		
INCO	0.90016	4.40%	0.00195	1.07174	0.00088		
ESSA	0.74649	3.65%	0.00317	1.53177	0.00210		
ICBP	0.64520	3.15%	0.00068	0.41056	0.00026		
PGAS	0.56349	2.75%	0.00109	0.71997	0.00048		
INDF	0.47382	2.31%	0.00035	0.17218	0.00016		
BMRI	0.34736	1.70%	0.00137	1.21818	0.00020		
UNVR	0.06595	0.32%	0.00061	0.47569	0.00049		
TOTAL	20.47870	100.00%	0.02969	12.51723	0.01040	0.00273	0.00018

Source: Processed Data (2026)

Based on table 11 it can be seen that the calculation results forreturn and the risk of each stock in the optimal portfolio for the 2022 period. Once the proportion of each stock in the optimal portfolio is known, it can be calculated return and the risks. It can be seen that the stocks that make up the optimal portfolio havereturn is 0.00273. And the optimal portfolio risk is 0.00018. It can be concluded that the optimal portfolio that has been analyzed hasreturn which is greater than the possible risks faced.

Table 12 Return and Optimal Portfolio Risk of LQ45 Stocks for the 2023 Period

Stock Code	Zi	Wi	α	β	σei²	E(R$_P$)	σ$_P$²
				2023			
ACES	1.65714	18.24%	0.00167	0.77683	0.00085		
BBNI	1.61333	17.75%	0.00050	0.83426	0.00015		
BMRI	1.60119	17.62%	0.00058	1.43532	0.00015		
BRPT	1.50907	16.61%	0.00263	1.70282	0.00150		
BBRI	1.06926	11.77%	0.00044	1.20225	0.00012		
MAPI	1.03920	11.44%	0.00106	1.15317	0.00073		
GGRM	0.39680	4.37%	0.00053	1.07195	0.00060		
ICBP	0.12565	1.38%	0.00022	0.25878	0.00024		
AMRT	0.07508	0.83%	0.00027	0.66078	0.00031		
TOTAL	9.08671	100.00%	0.00791	9.09616	0.00466	0.00145	0.00013

Source: Processed Data (2026)

Based on table 12 it can be seen that the calculation results forreturn and the risk of each stock in the optimal portfolio for the 2023 period. Once the proportion of each stock in the optimal portfolio is known, it can be calculated return and the risks. It can be seen that the stocks that make up the optimal portfolio havereturn is 0.00145. And the optimal portfolio risk is 0.00013. It can be concluded that the optimal portfolio that has been analyzed hasreturn which is greater than the possible risks faced.

Table 13 Returnn and Optimal Portfolio Risk of LQ45 Stocks Period from 2013-2023

Year	Return Portofolio	Var Portofolio
2013	0.00183	0.00020
2014	0.00200	**0.00009**
2015	0.00149	0.00014
2016	**0.00625**	0.00043
2017	0.00365	0.00010
2018	0.00312	0.00028
2019	0.00270	0.00017
2020	0.00415	**0.00052**
2021	0.00344	0.00043
2022	0.00273	0.00018
2023	**0.00145**	0.00013
Average	0.002984	0.000243

Source: Processed Data (2026)

