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Optimizing Portfolios Using Single Index Models and Mean-Variance From the Indonesia Stock Exchange: IDX30

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Abstract *The purpose of the study was to determine the optimal portfolio composition using the Single Index Model and Mean-variance Model methods, then the results of the two methods were compared. Data collection was carried out using secondary data from stocks that make up the IDX30 index for the 2013-2022 period. The research method is a comparative analysis of the returns and risks obtained from the Single Index Model portfolio then compared with the return and risk of the portfolio using the Mean-variance Model with 5 portfolio combinations. The comparison is carried out by comparing the coefficient of variance of each resulting portfolio composition. The comparison is carried out by comparing the coefficient of variance of each resulting portfolio composition. The analysis results show that the portfolio produced by the Mean-Variance Model has better returns and risks than the Single Index Model.*

Keywords: *Singel Index Model; Mean-variance; Portfolio*

1. INTRODUCTION

To achieve a corporate capital growth target, investors require not only capital but also analytical skills. According to capital investors' guidelines, lower risk typically corresponds to lower returns, while higher risks are associated with higher returns. It's widely argued that capital investment in developing nations carries greater risks compared to developed ones. This is primarily because legal frameworks, political stability, economic conditions, social and cultural factors, and defense structures often entail significant uncertainties. Investors often face doubts when diversifying their funding, distributing shares across various stocks, and constructing portfolios (Verkino et al., 2020).

Investing in multiple stocks to create a stock portfolio allows investors to diversify their holdings and lower the risks involved with capital investments. (Mahayani & Suarjaya, 2019). The key to determining the optimal portfolio lies in the capitalist's capacity to consider both the level of risk and the expected rate of return when establishing an efficient portfolio composition. The assurance of an efficient portfolio heavily relies on the analysis and precision of capital investors in interpreting and comprehending the market. Therefore, this research holds significance as it can provide insights into how the analysis for calculating the return and risk of equity investment should be conducted by capital investors.

Investing capital in stocks inherently carries risk as their value fluctuates constantly across all investment periods. For any prudent capital investor prioritizing risk aversion, efficient diversification techniques are essential for investment. Achieving portfolio efficiency

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relies on precise analysis of returns and risks. Research should aim to establish an optimal stock financing portfolio during the study period, sharing investment strategies that offer the best balance of return and risk.

In 1963, William Sharpe introduced the Single Index Model, which posits that securities' prices fluctuate in tandem with the market price index. This model simplifies the complex analysis of portfolio risk into basic calculations, building upon the concepts established by the Markowitz model (Sharpe, 1964). It serves as a tool for crafting optimal portfolios based on effective preferences.

The Single Index Model facilitates the computation of variables associated with stock returns and market index movements. Conversely, in 1952, Harry Markowitz developed the Optimal Portfolio Theory, also known as the Mean-variance Model. This approach utilizes statistical parameters like expected returns, securities' and portfolios' standard deviations, and covariances between share returns. Diversification and integration of various capital-raising instruments into a portfolio help minimize risk (Markowitz, 1952).

The Mean-variance Model addresses the challenge of distributing shares within a portfolio to achieve the most efficient risk allocation. It enables investors to minimize portfolio risk while aiming for an acceptable expected return and maximum income potential (Lyu, 2021).

In Markowitz's theory, risk calculation holds significant importance as portfolio risk is derived from the risk assessments of all stocks within the portfolio and the covariance between these stocks (Markowitz, 1952). Covariance, an absolute measure indicating the extent to which the returns of two securities move together, plays a crucial role in modeling return and risk calculations. However, to conduct such calculations, covariances must be determined at an amount equal to half the sum of the product of the forming stock's surplus and its forming share. As portfolios grow with more stocks, covariances increase accordingly.

Mean-variance expected returns are determined by selecting the lowest risk from various possible portfolio combinations. One approach to achieving this is through optimization models employing linear programming to maximize average returns and minimize risk. Previous research by Lee et al. (2016) examined the Capital Asset Pricing Model (CAPM) and the Markowitz model's application in portfolio diversification. Lee's study tested CAPM's validity in predicting individual stock behavior and returns, as well as its effectiveness in evaluating Malaysian funding portfolios. While the study found linearity in CAPM, it did not adequately capture unique and systematic risks. Managers can utilize CAPM as a predictive tool for share returns and employ portfolio diversification to mitigate unsystematic risks, facilitating accurate policy implementation for portfolio optimization. Utilizing portfolio diversification models like the Markowitz or Mean-variance models is recommended to reduce nonsystematic risk (Lee et al., 2016).

