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Mean-Variance Optimal Portfolio Selection with Risk Aversion on Transportation and Logistics Sector Stocks Based on Multi-Criteria Decision-Making

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Abstract

The importance of the transportation and logistics sector to a country's economy, coupled with the growth of this sector in Indonesia, requires investment support for this sector to continue to grow. Therefore, stocks in the transportation and logistics sector are attractive for investment portfolio consideration. The optimal portfolio selection is to minimize the risk with the expected return. In the formation of an investment portfolio, the problem is how to determine the weight of capital allocation in order to get the maximum return while still considering the risk in each stock, by considering several criteria in decision making. This study was conducted to determine the best stock selection in the transportation and logistics sector listed on the Indonesia Stock Exchange, and determine the optimal weight in the investment portfolio. The method used is Multi-Criteria Decision Making (MCDM), namely Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) using 15 financial metrics as relevant criteria in stock selection. Furthermore, to determine the allocation weight to form an optimal stock portfolio using the Mean-Variance model with Risk Aversion. The stocks analyzed were 28 stocks in the transportation and logistics sector. The results of research based on MCDM selected 9 stocks, namely MITI, BIRD, HATM, TMAS, JAYA, PPGL, BPTR, ASSA, and RCCC. However, TMAS, PPGL, and BPTR stocks are not included in portfolio formation because they have a negative average return. Based on the optimization results, the allocation weights of the 6 stocks included in the optimal portfolio are BIRD (37.7%), JAYA (24.6%), MITI (12.9%), HATM (9.9%), ASSA (7.5%), and RCCC (7.4%). The results of this study are expected to be a consideration in making investment decisions.

Keywords: MCDM; TOPSIS; Stocks; Mean-Variance Risk Aversion; Optimal Portfolio

1. Introduction

The transportation sector is one of the most important industries for a country's economy, including Indonesia. It can be seen that in two consecutive years this sector has increased. In 2023, significant growth occurred in the transportation and warehousing sector, which amounted to 13.96% (year on year) with national economic growth of 5.05% (cumulative-to-cumulative) (Kemenko Perekonomian RI, 2024). In the second quarter of 2022, the transportation and warehousing sector also experienced growth of 21.27% (year on year) (Kementerian Perhubungan RI, 2022).

The growth that occurred is proof that the transportation and logistics industry in Indonesia is currently important. In addition, whether we realize it or not, we must mobilize every day. Traveling activities and goods purchased online require mobilization to get to the orderer's house. The geographical condition of Indonesia, which is divided into thousands of islands, makes the transportation industry important as a link to distribute goods or services. The important role of transportation and logistics results in the need for investment support so that this sector continues to grow.

The Transportation and logistics industry in the Indonesia Stock Exchange (IDX) is classified as a company engaged in working on the movement and transportation of goods. Transportation provider companies are companies that provide logistics and delivery services (Indonesia Stock Exchange, 2021). Currently, there are 37 stocks in the transportation and logistics sector on the Indonesia Stock Exchange that can be purchased by investors.

Investment-related decisions and stock portfolio selection are to minimize risk with expected returns (Jing et al., 2023). Therefore, portfolio formation for investors is a challenge. The task of combining multiple factors, considering risk with expected return in order to select profitable stocks (Ma et al., 2024).

One of the key principles behind managing asset allocation is diversification. By spreading investments across different asset classes, investors can reduce the overall risk of their portfolio (Mhadhbi, 2013). Portfolio diversification is done by investing in stocks spread across several locations with different compositions (Rokhmawati, 2021).

Multi-Criteria Decision Making (MCDM) is one of the methods for selecting stocks whose purpose is to create an optimal portfolio. The MCDM method is a branch of operations research that has to do with decision making (Saputra, 2017). Research on MCDM in asset management, one of which was conducted by Ozcalici (2022). In his findings, MCDM is effective in determining asset allocation because it can consider portfolio selection preferences and other criteria relevant to asset selection. Meanwhile, Mortazavi (2023) implemented MCDM which is considered very suitable for handling various financial decision-making topics. In this study, 15 financial criteria were used in making decisions on stocks on the Toronto Stock Exchange. This research combines the MCDM method and the Decision Making Trial and Evaluation Laboratory (DEMATEL) whose results show effectiveness in optimizing stock selection.