Based on table 13 it can be seen thatreturn the portfolio with the highest value was in 2016 at 0.00625 andreturn the portfolio with the lowest value was in 2023 at 0.00145. The highest portfolio risk was in 2020 at 0.00052, and the lowest portfolio risk was in 2014 at 0.00009 return portfolio from 2013-2023 is 0.002984 with a portfolio risk of 0.000243.
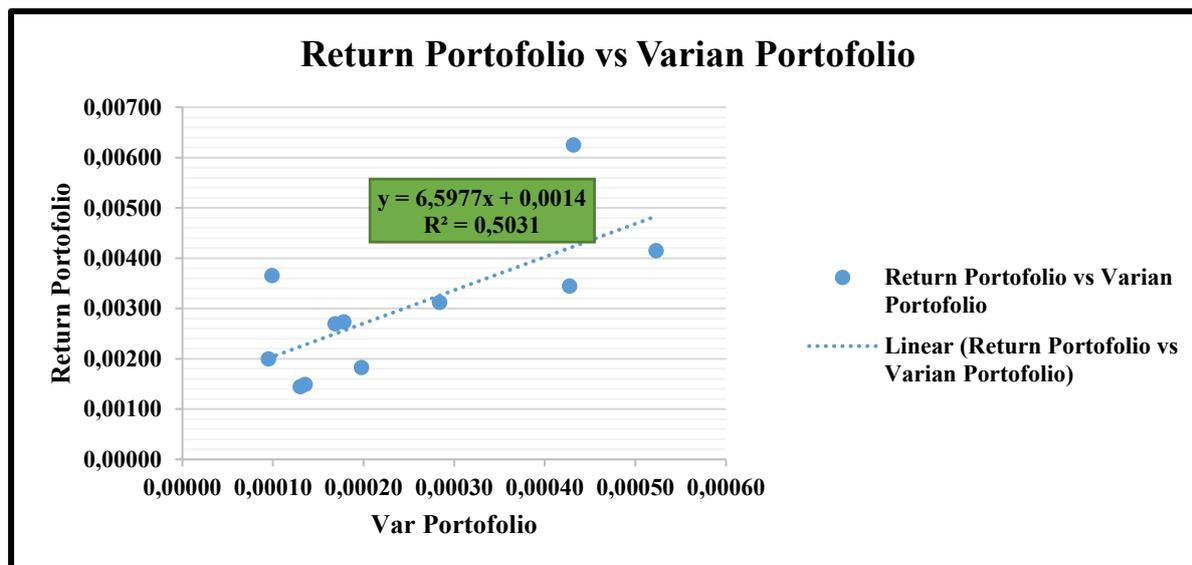
Source: Processed Data (2026)
Figure 3 Return and Optimal Portfolio Risk of LQ45 Stocks for the 2013-2023

Based on Figure 3, it can be seen thatreturn portfolio and portfolio variance, the regression coefficient for portfolio variance is 6.59977. The R square is 0.5031 or 50.31%. This indicates that 50.31%return portfolio can be explained or influenced by portfolio variance.

Table 14. Return, Variance, Standard Deviation of Markowitz Model Portfolio and Single Index Model Period 2013-2023

Year	Markowitz			Single Index Model			Difference		
	Return Portfolio	Variance Portfolio	Standard Deviasi Portfolio	Return Portfolio	Variance Portfolio	Standard Deviasi Portfolio	Return Portfolio	Variance Portfolio	Standard Deviasi Portfolio
2013	0.00183	0.00020	0.01405	0.00183	0.00080	0.02825	-	-0.00060	-0.01420
2014	0.00200	0.00009	0.00973	0.00200	0.00044	0.02095	-	-0.00034	-0.01122
2015	0.00149	0.00014	0.01164	0.00149	0.00055	0.02355	-	-0.00042	-0.01191
2016	0.00625	0.00043	0.02078	0.00625	0.00132	0.03633	-	-0.00089	-0.01556
2017	0.00365	0.00010	0.00993	0.00365	0.00060	0.02440	-	-0.00050	-0.01447
2018	0.00312	0.00028	0.01684	0.00312	0.00106	0.03259	-	-0.00078	-0.01575
2019	0.00270	0.00017	0.01297	0.00270	0.00052	0.02285	-	-0.00035	-0.00987
2020	0.00415	0.00052	0.02286	0.00415	0.00125	0.03535	-	-0.00073	-0.01249
2021	0.00344	0.00043	0.02067	0.00344	0.00140	0.03746	-	-0.00098	-0.01678
2022	0.00273	0.00018	0.01334	0.00273	0.00082	0.02859	-	-0.00064	-0.01525
2023	0.00145	0.00013	0.01141	0.00145	0.00064	0.02523	-	-0.00051	-0.01382

Source: Processed Data (2026)

Based on table 14, it can be seen that the portfolio returns using the Markowitz Model and Single Index Model methods for the 2013-2023 period do not show any differences in the results obtained for portfolio variance by having differences in the results obtained. for the standard deviation of the portfolio there are differences in the results obtained. Then, after conducting an evaluation and obtaining the results, it was found that the recommended shares and the use of the predetermined proportion of funds were the most optimal portfolio.