Research conducted by Akhter et al. (2020) focused on stock portfolios using the Single Index Model technique, which requires fewer variables compared to the Mean-variance model. The study involved thirty companies from the DSE-30, selecting twenty-five companies to form an optimal portfolio. IFAD Autos Limited constituted 21.37% of the portfolio, followed by 15.25% of Pubali Bank Ltd. IFAD Auto Limited yielded the highest portfolio return at 2.608%, while Unique Hotel & Resorts Limited had the lowest return at 0.00003%. The total return of the optimal portfolio was 5.887%. The researchers observed that the individual returns of IFAD AUTOS Limited and Pubali Bank Ltd exceeded that of the portfolio. Capital investors are advised to consider investing in twenty-five shares out of thirty based on the Sharpe Single Index Model (Akhter et al., 2020).

Additionally, Yunita (2018) conducted a study using data from the Jakarta Islamic Index and mean-variance techniques to identify optimal portfolios. The findings revealed that only ten shares, including AKRA (3.4%), ADRO (3.3%), ICBP (4.7%), INCO (2.6%), MYRX (13.6%), PTPP (14.9%), PWON (11.3%), TPIA (1%), UNTR (15.7%), and UNVR (39.5%), comprised the optimal portfolio. The average portfolio return rate stood at 1.22%, with a portfolio risk of 0.0312, indicating lower risk compared to any individual stock within the portfolio (Yunita, 2018).

In a separate study by Verkino et al. (2020), the Sharpe, Treynor, and Jensen ratios were utilized to assess portfolio performance generated by the Single Index Model using shares from the LQ45 index. The portfolio comprised shares in BBCA (85.75%), SRIL (13.12%), PTBA (0.93%), and WSKT (0.19%). According to one-sample t-test results, the portfolio's expected return (0.351%) significantly exceeded the IHSG's return (0.09%). Moreover, the portfolio outperformed IHSG with better ratio values: 0.117 for Sharpe (IHSG Sharpe -0.0156) and 0.0022 for Treynor (IHSG Treynor -0.0003). Additionally, the Jensen test yielded a positive ratio of 0.002. These findings confirm that the investment portfolio's expected return nearly surpassed that of the IHSG or the market (Verkino et al., 2020).

The plethora of stock options available on the Indonesian Stock Exchange has left capital investors perplexed in selecting suitable stocks for their portfolios (Wulandari et al., 2018). Capital market transformation is deemed necessary to prevent index saturation, with indices serving not only as indicators of stock price movements but also as the underlying components of financial products like ETFs, DCFs, options, or futures. In April 2012, the BEI introduced a new stock index, IDX30, as part of this transformation, comprising thirty shares selected from the LQ45 index. IDX30 aims to represent stocks with ample liquidity and market capacity, offering a lighter portfolio reference compared to LQ45. This index formation reflects the ideal asset diversity for portfolios (Indonesia Stock Exchange, 2021).

Stock exchanges occur biannually, from February to July and August to January. Stocks failing to meet specified criteria are removed from the index and replaced with equally qualifying ones. Despite the many advantages of industrial shares within the IDX30 index, including high liquidity and trading frequency, investors must consider uncertain investment returns. Investments in stock portfolios present promising opportunities for high returns but also carry high risks, necessitating diversification techniques for optimal returns with minimized risk.

Using daily stock price data, this research aims to construct the best liquid stock portfolio on the IDX30 BEI from 2013 to 2022. Employing longer observation periods and two approaches the Single Index Model and the Mean-Variance Model the study seeks to determine the optimal stock investment portfolio formation. The analysis results from both models will guide the selection of the portfolio model offering the best return and risk profile.

2. LITERATURE REVIEW

Pasar Modal

Capital markets serve dual roles, fulfilling both financial and economic functions simultaneously. Within these markets, activities encompass purchasing financial instruments with the anticipation of future profits (Puspita & Yuliari, 2019).

Investasi

One of the primary activities within the capital market is investment, which involves allocating funds for one or more assets, typically over an extended period, to realize future profits. Indirect investment occurs when transactions are conducted through financial intermediary institutions. Real investments generate asset profits, while financial investments yield capital gains and dividends, representing two distinct types of investments (Natalia et al., 2014). The objective of investment is to generate future profits while also contributing to financial prosperity, such as enhancing quality of life, mitigating inflationary pressures, and minimizing tax burdens.

Investors make investment decisions by allocating their wealth to stocks, following a set of steps outlined by (Yunita, 2018):

1) Establishment of Investment Procedures: Investors define the purpose and required

amount of investment, recognizing the positive relationship between risk and profit. Investment objectives must account for potential losses, encompassing both profit and risk considerations.