Lakshmi & Kumara (2024) also conducted research using MCDM in the stock portfolio selection model. Using 8 financial criteria, the combination of Randomized Weighted Fuzzy Analytic Hierarchy (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) process proved to be a powerful approach for stock selection.

Jing et al. (2023) used MCDM in determining the best stocks in Tehran Stock Exchange (TSE). This research uses various MCDM approaches and then ranks each stock, then the stocks are ranked again using the mean rank, borda count, and copeland methods. Various MCDM approaches were used in this study to provide a broader perspective. Each method has a unique approach and criteria in evaluating alternatives, TOPSIS ranks alternatives by calculating the distance of each alternative from the Positive Ideal Solution (PIS) and Negative Ideal Solution (NIS). The closer the alternative is to the PIS and the further it is from the NIS, the better the alternative is. This distance-based approach allows a clear comparison between different options.

Research on asset allocation methods and stock selection, among others, was conducted by Porajow (2022) who examined stock portfolio selection in the transportation and logistics sector using the Markowitz model. The research was conducted on 10 stocks, which resulted in two stocks in the transportation and logistics sector that had optimal portfolio values. Tian & Zhao (2023) optimized the investment portfolio with Mean-Variance using historical data on the return of several stock indices. This research successfully shows how to build a portfolio that minimizes risk while achieving the desired return.

Research by Basuki et al. (2017) used the Mean-Variance model for risk-free assets. The results of this study obtained that the investment portfolio with risk-free assets is more profitable than the investment portfolio without risk-free.

Based on these studies, this study uses the MCDM approach, namely TOPSIS to find the best stocks on the Indonesia Stock Exchange in the transportation and logistics sector which then determines the allocation weight using Mean-Variance with Risk Aversion. Thus, an optimal portfolio is produced with each allocation weight that maximizes return while minimizing risk.

2. Literature Review

2.1. Investment

Investment is placing a number of funds in the hope of obtaining future profits. Investments can be made in two types of assets. The first is Real Asset, where investments are made in tangible assets, such as gold, real estate, and artwork. Investments can also be made in financial sectors (Financial Assets) such as deposits, stocks, bonds, and mutual funds (Adnyana, 2020).

Investors (people who make investments) can take the results of their investments in two ways. First, if the investment made is with the expectation of return, then the investor obtains the profit results from the accumulation of profit profits or company revenues. If investors invest in assets that can be sold, investors can generate profits from the sale of these assets (Wardhana, 2022).

2.2. Stock Return, Expectation, Variance, and Covariance of Stock Return

Shares are proof of ownership of the company in the form of a piece of paper that is traded by the stock exchange (Adnyana, 2020; Suriyanti & Hamzah, 2024). The main objective of stock investment is to expect a return, which is the rate of return received by investors over a certain period. The returns obtained when investing in stocks are divided into two, namely dividends and capital gains (Alexander & Destriana, 2013). Dividends are company profits that are distributed to shareholders. While capital gain is the profit obtained when selling assets (Samsul, 2015). According to Bodie et al., calculating stock returns based on historical data for a certain period can use equation (1),

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

where,

$R_{i,t}$: return of stock i at time t,

$P_{i,t}$: price of stock i at time t,

$P_{i(t-1)}$: price of stock i at time $(t - 1)$.

The return expected by investors and the return earned by investors are not always the same. The magnitude of the difference between the expected return and the one obtained is called risk. The greater the expected rate of return, the greater the level of risk borne (Firmansyah et al., 2022).

According to Hartono et al. (2021) stock return expectation is the return that investors expect to get. Stock return expectations $E(R_{i,t})$ can be obtained using equation (2),

$$E(R_{i,t}) = \frac{\sum_{i=1}^{n} R_{i,t}}{n}. \tag{2}$$

Variance (σ_i^2) is the relationship of stock returns with a number of n pieces of data. Equation (3) is to calculate the variance used to measure stock risk.

$$\sigma_i^2 = \frac{\sum_{i=1}^{n}\left(R_{i,t} - E(R_{i,t})\right)^2}{n-1}. \tag{3}$$

Return covariance shows how the returns of two stocks move in relation to each other. A positive covariance means that the returns tend to move in the same direction, while a negative covariance indicates that the returns move in the opposite direction. Through covariance analysis, investors can build a portfolio that can optimize returns with adjusted risk (Ferreira & Santos, 2017). Use equation (4) to find the return covariance.

$$Cov(X,Y) = Cor \cdot \sigma_X \cdot \sigma_Y, \tag{4}$$

with,

Cor : correlation coefficient,

σ_X : standard deviation of variable X,

σ_Y : standard deviation of variable Y.