Table 15. Percentage of Stock Investments from Portfolio Recommendations for the 2013-2023 Period

Sector	Stock Code	Wi 2013	Wi 2014	Wi 2015	Wi 2016	Wi 2017	Wi 2018
Consumer Non Cyclicals	AMRT	-	-	0.10890	**0.00618**	-	0.13544
Energy	MEDC	0.17867	**0.26683**	-	0.03918	0.06952	-
Infrastructures	TOWR	0.21441	0.21051	0.28721	-	0.01874	-
Technology	EMTK	**0.30092**	0.04919	0.10587	-	-	-
Basic Materials	ESSA	-	0.05365	-	-	0.03702	0.11444

Sector	Stock Code	Wi 2013	Wi 2014	Wi 2015	Wi 2016	Wi 2017	Wi 2018
Consumer Cyclicals	ACES	-	-	**0.02609**	-	0.04506	**0.06215**
Energy	ADRO	-	-	-	0.14902	-	-
Basic Materials	BRPT	-	-	-	**0.22190**	0.13704	-
Consumer Non Cyclicals	ICBP	0.09499	**0.00996**	-	-	-	-
Basic Materials	INCO	0.00313	0.06688	-	0.02302	-	-
Consumer Non Cyclicals	UNVR	0.00126	-	0.05779	-	0.09865	-
Energy	AKRA	-	-	**0.41415**	-	-	-
Financials	BBNI	-	0.03438	-	-	**0.16922**	-
Financials	BBRI	-	0.01115	-	-	0.06385	-
Financials	BMRI	-	-	-	-	0.01309	-
Energy	HRUM	-	-	-	0.10595	-	-
Basic Materials	INKP	0.20135	-	-	-	0.13474	0.14800
Energy	ITMG	-	-	-	0.15060	-	-
Healthcare	KLBF	**0.00081**	0.13004	-	-	-	-
Consumer Cyclicals	MAPI	-	-	-	-	-	-
Energy	PTBA	-	-	-	0.11143	-	0.24515
Basic Materials	ANTM	-	-	-	0.19272	-	-
Financials	BBCA	-	-	-	-	0.03142	-
Infrastructures	EXCL	-	-	-	-	**0.00055**	-
Consumer Non Cyclicals	GGRM	-	0.14358	-	-	-	-
Energy	PGAS	-	0.02383	-	-	-	-
Financials	BBTN	-	-	-	-	0.16057	-
Consumer Non Cyclicals	CPIN	-	-	-	-	-	**0.29483**
Consumer Non Cyclicals	INDF	-	-	-	-	-	-
Infrastructures	TLKM	0.00447	-	-	-	-	-
Industrials	UNTR	-	-	-	-	0.02052	-
AVERAGE		0.03226	0.03226	0.03226	0.03226	0.03226	0.03226

Sector	Stock Code	Wi 2019	Wi 2020	Wi 2021	Wi 2022	Wi 2023	Total	Average
Consumer Non Cyclicals	AMRT	-	-	0.16558	0.12807	**0.00826**	**0.55241**	**0.05022**
Energy	MEDC	0.01916	-	-	0.11022	-	**0.68358**	**0.06214**
Infrastructures	TOWR	**0.01601**	-	0.02585	-	-	**0.77273**	**0.07025**
Technology	EMTK	-	0.25256	0.09941	-	-	**0.80794**	**0.07345**
Basic Materials	ESSA	-	-	0.14509	0.03645	-	**0.38665**	**0.03515**
Consumer Cyclicals	ACES	-	-	-	-	**0.18237**	**0.31566**	**0.02870**
Energy	ADRO	0.02437	-	0.15646	0.05385	-	**0.38371**	**0.03488**
Basic Materials	BRPT	0.35243	-	-	-	0.16607	**0.87744**	**0.07977**
Consumer Non Cyclicals	ICBP	-	-	-	0.03151	0.01383	**0.15028**	**0.01366**
Basic Materials	INCO	-	-	-	0.04396	-	**0.13699**	**0.01245**
Consumer Non Cyclicals	UNVR	-	-	-	**0.00322**	-	**0.16092**	**0.01463**
Energy	AKRA	-	-	**0.02492**	0.07509	-	**0.51416**	**0.04674**
Financials	BBNI	-	-	-	-	0.17755	**0.38115**	**0.03465**
Financials	BBRI	-	-	-	-	0.11767	**0.19268**	**0.01752**