2) Securities Analysis: Investors analyze individual and systematic risks associated with securities to evaluate whether their prices reflect fair value.
3) Portfolio Formation: Investors determine which securities to include in their portfolio and allocate funds accordingly, considering factors like cash needs, tax status, and risk preferences.
4) Portfolio Revision: Investors periodically review and adjust their portfolios to ensure alignment with their investment objectives.
5) Portfolio Performance Evaluation: Investors assess portfolio performance in terms of both returns and risk to gauge effectiveness. These steps guide investors in making informed investment decisions and managing their portfolios effectively.

Return

As highlighted by Hadi (Jayati et al., 2017), "return" refers to the profits investors anticipate from their investments. Investors are unwilling to invest if there's no expectation of profit. Returns come in two forms: historical returns, which reflect past performance, and expected returns, which align with investors' future targets.

Profit from a company's stock signifies the earnings investors derive from business trends, outlined in the Yield and Capital Addition. It denotes individuals' periodic income, commonly known as profit, which can be either zero or positive. The return investors receive is termed capital gain or loss, determined by the price fluctuations of their assets. Capital gain occurs with positive price changes, while capital loss results from negative price changes (Ratna et al., 2016).

Risk

Investors should prioritize investment risk ratings over return estimates when making investment decisions. Risk ratings reflect the probability of a significant gap between the actual return and the expected return. A larger gap signifies higher investment risk. Risks are classified into two categories: structured and non-structured. Structured risks are inherent to individual companies and cannot be mitigated by market diversification. In contrast, non-structured risks can be reduced through diversification (Jayati et al., 2017).

Portfolio

Investments inherently involve risks, but investors can mitigate these risks by creating portfolios. A portfolio consolidates an investor's assets, both real and financial, into a single entity. This approach reduces risk by spreading substantial funds across various investment options (Rifaldy et al., 2016). Optimal portfolios encompass a diverse array of effective investments, offering the best potential benefits for investors. These portfolios are deemed efficient when they minimize risk for a given expected return or maximize expected return for a given level of risk.

3. METHOD

This descriptive study employs a quantitative approach. It uses secondary data from observations of stocks included in the IDX30 index calculations. Data collection employs purposive sampling techniques, focusing on shares listed in the IDX30 from January 2013 to November 2022, all of which have an expected positive return value. Documentation methods are used to gather data, which include the stock prices of companies on the IDX30 of the Indonesia Stock Exchange. Data is obtained from the Indonesian Stock Exchange website (www.idx.co.id), the BI-7 Day Reverse Repo Rate (BI7DRR) as a risk-free parameter (R_f) from www.bi.go.id, and the Composite Stock Price Index (IHSG) for market return calculations from id.investing.com for stock closing prices.

The study determines the optimum portfolio layout of IDX30 stocks using the Single Index Model and Mean-Variance Model techniques. The Single Index Model, introduced by Sharpe (1963), simplifies the relationship between securities and market indices. The model calculates returns based on two fundamental factors: the return associated with the company's characteristics, represented by alpha (α), and the return associated with market movements, represented by beta (β). Beta measures the sensitivity of a security's return relative to market returns, making it a crucial component of the Single Index Model. This model allows the estimation of expected returns for individual securities and the inclusion of risk-free assets in investors' portfolios.

The Single Index Model can be formulated as follows (Akhter et al., 2020). Calculating beta and alpha for stocks:

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2} \qquad \text{1)}$$

$$a_i = E(R_i) - (\beta_i . E(R_m)) \qquad \text{2)}$$

Calculates the Excess Return to Beta (ERB) level, which estimates the relative surplus return for a non-diversified unit of risk as measured by beta (Rout & Panda, 2020).

$$ERB = \frac{E\,(R_i) - R_f}{\beta_i} \qquad \text{3)}$$

Calculates the cut-off rate (Ci) threshold, which determines whether a stock qualifies for inclusion in the portfolio. The Ci value must be less than the ERB for the selected stock.

$$C_i = \frac{\sigma_m^2 \sum_{j-1}^{i} \frac{[E(R_i)-R_f]\beta_i}{\sigma_{ei}^2}}{1+\sigma_m^2 \sum_{j-i}^{i} \frac{\beta_i^2}{\sigma_{ei}^2}} \quad \ldots\ldots 4)$$

