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Comparative Analysis of Optimal Stock Portfolio Results using The Markowitz Method and a Single Index (Study on LQ 45 Company Shares Listed on the Indonesia Stock Exchange Period January – December 2024)

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Abstract: In the era of digital technology advancement, Indonesia has become an alternative investment destination in the capital market, attracting global attention. Investing in the capital market offers high returns and significant risks. Therefore, investors need strategic skills to mitigate risk. Risk reduction can be achieved through asset diversification, also known as portfolio formation. This study aims to develop an optimal portfolio using the Markowitz Single Index method and to determine the optimal investment proportion for the LQ45 Index. The sample used was the LQ45 index members from January 2024 to December 2024. This method is a comparative study with daily data, using calculations of realized return, variance, covariance, and cut-off rate for a single index. The analysis using the Markowitz method resulted in seven stocks as optimal portfolio recommendations, the stock composition is different between the two methods with a return of 0.15% and a risk of 1.25%. The analysis using the Single Index method resulted in seven stocks as optimal portfolio recommendations, with a return of 0.037% and a risk of 0.07%.

Keyword: Optimal Portfolio, Single Index Model, Markowitz Model, Stock Investment.

INTRODUCTION

The Capital Market Law, namely Law Number 8 of 1995 Article 1 Number 13 explains, Capital markets are activities related to the public offering and trading of securities, public companies related to the securities they issue, as well as institutions and professions related to securities. The Capital Market can be defined as a market that trades various long-term financial instruments (securities), both in the form of debt and equity issued by securities companies. When a company requires large capital at a low cost, the capital market plays a role as a means that can facilitate the company to obtain cheap funds. The flow of investment in a country can be seen from the movement of stock prices in the capital market.

The high liquidity of stock trading indicates that the capital market has a place in society as a means of investment.

The Financial Services Authority (OJK) released data showing that Indonesia's national financial literacy rate was 3.79% in 2023 and 4.40% in 2024. Meanwhile, national financial inclusion was 0.11% in 2025 and 1.25% in 2024 (data downloaded on March 17, 2023, at 6:25 PM). The data shows that Indonesians' participation in investing in the capital market is low.

Variety of instruments investment encourages prospective investors to be proficient in analyzing investment objects, particularly in the capital market. The amount of investment made by an investor is based on the expected future returns. The more positive the market outlook is, the more likely investors are to entrust their funds to investments. The essence of investing is inseparable from two main factors: return and risk. The relationship between these two factors is linear: the greater the expected return, the greater the risk faced. Consequently, prospective investors are required to be intelligent and wise in determining their target allocation of funds and assets when investing in the capital market.

Research conducted by (Christelis, D., T, Japelli., M, Padula: 2008) shows that investment behavior tendencies are based on cognitive skills or knowledge. Cognitive skills and knowledge will influence the level of rationality of a potential investor in making investment decisions. This rationality can be measured by how a potential investor determines and selects investments that will be the target of asset allocation with the expectation of maximum returns or returns with a certain level of risk or have the minimum risk with a certain level of return.

Indonesia has several stock indexes that investors use as references for investment decisions. The stock index is a way to describe the overall movement of stocks based on predetermined criteria. It is useful for investors to observe fluctuations in stock prices and as a comparative tool in assessing the performance of stock-related investments. Two of the many stock exchanges in Indonesia, the Jakarta Composite Index (JCI) and the LQ45 (Liquidity 45), are the most well-known and popular indices for assessing investment performance. Using the JCI as a proxy for calculating market returns has a weakness the JCI uses the entire capitalization of listed stocks for its weighting, which is less effective in reflecting actual stock movements. Therefore, the JCI only reflects the movement of actively traded stocks on the exchange and does not accurately reflect fewer active stocks. Meanwhile, the stocks included in the LQ45 index are stocks with good liquidity, large market capitalization, massive transaction activity, good financial condition, small company value fluctuations, and have been objectively selected by the IDX, which adds to the safe and low-risk image of investing in LQ45.

In general, investors are risk averse. Therefore, the LQ45 index was chosen as the research object, based on the basic assumption that it eliminates unsystematic risk in terms of stock liquidity, which will be included in the optimal portfolio candidates. The LQ45 index consists of 45 publicly traded companies in Indonesia with the best liquidity and positive market capitalization prospects. The LQ45 index membership changes over time. The IDX evaluates listed stocks every three months and makes adjustments every six months in February and August.