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Sector	Stock Code	Wi 2019	Wi 2020	Wi 2021	Wi 2022	Wi 2023	Total	Average
Financials	BMRI	-	-	-	0.01696	0.17621	**0.20626**	**0.01875**
Energy	HRUM	-	**0.53140**	**0.25539**	-	-	**0.89274**	**0.08116**
Basic Materials	INKP	-	-	-	-	-	**0.48408**	**0.04401**
Energy	ITMG	-	-	0.12730	**0.18314**	-	**0.46105**	**0.04191**
Healthcare	KLBF	-	-	-	0.07096	-	**0.20181**	**0.01835**
Consumer Cyclicals	MAPI	0.06624	-	-	0.14664	0.11436	**0.32725**	**0.02975**
Energy	PTBA	-	-	-	0.04928	-	**0.40586**	**0.03690**
Basic Materials	ANTM	-	**0.21604**	-	-	-	**0.40876**	**0.03716**
Financials	BBCA	**0.37962**	-	-	-	-	**0.41104**	**0.03737**
Infrastructures	EXCL	0.14217	-	-	-	-	**0.14272**	**0.01297**
Consumer Non Cyclicals	GGRM	-	-	-	-	0.04367	**0.18725**	**0.01702**
Energy	PGAS	-	-	-	0.02752	-	**0.05135**	**0.00467**
Financials	BBTN	-	-	-	-	-	**0.16057**	**0.01460**
Consumer Non Cyclicals	CPIN	-	-	-	-	-	**0.29483**	**0.02680**
Consumer Non Cyclicals	INDF	-	-	-	0.02314	-	**0.02314**	**0.00210**
Infrastructures	TLKM	-	-	-	-	-	**0.00447**	**0.00041**
Industrials	UNTR	-	-	-	-	-	**0.02052**	**0.00187**
AVERAGE		0.03226	0.03226	0.03226	0.03226	0.03226		

Source: Processed Data (2026)

Based on table 15, we can see the recommended shares in the optimal portfolio for the 2013-2023 period with the respective recommended percentage proportions.

Table 16 Frequency Sektor Saham Rekomendasi Portofolio Periode 2013-2023

Sector	Frequency 2013-2023	Freq 2013	Freq 2014	Freq 2015	Freq 2016	Freq 2017	Freq 2018	Freq 2019	Freq 2020	Freq 2021	Freq 2022	Freq 2023
Energy	7	1	2	1	5	1	1	2	1	4	6	-
Basic Materials	5	2	2	-	3	3	2	1	1	1	2	1
Consumer Non Cyclicals	6	2	2	2	1	1	2	-	-	1	4	3
Infrastructures	3	2	1	1	-	2	-	2	-	1	-	-
Consumer Cyclicals	2	-	-	1	-	1	1	1	-	-	1	2
Technology	1	1	1	1	-	-	-	-	1	1	-	-
Financials	5	-	2	-	-	5	-	1	-	-	1	3
Healthcare	1	1	1	-	-	-	-	-	-	-	1	-
Industrials	1	-	-	-	-	1	-	-	-	-	-	-
TOTAL	31	9	11	6	9	14	6	7	3	8	15	9
MAX	7	2	2	2	5	5	2	2	1	4	6	3
MIN	1	1	1	1	1	1	1	1	1	1	1	1

Source: Processed Data (2026)

Based on table 16, the sectors for stocks recommended in the optimal portfolio for the 2013-2023 period can be seen. For the 2013-2023 period, it can be seen that the number of stocks recommended in the optimal portfolio is stocks with the Energy sector, namely 7 stocks, then the Consumer Non-Cyclicals sector with 6 stocks, Basic Materials and Financials with 5 stocks, Infrastructure with 3 stocks, Consumer Cyclicals with 2 stocks, for Technology, Healthcare, and Industrial with 1 stock each. If seen from the table for the sectors that appeared the most between 2013-2023 in the following order, the Energy sector in 10 years, Basic Materials in 10 years, Consumer Non-Cyclicals in 9 years, Infrastructure and Consumer Cyclicals in 6 years, Technology and Financials in 5 years, Healthcare in 3 years, and industrial in 1 year.