Calculating the ratio of each share (W_i), stocks with a Ci value greater than or equal to the cut-off point are selected for the optimal portfolio. The size of the capital ratio is determined after the portfolio is formed, using the following formula:

$$W_i = \frac{Z_i}{\sum_{j=1}^{i} Z_j} \quad \ldots\ldots 5)$$

Zi is calculated using the subsequent formula:

$$Z_i = \frac{\beta_i}{\sigma_{ei}^2}.(ERB - C^*) \quad \ldots\ldots 6)$$

The Portfolio Expected Return ($E(R_P)$) and Portfolio Risk (σ_p^2) are calculated using the following formulas:

$$E(R_P) = a_p + \beta_p.\mathrm{E}(R_m) \quad \ldots\ldots 7)$$

$$\sigma_p^2 = \beta_p^2.\sigma_m^2 + (\sum_{i=1}^{n} W_i.\sigma_{ei})^2 \quad \ldots\ldots 8)$$

The mean-variance model illustrates a proportional relationship between the expected return, which estimates the average asset return, and the return variance, which estimates the risk of a portfolio of shares (Ivanova & Dospatliev, 2018). The process of determining an optimum portfolio employs the Mean-Variance model with the assistance of Excel's Solver program. The Solver program helps find the optimal share weights to determine the optimal portfolio ratio. Setting up the optimum portfolio using the Mean-Variance model involves the following steps (Xie, 2021):

Calculating stock-to-stock Covariance (σ_{ij}) :

$$\sigma_{ij} = \frac{\sum_{t=1}^{n}(R_i - E(R_i)).(R_j - E(R_j))}{n} \quad \ldots\ldots 9)$$

Calculating the Expected Return Portfolio $E(R_P)$, which is the weighted average of the expected returns for each share in the portfolio.

$$E(R_P) = \sum_{i=1}^{n} W_i \,.E(R_i) \quad \ldots\ldots 10)$$

Calculating Portfolio Risk (σ_p), The calculation involves multiplying the covariance matrix by the ratio matrix of each share using the following formula.

$$\sigma_P^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} W_i \; W_j \sigma_{ij} \quad \ldots\ldots 11)$$

Dimana :

β_i= Beta of stock i

a_i= Alpha of stock i

σ_m^2 = Market variance

σ_{ei}^2 = Residual stock error variance

W_i = Weight of each stock

Z_i = Investment ratio of each stock

Z_j= Total investment ratio over each stock

C^* = Critical investment value of Ci

W_j= Total weights on each stock

Out of all portfolios created using the Single Index Model and Mean-Variance approach, the selection is further refined based on the Coefficient of Variation (CV) values.

$$CV = \frac{\sigma_P^2}{E(R_p)} \quad \text{12)}$$

The coefficient of variance considers two factors: portfolio expected return and portfolio risk. A smaller coefficient of variation indicates lower portfolio risks, while a larger expected return is reflected by a larger coefficient. The optimal portfolio is identified by the smallest CV value (Paramitasari & Mulyono, 2015).

4. ANALYSIS AND DISCUSSION

The survey population consisted of 14 out of 30 IDX30 shareholders. Shares with negative expected returns or equal to zero are excluded as candidates for the optimal portfolio composition. Consequently, only thirteen shares meet the criteria for the optimal portfolio composition in the third stage due to their positive expected returns ($E(R_i)$).

Table 1 IDX30

No	Code issue	Stock Name	$E(R_i)$
1	ADRO	Adaro Energy Tbk	0.009915
2	ASII	Asta International Tbk	-0.000160
3	BBCA	Bank Central Asia Tbk	0.007523
4	BBNI	Bank Negara Indonesia (Pesero) Tbk	0.010207
5	BBRI	Bank Rakyat Indonesia (Persero) Tbk	0.012908
6	BMRI	Bank Mandiri (Persero) Tbk	0.010552
7	ICBP	Indofood CBP Sukses Makmur Tbk	0.010533
8	INDF	Indofood Sukses Makmur Tbk	0.004455
9	KLBF	Kalbe Farma Tbk	0.008181
10	PGAS	Perusahaan Gas Negara (Persero) Tbk	0.000176

No	Code issue	Stock Name	$E\ (R_i)$
11	SMGR	Semen Indonesia (Persero) Tbk	0.000775
12	TLKM	Telekomunikasi Indonesia (Persero) Tbk	0.009607
13	UNTR	United Tractors Tbk	0.008058
14	UNVR	Uniliver IndonesiaTbk	0.005110

Source: Research data processed, 2023

The process of determining the optimal portfolio composition using the Single Index Model begins with calculating the expected market return rate (IHSG) and the variance of the market portfolio return rate. The calculated values are as follows: the expected market return $E(R_m)$ is found to be 0.003866, the market return variance (σ_m^2) is 0.001435, and the market portfolio return rate variability (σ_m) is 0.037886.