Although the LQ45 index boasts many advantages and tends to be popular with investors, it is possible for the index to experience unstable and worrying fluctuations in returns. As shown in table 1 of the 29 companies listed on the LQ45, only three experienced a positive trend, or 89.6% experienced a negative trend, illustrating the instability of the company's value in the index.

This phenomenon encourages scientists, experts, and investment practitioners, particularly those in the capital market, to develop and innovate more precise methods and

approaches to ensure that expectations regarding returns and risks become truly effective and optimal investment decisions. This means that at a given level of return, an investment decision with minimal risk can be selected, or vice versa, a certain risk with an investment decision that provides a maximum return. Various variations and combinations of existing methods and knowledge can include fundamental technical analysis, single investments with massive investments (portfolios), systematic and unsystematic risks, and of course, the rational and irrational nature of an investor in complex investments in determining investment goals and visions.

Investors need to understand and be aware of the "high risk, high return" principle when investing, especially in the capital market. Investors can mitigate this risk by diversifying their stocks and creating an optimal portfolio. Diversification in investing is crucial due to the uncertainty surrounding the future direction of the economy. Since Harry Markowitz (1952) coined modern portfolio theory, investment risk has been reduced through efficient portfolios, so that the risk is lower than the risk of each individual investment instrument (Zubir, 2011:19). The problem with portfolio formation is that there are countless possible portfolios that can be formed from combinations of risk assets available in the market. The number of combinations in an efficient portfolio can be infinite due to the wide variety of stock options.

A portfolio is categorized as efficient if it has the same level of risk, is able to provide a higher level of return, or is able to generate the same level of return but with lower risk. In accordance with the definition of an efficient portfolio, the LQ 45 Index can be called an efficient portfolio (Windy, et al.: 2014). Meanwhile, an optimal portfolio is an efficient portfolio chosen by investors with the hope of providing maximum returns in the future. The optimal portfolio is formed from stocks derived from indexes that investors use to analyze comparative investment performance, especially those related to stocks.

METHOD

This study illustrates and explains the existence of portfolio theory in its application to investment activities, particularly in the capital market. This study uses secondary data obtained and accessed through the official Yahoo Finance website and also tracked stock prices listed on the LQ-45 on the Indonesia Stock Exchange for the 2024 period. The sample in this study consists of 37 of the 45 companies that are the object of this study. The analysis technique in this study uses a formula that has been formulated based on each existing portfolio theory. The following is a description of the analysis technique, which also illustrates the measurement of variables:

Analysis Techniques

The sequence of procedures carried out to form an optimal portfolio using the Markowitz method is:

1. Collecting daily Close Price data for stocks included in the L 45 Index during the research period, namely 2024.
2. Calculating realized stock returns Realized returns are the percentage of the closing price of stock A on day/month/year minus the closing price of stock A on day/month/year t-1, then the result is divided by the closing price of stock A on month t-1.

$$Ri = \frac{P_t - (P_t^{-}{}_1)}{P_{t-1}}$$

3. The expected return level for each individual share is the weighted average of the realized share returns.

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

4. Variance stock, namely the deviation from the average stock return

$$\sigma^2 i = \frac{\sum_{t=1}^{n} (Ri - E(Ri))^2}{n}$$

5. Standard deviation, which is the level of risk accepted by investors in carrying out investment activities in shares.

$$SD = \sqrt{\sigma^2 i}$$

6. The covariance between stock returns indicates the relationship between the direction of movement of security returns. A positive covariance indicates that both stocks are moving in the same direction, while a negative covariance indicates that both stocks are moving in opposite directions. A zero covariance indicates that the stocks have no effect on each other.

$$Cov(R_A, R_B) = \sigma R_A, R_B$$
$$= \sum_{i=1}^{n} \frac{[(R_{Ai} - E(R_A).(R_{Bi} - E(R_{Bi})]}{n}$$

7. Correlation is a statistical term for an indicator that shows the relationship between two assets. Correlation values can be "strong" or "weak," indicated by a number ranging from 0 for a very weak relationship to 1 for a very strong relationship. Correlation values can also be "positive" if the two assets tend to move in the same direction, or "negative" if they tend to move in opposite directions. A value equal to 0 indicates no relationship at all.

$$\rho = \frac{n\sum XY - \sum X \sum Y}{\sqrt{\{[n\sum X^2 - (\sum X)][n\sum Y^2 - (\sum Y)^2]\}}}$$

8. Expected Return portfolio is the weighted average of the expected returns of each individual security in the portfolio

$$E(R_p) = \sum_{i=1}^{n} (w_i . E(R_i)$$

9. Portfolio variance and portfolio standard deviation are used to measure the deviation and risk of stocks that have been formed into an optimal portfolio.