From Table 16, for 2013, the sectors for stocks recommended in the optimal portfolio were energy, basic materials, consumer non-cyclicals, infrastructure, technology, and healthcare. In 2014, the sectors for stocks recommended in the optimal portfolio were energy, basic materials, consumer non-cyclicals, infrastructure, technology, financials, and healthcare. In 2015, the sectors for stocks recommended in the optimal portfolio were

energy, consumer non-cyclicals, infrastructure, consumer cyclicals, and technology. In 2016, the sectors for stocks recommended in the optimal portfolio were energy, basic materials, and consumer non-cyclicals. In 2017, the sectors for stocks recommended in the optimal portfolio were energy, basic materials, consumer non-cyclicals, infrastructure, consumer cyclicals, financials, and industrials. In 2018, the sectors for stocks recommended in the optimal portfolio were energy, basic materials, consumer non-cyclicals, and consumer cyclicals. For 2019, the recommended stock sectors for an optimal portfolio were energy, basic materials, infrastructure, consumer cyclicals, and financials. For 2020, the recommended stock sectors for an optimal portfolio were energy, basic materials, and technology. For 2021, the recommended stock sectors for an optimal portfolio were energy, basic materials, consumer non-cyclicals, infrastructure, and technology. For 2022, the recommended stock sectors for an optimal portfolio were energy, basic materials, consumer non-cyclicals, consumer cyclicals, financials, and healthcare. For 2023, the recommended stock sectors for an optimal portfolio were basic materials, consumer non-cyclicals, consumer cyclicals, and financials.

Table 17 Expected Return on Stock Investments from Recommended Portfolios for the 2013-2023 Period

Sector	Stock Code	ER 2013	ER 2014	ER 2015	ER 2016	ER 2017	ER 2018
Basic Materials	BRPT	-	-	-	**0.01090**	0.00500	-
Energy	MEDC	0.00130	**0.00270**	-	0.00294	0.00533	-
Basic Materials	ESSA	-	0.00137	-	-	0.00220	0.00374
Basic Materials	INKP	**0.00363**	-	-	-	**0.00787**	**0.00388**
Energy	HRUM	-	-	-	0.00538	-	-
Technology	EMTK	0.00176	0.00249	0.00186	-	-	-
Energy	ADRO	-	-	-	0.00563	-	-
Energy	ITMG	-	-	-	0.00492	-	-
Consumer Non Cyclicals	AMRT	-	-	0.00101	**0.00057**	-	0.00214
Basic Materials	ANTM	-	-	-	0.00493	-	-
Energy	PTBA	-	-	-	0.00489	-	0.00264
Basic Materials	INCO	**0.00073**	0.00185	-	0.00304	-	-
Infrastructures	TOWR	0.00093	0.00195	0.00080	-	**0.00070**	-
Consumer Cyclicals	MAPI	-	-	-	-	-	-
Energy	AKRA	-	-	**0.00216**	-	-	-
Consumer Cyclicals	ACES	-	-	**0.00061**	-	0.00176	**0.00131**
Financials	BBNI	-	0.00197	-	-	0.00260	-
Financials	BBRI	-	0.00215	-	-	0.00187	-
Consumer Non Cyclicals	UNVR	0.00109	-	0.00075	-	0.00159	-
Financials	BMRI	-	-	-	-	0.00154	-
Healthcare	KLBF	0.00110	0.00146	-	-	-	-
Consumer Non Cyclicals	CPIN	-	-	-	-	-	0.00373
Infrastructures	EXCL	-	-	-	-	0.00139	-
Consumer Non Cyclicals	ICBP	0.00134	**0.00107**	-	-	-	-
Financials	BBTN	-	-	-	-	0.00330	-
Financials	BBCA	-	-	-	-	0.00145	-
Industrials	UNTR	-	-	-	-	0.00245	-
Energy	PGAS	-	0.00122	-	-	-	-
Consumer Non Cyclicals	GGRM	-	0.00159	-	-	-	-
Infrastructures	TLKM	0.00105	-	-	-	-	-
Consumer Non Cyclicals	INDF	-	-	-	-	-	-
TOTAL		0.01293	0.01981	0.00719	0.04321	0.03906	0.01745
AVERAGE		0.00042	0.00064	0.00023	0.00139	0.00126	0.00056
MAX		**0.00363**	**0.00270**	**0.00216**	**0.01090**	**0.00787**	**0.00388**
MIN		**0.00073**	**0.00107**	**0.00061**	**0.00057**	**0.00070**	**0.00131**