Next, positive return rates (R_i) of individual company shares are compared with the risk-free return (R_f), which averages 0.46% based on the range of interest rate data (BI 7-Day Repo Rate). The covariance between stock and market (σ_{im}) indicates the relationship between share return and market return. A positive covariance value suggests that the movements of the two securities are positively correlated; thus, when share return increases, market return also tends to increase, and vice versa. These results are presented in Table 2.

Beta (β) measures the volatility of stock return compared to market return, providing a systematic calculation of stock risk based on market risk. A βi>1 indicates a stock whose return escalates more than the market return, with higher βi values indicating greater systematic risk (Rout & Panda, 2020). Based on the calculations conducted, the top result for PGAS beta is 2.035400.

Table 2 ERB and SIM calculations

Code issue	σ_i	σ_i^2	σ_{im}	β_i	a_i	σ_{ei}^2
ICBP	0.06586	0.00434	0.00080	0.56079	0.00837	0.00389
ADRO	0.11584	0.01342	0.00092	0.63861	0.00745	0.01283
UNTR	0.08179	0.00669	0.00065	0.45187	0.00631	0.00640
TLKM	0.06148	0.00378	0.00104	0.72474	0.00681	0.00303
BBRI	0.07759	0.00602	0.00211	1.47253	0.00721	0.00291
KLBF	0.06375	0.00406	0.00101	0.70446	0.00546	0.00335
BMRI	0.07533	0.00567	0.00197	1.37596	0.00523	0.00296
BBNI	0.10222	0.01045	0.00276	1.92540	0.00276	0.00513
BBCA	0.09592	0.00920	0.00235	1.63990	0.00118	0.00534
UNVR	0.06431	0.00414	0.00050	0.34640	0.00377	0.00396

Code issue	σ_i	σ_i^2	σ_{im}	β_i	a_i	σ_{ei}^2
INDF	0.06379	0.00407	0.00093	0.65105	0.00194	0.00346
PGAS	0.12933	0.01673	0.00292	2.03540	-0.00769	0.01078
SMGR	0.09337	0.00872	0.00200	1.39157	-0.00461	0.00594

Source: Research data processed, 2023

Alpha represents the anticipated value of a security's return independent of market fluctuations. A positive alpha indicates the ability to enhance the expected return regardless of market movements (Rout & Panda, 2020). The highest positive alpha value for ICBP shares is calculated to be 0.008366.

To determine which stocks are eligible for inclusion in the portfolio, ERB scores and stock rankings are assessed based on their ERB rank, ordered from lowest to highest. Among the numerous shares with positive ERB, those with the highest yield distribution must be selected, subject to a predetermined threshold known as the cut-off rate (Ci). Each share can only be included in the portfolio if its ERB equals or exceeds the Ci value.

Through the calculation of excess return to beta (ERB), it is confirmed that ICBP holds the highest ERB value of 0.010670, whereas SMGR exhibits the lowest ERB value of -0.002713.

Table 3 ERB and SIM calculation

No	Code issue	ERB		Ci
1	ICBP	0.010670	>	0.001111
2	ADRO	0.008400	>	0.001397
3	UNTR	0.007763	>	0.001638
4	TLKM	0.006977	>	0.002552
5	BBRI	0.005676	>	0.003875
6	KLBF	0.005154	>	0.003974
7	BMRI	0.004362	>	**0.004071**
8	BBNI	0.002938	<	0.003821
9	BBCA	0.001813	<	0.003553
10	UNVR	0.001616	<	0.003538
11	INDF	-0.000146	<	0.003423
12	PGAS	-0.002149	<	0.002926
13	SMGR	-0.002713	<	0.002530

Source: Research data processed, 2023

Establishing the specific cut-off point involves selecting the last Ci level that is lower than the ERB level. Based on the preceding calculations, we ascertain the value of C* for BMRI shares to be 0.00407. Once the shares that will constitute the optimal portfolio have been identified, the subsequent step entails determining the capital ratio for the selected shares.