Variance: $\sigma_p^2 = w_A^2 . \sigma_A^2 + w_B^2 . \sigma_B^2 + 2 w_A w_B \sigma_{AB}$

Standard deviation: $\sigma p = \sqrt{\sigma_p{}^2},$

The steps used in forming an optimal portfolio using the Single Index method are:

1. Collecting daily Close Price data for stocks included in the L 45 Index during the research period, namely 2024.
2. Calculating realized stock returns

Return realization is the percentage of the closing price of share A on day/month/year t minus the closing price of share A on day/month/year t-1 then the result is divided by the closing price of share and one-month t-1.

$$\mathbf{Ri} = \frac{\mathbf{P_t} - (\mathbf{P_t}^{-}{}_1)}{\mathbf{P_{t-1}}}$$

3. The expected return level for each individual share is the weighted average of the realized share returns.

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

4. Variance stock, namely the deviation from the average stock return

$$\sigma^2 i = \frac{\sum_{t=1}^{n} (Ri - E(Ri))^2}{\mathrm{n}}$$

5. Standard deviation, which is the level of risk accepted by investors in carrying out investment activities in shares.

$$\mathrm{SD} = \sqrt{\sigma^2 \mathrm{i}}$$

6. Return market, market expected return and market risk

Return market: $\mathrm{R_{M,t}} = \frac{\mathrm{JIIt} - \mathrm{JIIt_{-1}}}{\mathrm{JIIt_{-1}}}$

Return market expectations: $\mathrm{E(R_M)} = \frac{\sum_{t=1}^{n} \mathrm{R_M{}^t}}{\mathrm{n}}$

7. Return the risk-free rate (RBR) is the risk-free rate of return calculated from Bank Indonesia (BI) interest rate data. This assumes that the risk of BI not paying interest is very small (Tandelilin, 2010, page 7).

8. Calculating and sorting ERB

The ERB ratio shows the relationship between two investment determinants: return and risk. Securities with the highest ERB values are candidates for inclusion in an optimal portfolio.

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

9. Calculate the Ai and Bi values for each security

$$A_i = \frac{[E(R_i) - R_{BR}].\beta_i}{\sigma_{ei}^2} \qquad B_i = \frac{\beta_i}{\sigma_{ei}^2}$$

10. Calculating the cut-off value (Ci)

Limiting the value of a stock with Ci. If a stock has an ERB value higher than Ci, then the stock is a candidate and worthy of inclusion in the optimal portfolio.

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

11. Determine the proportion of funds for each selected stock.

With Zi as big as

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

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

12. Calculating portfolio alpha and beta

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

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

13. Calculating the Return of a Single Index Model Portfolio

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

14. Calculating the standard deviation and variance of a single index model portfolio

Variants

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

Standard Deviation

$$\sigma p = \sqrt{\sigma_p^2}$$

The research method contains the type of research, sample and population or research subjects, time and place of research, instruments, procedures, and research techniques, as well as other matters relating to the method of research. This section can be divided into several sub-chapters, but no numbering is necessary.

RESULT AND DISCUSSION

Table 1. Comparison of Optimal Portfolio Composition Using the Markowitz and Single Index Methods (2024 Period)

Markowitz Method		Single Index Method	
Share	**Proportion**	**Share**	**Proportion**
WIKA	0.81%	ANTM	8.13%
SRIL	5.12%	BBCA	33.09%
SMGR	5.16%	BBRI	13.00%
PTBA	32.72%	BMRI	12.98%
PGAS	0.33%	GGRM	19.63%
ICBP	20.81%	PGAS	4.05%
BBCA	30.65%	WIKA	9.13%