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Sector	Stock Code	ER 2019	ER 2020	ER 2021	ER 2022	ER 2023	Total	Average
Basic Materials	BRPT	**0.00514**	-	-	-	**0.00309**	**0.02413**	**0.00219**
Energy	MEDC	0.00113	-	-	**0.00384**	-	**0.01724**	**0.00157**
Basic Materials	ESSA	-	-	0.00485	0.00339	-	**0.01556**	**0.00141**
Basic Materials	INKP	-	-	-	-	-	**0.01539**	**0.00140**
Energy	HRUM	-	0.00374	0.00595	-	-	**0.01507**	**0.00137**
Technology	EMTK	-	**0.00489**	0.00215	-	-	**0.01314**	**0.00119**
Energy	ADRO	0.00134	-	0.00212	0.00239	-	**0.01148**	**0.00104**
Energy	ITMG	-	-	0.00205	0.00315	-	**0.01013**	**0.00092**
Consumer Non Cyclicals	AMRT	-	-	0.00217	0.00358	0.00045	**0.00992**	**0.00090**
Basic Materials	ANTM	-	0.00432	-	-	-	**0.00926**	**0.00084**
Energy	PTBA	-	-	-	0.00158	-	**0.00911**	**0.00083**
Basic Materials	INCO	-	-	-	0.00210	-	**0.00773**	**0.00070**
Infrastructures	TOWR	0.00103	-	0.00085	-	-	**0.00627**	**0.00057**
Consumer Cyclicals	MAPI	0.00148	-	-	0.00338	0.00137	**0.00623**	**0.00057**
Energy	AKRA	-	-	0.00120	0.00237	-	**0.00573**	**0.00052**
Consumer Cyclicals	ACES	-	-	-	-	0.00187	**0.00555**	**0.00050**
Financials	BBNI	-	-	-	-	0.00073	**0.00530**	**0.00048**
Financials	BBRI	-	-	-	-	0.00077	**0.00479**	**0.00044**
Consumer Non Cyclicals	UNVR	-	-	-	0.00068	-	**0.00411**	**0.00037**
Financials	BMRI	-	-	-	0.00155	0.00097	**0.00406**	**0.00037**
Healthcare	KLBF	-	-	-	0.00120	-	**0.00376**	**0.00034**
Consumer Non Cyclicals	CPIN	-	-	-	-	-	**0.00373**	**0.00034**
Infrastructures	EXCL	0.00222	-	-	-	-	**0.00361**	**0.00033**
Consumer Non Cyclicals	ICBP	-	-	-	0.00074	0.00029	0.00344	0.00031
Financials	BBTN	-	-	-	-	-	**0.00330**	**0.00030**
Financials	BBCA	0.00105	-	-	-	-	**0.00250**	**0.00023**
Industrials	UNTR	-	-	-	-	-	**0.00245**	**0.00022**
Energy	PGAS	-	-	-	0.00119	-	**0.00241**	**0.00022**
Consumer Non Cyclicals	GGRM	-	-	-	-	0.00082	**0.00241**	**0.00022**
Infrastructures	TLKM	-	-	-	-	-	**0.00105**	**0.00010**
Consumer Non Cyclicals	INDF	-	-	-	0.00038	-	**0.00038**	**0.00003**
AVERAGE		0.00043	0.00042	0.00069	0.00102	0.00033		

Source: Processed Data (2026)

Based on table 17, we can see the recommended shares in the optimal portfolio for the 2013-2023 period with their respective ExpectedReturn each of them. In the 2013-2023 period, it can be seen that the shares with ExpectedReturn The highest is BRPT with a total of 0.02413 and an average of 0.00219 Expected.