2.3. Modern Portofolio Theory (MPT)

Harry Markowitz published Modern Portfolio Theory (MPT) in 1952. According to Markowitz, a portfolio is defined by an array of securities with their respective weights. Markowitz also said that investors will choose the security with lower risk from two securities that offer the same level of return. Using MPT, investors can optimize the allocation of their assets across various securities by achieving higher returns compared to investing only in individual assets (Wen, 2023). To determine an efficient investment portfolio, MPT uses return and risk by changing asset weights to create a portfolio with a total weight of one (Surtee & Alagidede, 2023).

2.4. Multi-Criteria Decision Making (MCDM)

Multi-Criteria Decision Making (MCDM) involves a decision-making process where there are at least two criteria and two different solutions considered for evaluation (Yikici & Özçelik, 2023). MCDM enables portfolio performance evaluation by analyzing historical returns and industry-specific variations.

2.4.1 TOPSIS Method

Referring to Yikici & Özçelik (2023), Hwang and Yoon proposed Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) for the first time in 1981. TOPSIS defines positive ideal solution (PIS) and negative ideal (anti-ideal) solution (NIS). PIS is maximizing the profit criteria (+) and minimizing the cost criteria (-). While NIS is maximizing cost criteria (-) and minimizing profit criteria (+). The selected alternative is the closest to the solution that provides benefits, namely the optimal value, and the farthest from the non-optimal value. The following steps using TOPSIS:

1) Construct a matrix of decision point values, listed in the decision/alternative matrix rows and criteria columns. The matrix element a_{mn} means the value of the decision point on the m-th decision/alternative and the n-th criterion.
2) Normalize the decision matrix using Equation (5) r_{ij} is a_{mn} after normalization.

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} {a_{ij}}^2}} \quad i = 1,2,3,\dots,m \quad j = 1,2,3,\dots,n. \tag{5}$$

3) Calculate the weighted matrix **V** as shown in equation (6). Make sure that the sum of the weighted value is 1 $\left(\sum_{j=1}^{n} w_j = 1\right)$.

$$\boldsymbol{V} = \begin{bmatrix} w_1 r_{11} & \cdots & w_n r_{1n} \\ \vdots & \ddots & \vdots \\ w_1 r_{m1} & \cdots & w_n r_{mn} \end{bmatrix}. \tag{6}$$

4) Calculate PIS (A^+) and NIS (A^-) in equation (7).

$$A^+ = \left[The\ best\ value\ vector\ of\ each\ alternative\ in\ {v_j}^+ |\ V\right],$$
$$A^- = \left[The\ worst\ value\ vector\ of\ each\ alternative\ in\ {v_j}^- |\ V\right]. \tag{7}$$

5) Calculate the distance of each alternative from PIS and NIS using the equation (8). ${S_i}^+$ shows the distance between each ${A_j}^+$, while ${S_i}^-$ shows the distance between each ${A_j}^-$. The numbers ${S_i}^+$ and ${S_i}^-$ are equal to the number of decision points.

$${S_i}^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - {v_j}^+)^2} \quad i = 1,2,3, \dots, m, \tag{8}$$
$${S_i}^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - {v_j}^-)^2} \quad i = 1,2,3, \dots, m,$$

6) Calculate the relative closeness coefficient of each alternative to the ideal solution using the equation (9). Rank is determined by sorting the values from largest to smallest.

$${C_i}^+ = \frac{{S_i}^-}{{S_i}^- + {S_i}^+} \quad i = 1,2,3, \dots, m, \tag{9}$$

2.4.2 Evaluation Metrics

Evaluation metrics are used as criteria in this study to measure quantitatively to assess the stocks used. The study conducted by Roodposhti et al in (Jing et al., 2023) used 15 metrics from five classes of financial ratios. The 15 criteria for this MCDM method include sales growth rate, net income growth rate, Earnings Per Share (EPS) growth rate, Earnings Per Share (EPS), net profit margin, operating margin, Return On Assets (ROA), Return On Equity (ROE), total asset turnover, accounts receivable turnover, inventory turnover, beta coefficient (β), financial risk, price to EPS, price to Book Value Per Share (BVPS). The expert determined the positive/profit and negative/cost criteria. The weights of the indicators were 0.04, 0.05, 0.05, 0.02, 0.04, 0.05, 0.09, 0.08, 0.09, 0.10, 0.12, 0.08, 0.05, 0.07, and 0.07.