Source: Data processed 2026

The Markowitz method is a method for forming an optimal portfolio for stock investing, developed by Harry M. Markowitz in 1952. The core of Markowitz's portfolio theory is not to place or invest in the same "basket." The Markowitz portfolio is based on two basic indicators that are the main indicators in forming an optimal portfolio: the expected portfolio returns and the Expected Return Risk Portfolio. This is a weakness of this method because it does not accurately reflect the existing investment environment. In this study, this study used stocks listed on the LQ-45 index during the 2024 period as research material. In 2024, a global phenomenon occurs, namely the Trade War between the United States and China, which affects the condition of the Indonesian capital market, resulting in a decrease in investment returns and a simultaneous increase in risk. In 2024, most stocks in the LQ-45 index generated low returns, and some even negative returns. Therefore, a selection of those with the highest and most appropriate returns was conducted to maximize research results. Based on the selection process, only 37 of the 45 companies that are members of the LQ-45 index were included in the sample. The 37 companies that have been selected are used as research objects using the Markowitz method and produce 7 stocks that are recommended for optimal portfolio formation with aligned returns and risks, namely: PT Wijaya Karya Tbk (WIKA) 0.81%, PT Sri Rejeki Isman Tbk (SRIL) 5.12%, PT Semen Indonesia Tbk (SMGR) 5.16%, PT Bukit Asam Tbk (PTBA) 32.72%, PT Perusahaan Gas Negara Tbk (PGAS) 0.33%, PT Indofood CBP Sukses Tbk (ICBP) 20.81%, PT Bank Central Asia Tbk (BBCA) 30.65%, with a Portfolio Return value of 0.15% with a Portfolio Risk of 1.25%.

The return and risk values of the Portfolio are based on the value at the red point on the Efficient Frontier curve, the point is taken based on being the boundary point between optimal and non-optimal portfolio returns. Based on the calculations, we can conclude that the Markowitz method remains relevant as a basic theory for optimal portfolio formation. This is because optimal portfolio formation using the Markowitz method can reduce and minimize the significant risks faced when investing in a single stock asset. Whereas the Single Index Method is an innovation of the older Markowitz method. This method was discovered and developed by William F. Sharpe in 1963. The Single Index Method is more complex in its discussion components and certainly influences the assumptions made in forming an Optimal Stock Investment Portfolio. Forming an Optimal Portfolio using the Single Index Method is certainly different from using the Markowitz Method, where the Single Index also considers Central Bank Interest Rates and the Market Value of the Main Index (IHSG) in its calculations. Research using this method uses the same materials or research objects as the previous method, the Markowitz Method, namely the LQ-45 Index. Due to the same data sources and results, based on the LQ-45 Index member population, 37 companies with decent returns have been selected.

However, in the formation of an optimal portfolio using the single index method, the recommended company shares are different from the formation of an optimal portfolio using the Markowitz method, namely: ANTM (Aneka Tambang Tbk) 8.13%, BBCA (Bank Central Asia Tbk) 33.09%, BBRI (Bank Rakyat Indonesia Tbk) 13.00%, BMRI (Bank Mandiri Tbk) 12.98%, GGRM (Gudang Garam Tbk) 19.63%, PGAS (Perusahaan Gas Negara Tbk) 4.05%, WIKA (Wijaya Karya Tbk) 9.13%. The portfolio formed using the Single Index Method produces an Expected Return level of 0.037% with a Portfolio risk of 0.07%. Creating an optimal portfolio using a single index yields different returns and stock recommendations than creating an optimal portfolio using the Markowitz method. The returns on the optimal portfolio created using the single index method are lower but also involve a lower level of risk compared to the Markowitz method.

This is due to differences in the assumptions and elements included in the optimal portfolio calculation process. Based on the results above, the optimal portfolio creation using the single index method can reduce risk and optimize portfolio investment returns compared to investing in individual assets. This indicates that the single index method remains relevant as a theoretical basis and tool for analyzing investment optimization.

CONCLUSION

Based on the results that have been described and explained in chapter IV, the following conclusions were obtained:

1. In the Markowitz Method, there are 7 company shares that form the optimal portfolio, namely PT Wijaya Karya Tbk (WIKA) 0.81%, PT Sri Rejeki Isman Tbk (SRIL) 5.12%, PT Semen Indonesia Tbk (SMGR) 5.16%, PT Bukit Asam Tbk (PTBA) 32.72%, PT Perusahaan Gas Negara Tbk (PGAS) 0.33%, PT Indofood CBP Sukses Tbk (ICBP) 20.81%, PT Bank Central Asia Tbk (BBCA) 30.65%, with a Portfolio Return value of 0.15% with a Portfolio Risk of 1.25%.
2. The Single Index Method produces different results with a smaller Portfolio Expected Return value with a smaller Portfolio Risk value, namely: ANTM (Aneka Tambang Tbk) 8.13%, BBCA (Bank Central Asia Tbk) 33.09%, BBRI (Bank Rakyat Indonesia Tbk) 13.00%, BMRI (Bank Mandiri Tbk) 12.98%, GGRM (Gudang Garam Tbk) 19.63%, PGAS (Perusahaan Gas Negara Tbk) 4.05%, WIKA (Wijaya Karya Tbk) 9.13%. The portfolio formed using the Single Index Method produces an expected return level of 0.037% with a portfolio risk of 0.07%.

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