Return The lowest is INDF with a total of 0.000038 and an average of 0.00003. From Table 17 for 2013-2023, the recommended stocks can be seen, if seen from the events that occurred in that year as follows, in 2013, the tapering policy by the Federal Reserve and the increase in fuel prices in Indonesia caused significant market volatility. The announcement of tapering by the Federal Reserve, the increase in subsidized fuel prices in Indonesia, and the increase in interest rates by Bank Indonesia had a significant impact on the stock market. Under these conditions, the optimal portfolio recommended according to the following analysis is EMTK, TOWR, INKP, MEDC, ICBP, INCO, TLKM, UNVR, and KLBF. EMTK and TOWR media and telecommunications sectors remained stable amid market volatility. Stocks such as MEDC and INCO benefited from fluctuations in commodity prices. In 2014, the Fed's stimulus reduction and political uncertainty stemming from the Indonesian presidential election, and the optimal stocks recommended according to the following analysis were MEDC, TOWR, GGRM, KLBF, INCO, ESSA, EMTK, BBNI, PGAS, BBRI, and ICBP, which offered stability. The emphasis on energy and telecommunications stocks such as MEDC, TOWR, and PGAS reflected a response to the Fed's stimulus reduction, which increased energy prices.

2015 was marked by the PBoC's devaluation of the yuan and the first simultaneous regional elections in December, which benefited distribution companies like AKRA and other stocks like TOWR, AMRT, EMTK, UNVR, and ACES in optimal portfolios. Focusing on energy distribution stocks like AKRA and retail stocks like AMRT and ACES demonstrates a strategy to navigate market uncertainty caused by the yuan devaluation.

Global uncertainty in 2016 due to the US Election and Brexit is in line with recommended stocks such as BRPT, ANTM, ITMG, ADRO, PTBA, HRUM, MEDC, INCO, and AMRT which have good prospects in the energy and mining sectors.

In 2017, Trump's US tax reforms increased capital flows to emerging markets, and Indonesia's simultaneous regional elections made stocks like BBNI, BBTN, BRPT, INKP, UNVR, MEDC, BBRI, ACES, ESSA, BBCA, UNTR, TOWR, BMRI, and EXCL part of optimal portfolios. Recommendations for banking stocks like BBNI, BBTN, and BBCA demonstrate confidence in the financial sector.

In 2018, the US-China trade war increased global uncertainty and the simultaneous regional elections in Indonesia were related to the portfolio recommendations given such as CPIN, PTBA, INKP, AMRT, ESSA, and ACES, focusing on food industry stocks such as CPIN and retail stocks such as AMRT reflecting a strategy to face global economic uncertainty.

The 2019 Indonesian presidential election and drone attacks on oil facilities in Saudi Arabia heightened domestic political uncertainty, and the recommended optimal portfolio consists of BBCA, BRPT, EXCL, MAPI, ADRO, MEDC, and TOWR. Banking and energy stocks, such as BBCA and BRPT, demonstrate a response to political uncertainty and energy price volatility.

In 2020, the COVID-19 pandemic shook global markets, and technology and mining companies like HRUM, EMTK, and ANTM became dominant in optimal portfolios. The focus on mining and media stocks like HRUM and EMTK demonstrates adaptation to drastic changes in the global economy.

The COVID-19 vaccination program in 2021 helped the global economic recovery, and with the inauguration of Joe Biden as US President, recommended stocks such as HRUM, AMRT, ADRO, ESSA, ITMG, EMTK, TOWR, and AKRA showed improved performance during the period due to the recovery from the COVID-19 pandemic. Mining and energy stocks such as HRUM and ADRO illustrate the response to the global economic recovery.