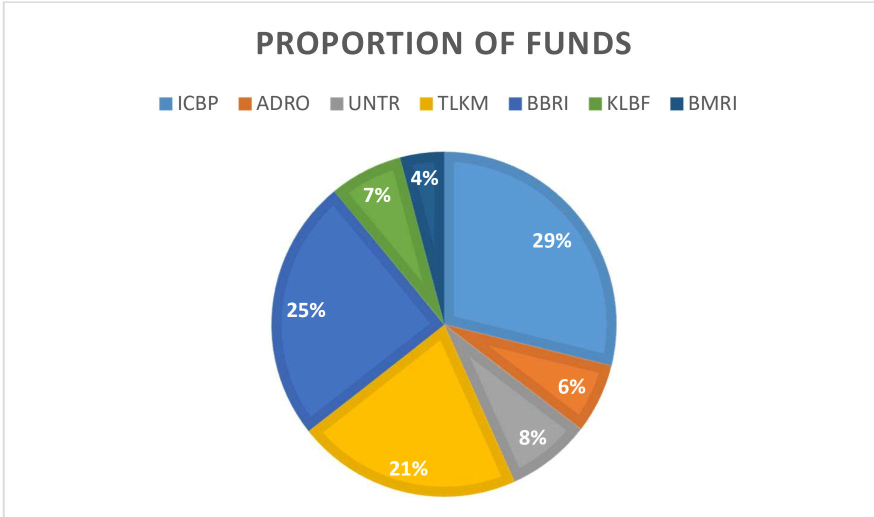


Figure 1 Single Capital Ratio Index Model

Source: Research data processed, 2023

The calculations conducted using the Single Index Model revealed that out of the 13 sampled shares, 7 were incorporated into the optimal candidate portfolio. Table 3 displays an expected portfolio gain of 0.010525 (1.1%) with a portfolio variance of 0.001811 (0.18%). The arrangement of the portfolio is pivotal in determining the composition of the stock portfolio, as it not only maximizes returns but also mitigates risks compared to investing solely in one type of stock. The research analysis results offer valuable insights into constructing an effective portfolio (Yunita, 2018).

Table 4 Expected Portfolio Return and Single Index Model Portfolio Risk

No	Code issue	αi	βi	Wi	Wi.αi	Wi.βi	σep2
1	ICBP	0.008366	0.560791	0.288597	0.002414	0.161843	0.000324
2	ADRO	0.007446	0.638613	0.065276	0.000486	0.041686	0.000055
3	UNTR	0.006311	0.451873	0.079036	0.000499	0.035714	0.000040
4	TLKM	0.006805	0.724738	0.210953	0.001436	0.152886	0.000135
5	BBRI	0.007215	1.472532	0.246211	0.001776	0.362553	0.000176
6	KLBF	0.005457	0.704462	0.068931	0.000376	0.048559	0.000016
7	BMRI	0.005233	1.375961	0.040997	0.000215	0.056410	0.000005
	E(Rm)			**0.003866**			
	E(Rp)			**0.010525**			
	σ_P^2			**0.001811**			

Source: Research data processed, 2023

This technique illustrates that as the expected return increases, so does the associated risk compared to the risk of the formed portfolio. Results of the Mean-Variance model calculation:

Table 5 ***Covariance***

Covariance	*ADRO*	*BBCA*	*BBNI*	*BBRI*	*BMRI*	*ICBP*	*INDF*	*KLBF*	*PGAS*	*SMGR*	*TLKM*	*UNTR*	*UNVR*
ADRO	0.0134												
BBCA	0.0014	0.0092											
BBNI	0.0021	0.0070	0.0104										
BBRI	0.0013	0.0045	0.0059	0.0060									
BMRI	0.0014	0.0053	0.0060	0.0045	0.0057								
ICBP	-0.0014	0.0007	0.0019	0.0009	0.0011	0.0043							
INDF	0.0003	0.0010	0.0016	0.0010	0.0010	0.0023	0.0041						
KLBF	0.0005	0.0009	0.0025	0.0018	0.0017	0.0018	0.0015	0.0041					
PGAS	0.0040	0.0060	0.0066	0.0040	0.0046	0.0009	0.0024	0.0021	0.0167				
SMGR	0.0005	0.0037	0.0050	0.0038	0.0034	0.0016	0.0016	0.0022	0.0053	0.0087			
TLKM	0.0009	0.0017	0.0024	0.0019	0.0016	0.0006	0.0004	0.0015	0.0020	0.0007	0.0038		
UNTR	0.0046	0.0005	0.0016	0.0012	0.0015	-0.0004	0.0004	0.0008	0.0027	0.0002	0.0007	0.0067	
UNVR	-0.0008	-0.0004	0.0011	0.0005	0.0001	0.0018	0.0012	0.0020	0.0015	0.0009	0.0007	0.0001	0.0041

Source: Research data processed, 2023

The table above displays various covariances between the two stocks, indicating both positive and negative values. Positive covariance suggests that the returns of two stocks tend to move in the same direction, while negative covariance suggests movement in opposite directions. Stocks with no covariance indicate that their movements are unrelated (Mahayani & Suarjaya, 2019).

MV-1 (Mean-Variance 1) represents a portfolio formed with a minimum risk from 13 shares in the candidate portfolio, resulting in 11 shares accepted in the optimal portfolio. This optimization yields an expected portfolio return of 0.75% and a portfolio risk of 0.00107. MV-2 portfolio is structured based on the expected return from the Single Index Model, leading to a composition of 5 shares accepted in the optimal portfolio. MV-2 delivers an expected return value of 1.05% and a portfolio risk of 0.00421. Compared with the Single Index Model, the risk is higher for the same expected return.