The increase in fuel prices in Indonesia in 2022 increased operational costs, and the Russian invasion of Ukraine and the subsequent increase in fuel prices in Indonesia have made energy stocks and companies with good operational control, as well as recovering from the COVID-19 pandemic, such as stocks recommended in the optimal portfolio, namely ITMG, MAPI, AMRT, MEDC, AKRA, KLBF, ADRO, PTBA, INCO, ESSA, ICBP, PGAS, INDF, BMRI, and UNVR, part of the optimal portfolio. The focus on energy and retail stocks such as ITMG and MAPI reflects adaptation to global energy price volatility.

2023 was marked by interest rate hikes by the Fed, which increased borrowing costs and affected market liquidity. The recommended portfolio stocks are: ACES, BBNI, BMRI, BRPT, BBRI, MAPI, GGRM, ICBP, and AMRT. Optimal portfolio stock recommendations include retail and banking stocks, such as ACES, BBNI, and BMRI, which have demonstrated a response to tight monetary policy and economic uncertainty. They are recommended for optimal portfolios due to their potential to survive and thrive under these conditions.

CONCLUSION

This study aims to apply the single index method to optimal portfolio formation and performance evaluation. Based on portfolio calculations and analysis using the Single Index Model on LQ45 stocks for the 2013-2023 period, the following conclusions are obtained:

Based on the results, it can be seen that the performance of the Single Index and Markowitz methods in forming an optimal portfolio produces...return the same portfolio, only those showing differences in variance and standard deviation have different values between the methods, with the values shown being higher in the Single Index method than in the Markowitz method.

Based on the calculation of 34 stock samples studied, they were selected using a single index method so that company shares were obtained that met the criteria and were worthy of being included in the optimal stock portfolio for the 2013-2023 period, there were 31, namely HRUM, BRPT, EMTK, TOWR, MEDC, AMRT, AKRA, INKP, ITMG, BBCA, ANTM, PTBA, ESSA, ADRO, BBNI, MAPI, ACES, CPIN, BMRI, KLBF, BBRI, GGRM, UNVR, BBTN, ICBP, EXCL, INCO, PGAS, INDF, UNTR, and TLKM.

The optimal portfolio is expected to provide return with a risk of, for the period 2013 return of 0.183% and a risk of 0.020%. For the 2014 period return of 0.200% and a risk of 0.009%. For the 2015 period return of 0.149% and a risk of 0.014%. For the 2016 period return of 0.625% and a risk of 0.043%. For the 2017 period return of 0.365% and a risk of 0.010%. For the 2018 period return of 0.312% and a risk of 0.028%. For the 2019 period return of 0.270% and a risk of 0.017%. For the 2020 period return of 0.415% and a risk of 0.052%. For the 2021 period return of 0.344% and a risk of 0.043%. For the 2022 period return of 0.273% and a risk of 0.018%. For the 2023 period return of 0.145% and a risk of 0.013%.

The average fund proportion for each stock that forms the optimal portfolio for the 2013-2023 period is HRUM at 8.12%, BRPT at 7.98%, EMTK at 7.34%, TOWR at 7.02%, MEDC at 6.21%, AMRT at 5.02%, AKRA at 4.67%, INKP at 4.4%, ITMG at 4.19%, BBCA at 3.74%, ANTM at 3.72%, PTBA at 3.69%, ESSA at 3.52%, ADRO at 3.49%, BBNI at 3.47%, MAPI at 2.98%, ACES at 2.87%, CPIN at 2.68%, BMRI at 1.88%, KLBF at 1.83%, BBRI at 1.75%, GGRM by 1.7%, UNVR by 1.46%, BBTN by 1.46%, ICBP by 1.37%, EXCL by 1.3%, INCO by 1.25%, PGAS by 0.47%, INDF by 0.21%, UNTR by 0.19%, and TLKM by 0.04%.

By paying attention to the conclusions above, there are suggestions that are expected to be useful for certain parties, namely: (1) For investors, as follows: For investors who plan to invest in shares, especially in the LQ45 stock index, it can be a reference for investing by forming a portfolio using...excess return to beta using the single index model method and it is also necessary to pay attention to the company's risk section, as well as paying attention to the shares listed on the LQ45 index in order to obtain an optimal portfolio that will produce better investment performance in the future. (2) For further researchers, as follows: For further researchers, it is hoped that they can use or compare with other models or other stock indexes to form an optimal portfolio to see the differences or similarities.

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