MV-3 is formed with candidates received in a single index portfolio, with 7 shares accepted within the portfolio. Despite including the same shares, the optimal proportions differ. Risks generated by MV-3 are lower than those produced by the Single Index Model.

Table 6 Mean-Variance Portfolio

Code issue	MV-1	MV-2	MV-3	MV-4	MV-5
ADRO	4.56%	0.00%	5.33%	7.69%	2.77%
BBCA	6.50%	0.00%	0.00%	7.69%	1.95%
BBNI	0.00%	0.00%	0.00%	7.69%	6.26%
BBRI	5.85%	77.82%	23.65%	7.69%	24.19%
BMRI	6.89%	0.00%	13.24%	7.69%	1.92%

Code issue	MV-1	MV-2	MV-3	MV-4	MV-5
ICBP	8.94%	0.00%	20.64%	7.69%	2.30%
INDF	10.97%	4.56%	0.00%	7.69%	2.31%
KLBF	0.00%	0.00%	0.00%	7.69%	1.70%
PGAS	0.06%	6.87%	0.00%	7.69%	3.95%
SMGR	7.24%	6.55%	0.00%	7.69%	2.28%
TLKM	16.49%	0.00%	24.52%	7.69%	2.38%
UNTR	12.22%	0.00%	12.61%	7.69%	2.24%
UNVR	20.27%	4.21%	0.00%	7.69%	45.77%
	100.00%	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Source: Research data processed, 2023

MV-4 is constructed by equalizing the capital ratio for all accepted shares in the candidate portfolio, resulting in a 7.69% allocation for each share. This portfolio yields an expected return of 0.75% and a portfolio risk of 0.00152. MV-5 is formed with portfolio risks equivalent to those generated by the Single Index Model. It produces a portfolio return of 0.76% and a portfolio risk of 0.00181. Although MV-5 employs the same risk, its returns are lower compared to those derived from the Single Index Model.

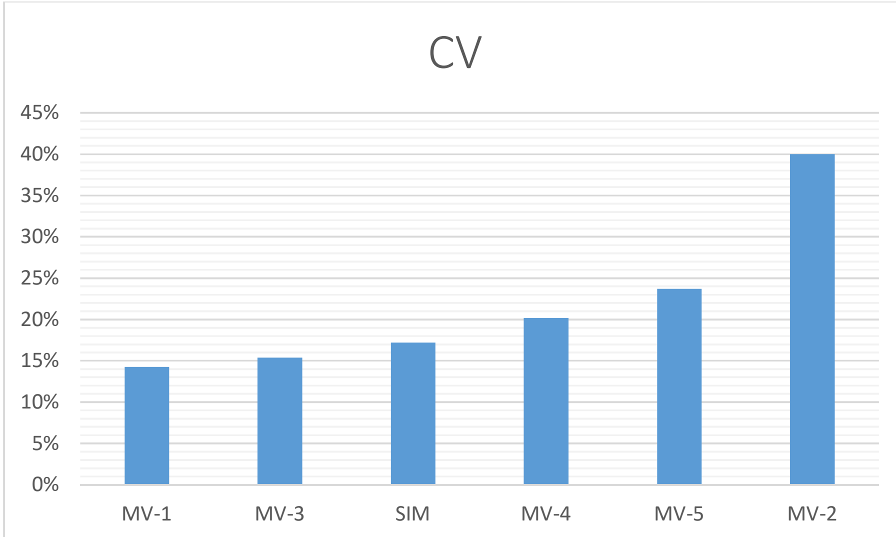
Portfolio simulations using Mean-Variance incorporate the five optimal portfolio compositions, maintaining portfolio risks below the standard deviation of each stock listed in Table 7. This confirms that through the creation of an optimal Portfolio model using Markowitz, portfolio diversification can effectively minimize risk (Yunita, 2018).

Table 7 Risk and Return Mean-Variance

Keterangan	MV-1	MV-2	MV-3	MV-4	MV-5	SIM
$E(R_P)$	0.75%	1.05%	1.05%	0.75%	0.76%	1.05%
Risk Std Dev	3.27%	6.49%	4.02%	3.90%	4.26%	4.26%
σ_P^2	0.00107	0.00421	0.00162	0.00152	0.00181	0.00181
CV	14.24%	40.03%	15.37%	20.18%	23.70%	17.20%

Source: Research data processed, 2023

The data processing results from two techniques indicate that the Coefficient of Variation (CV) generated by the Single Index Model remains relatively low at 17.20%. The portfolio generated by the Single Index Model is ranked as the third-best optimal portfolio, following the Mean-variance-produced portfolios. Among these, MV-1 from Mean-Variance is identified as the best optimal Portfolio, maintaining the smallest CV of 14.24%. Conversely, MV-2 exhibits a larger CV of 40.03%, categorizing it as the worst portfolio, as illustrated in Figure 2.



Gambar 1 Coefficient of variantion (CV)

Source: Research data processed, 2023

The Single Index Model is widely adopted due to its simplicity and ease of use for calculating optimal portfolios, requiring fewer variables compared to the Markowitz model (Akhter et al., 2020). However, it has the limitation of producing only one optimal portfolio candidate, unlike the Mean-Variance model which can generate multiple optimal candidates. Research analysis using the Single Index Model identifies seven stocks for optimal portfolios, enabling greater profits through stock diversification compared to investing solely in a single or non-diversified asset. The optimal allocation for these seven shares includes ICBP (29%), ADRO (6%), UNTR (8%), TLKM (21%), BBRI (25%), KLBF (7%), and BMRI (4%).

Portfolio financing through the Single Index Model offers the advantage of risk reduction without sacrificing the expected rate of return. This aligns with the findings of Riset Verkino et al. (2020), who investigated stock portfolios using the Single Index Model and identified four shares qualifying for the optimal portfolio: BBCA (85.75%), SRIL (13.12%), PTBA (0.93%), and WSKT (0.19%). These portfolios outperformed the IHSG return rate by 0.351% per week.

Additionally, the mean-variance model generates portfolios with varying risk and return profiles. For instance, MV-1 yields 11 candidates with a portfolio risk of 0.00107 and a return of 0.75%, while MV-2 provides 5 candidates with a portfolio risk of 0.00421 and a return of 1.05%. MV-3, MV-4, and MV-5 offer different combinations of candidates and risk-return profiles.

The study findings are consistent with previous research by Yunita (2018), which identified ten shares for an optimal portfolio with an average return rate of 1.22% and a portfolio risk of 0.0312%. Moreover, portfolios produced by the Mean-Variance model (MV-3) exhibit lower portfolio risk rates (0.00162) compared to those generated by the Single Index Model (0.00181) at the same profit rate (1.05%) (Yunita, 2018).

Effective portfolio construction involves selecting stocks with lower correlation coefficients and balancing returns and risks. By optimizing this balance, investors can minimize non-systemic risk in their portfolios. The positive correlation between return rate and risk implies that investors tend to select assets with lower risk for the same return rate. An efficient portfolio maximizes profit while minimizing risk, considering the dissimilarities in share prices, return rates, and risks. Recommendations for optimal portfolio compilation prioritize stocks with positive return rates, indicating higher returns compared to the risk-free rate of return.

5. CONCLUSION

The optimal portfolio composition using the Single Index Model comprises 7 candidates: ICBP (29%), ADRO (7%), UNTR (8%), TLKM (21%), BBRI (25%), KLBF (7%), and BMRI (4%). This arrangement yields an expected portfolio return of 0.010525 (1.1%) with a portfolio variance of 0.001811 (0.18%).

On the other hand, the mean-variance model formulates 5 stock portfolios as follows: MV-1 generates 11 candidates with a portfolio risk of 0.00107 and a return of 0.75%; MV-2 produces 5 candidates with a portfolio risk of 0.00421 and a return of 1.05%; MV-3 generates 7 candidates with a portfolio risk of 0.00162 and a return of 1.05%; MV-4 demonstrates 13 candidates with a portfolio risk of 0.00152 and a return of 0.75%; and MV-5 generates 13 candidates with a portfolio risk of 0.00181 and a return of 0.76%.

According to the coefficient of variance (CV) calculations, the Markowitz model outperforms the Single Index Model, as it yields the smallest CV value for portfolio MV-1. These results indicate that portfolio construction effectively mitigates non-systemic portfolio hazards by selecting more equity stocks with lower risk variance and higher returns. Of the 6 optimal portfolios formed, the mean-variance model (MV-3) stands out as efficient, maintaining a lower portfolio risk rate (0.00162) compared to the Single Index Model (0.00181) at the same profit rate (1.05%).

6. LIMITATIONS AND RECOMMENDATION

To maximize profits, capital investors must periodically review their portfolios to adapt to changing stock prices. This ongoing monitoring enables them to stay informed about capital market dynamics and promptly respond to fluctuations that impact expected profit rates. Advanced researchers may employ methods such as Black Treynor, CAPM, or others, and integrate them with mean-variance techniques to identify superior portfolios.

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