2.5. Expected and Variance of Portfolio Return

Taken from Vimelia et al. (2024), let's say that an investment portfolio has N stocks with each return of $r_{1.t}, r_{2.t}, \dots, r_{N.t}$. **r** is the return vector which can be written as in the following equation.

$$\mathbf{r} = \begin{pmatrix} r_{1.t} \\ r_{2.t} \\ \vdots \\ r_{N.t} \end{pmatrix}.$$

Assume that **μ**, **w**, and **e** are vector of mean, vector of weights, and the unit vector written as in the following equation.

$$\boldsymbol{\mu} = \begin{pmatrix} \mu_1 \\ \mu_2 \\ \vdots \\ \mu_N \end{pmatrix}, \mathbf{w} = \begin{pmatrix} w_1 \\ w_2 \\ \vdots \\ w_N \end{pmatrix}, \text{and } \mathbf{e} = \begin{pmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{pmatrix}.$$

The sum of the weights of all stocks in the portfolio is equal to one. The return of the investment portfolio (r_p) expressed in the equation (10),

$$r_p = \mathbf{w}^T \mathbf{r}. \tag{10}$$

Meanwhile, the expected return of the (μ_P) portfolio is expressed as in equation (11),

$$\mu_P = \mathbf{w}^T\boldsymbol{\mu}. \tag{11}$$

Furthermore, $\sum$ denotes the covariance matrix and $\mathbf{I}$ denotes the identity matrix as shown in the equation (12). Thus, the portfolio return variance (σ_P^2) can be expressed in equation (13),

$$\sum = \begin{pmatrix} \sigma_{11}^2 & \sigma_{12} & \dots & \sigma_{1N} \\ \sigma_{21} & \sigma_{22}^2 & \dots & \sigma_{2N} \\ \vdots & \vdots & \vdots & \vdots \\ \sigma_{N1} & \sigma_{N2} & \dots & \sigma_{NN}^2 \end{pmatrix} \text{ and } \mathbf{I} = \begin{pmatrix} 1 & 0 & \dots & 0 \\ 0 & 1 & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & \dots & 1 \end{pmatrix}. \tag{12}$$

$$\sigma_P^2 = \mathbf{w}^T \sum \boldsymbol{w}. \tag{13}$$

2.6. Mean-Variance Risk Aversion ($\rho \geq 0$) Model Portfolio Optimization

Portfolio optimization according to Markowitz is to avoid risk and maximize profits. The mean-variance model is optimal portfolio optimization with a quantitative approach that connects the risk calculated using standard deviation or variance with its expected return or average return (Hartono et al., 2021). To get an efficient portfolio using model (14)

$$\begin{gathered} \text{Max}\{\mu_P - \frac{\rho}{2}\sigma_P^2\}, \\ \text{with the condition } \sum_{i=1}^{N} w_i = 1, w_i \geq 0, \\ \text{or can be written} \\ \text{Max}\left\{\mathbf{w}^T\boldsymbol{\mu} - \frac{\rho}{2}\mathbf{w}^T\sum\boldsymbol{w}\right\}, \\ \text{with the condition } \mathbf{w}^T\mathbf{e} = 1, w_i \geq 0. \end{gathered} \tag{14}$$

The solution of the model is shown in equation (15),

$$\begin{gathered} \mathbf{w} = \frac{1}{\rho}\sum\nolimits^{-\mathbf{1}}(\boldsymbol{\mu} + \lambda\mathbf{e}), \\ \text{with,} \\ \lambda = \frac{\rho - \boldsymbol{\mu}^{\mathrm{T}}\sum^{-\mathbf{1}}\mathbf{e}}{\mathbf{e}^{\mathrm{T}}\sum^{-\mathbf{1}}\mathbf{e}}. \end{gathered} \tag{15}$$

3. Materials and Methods

3.1. Materials

The research object in this study are stocks listed on the Indonesia Stock Exchange (IDX) in the transportation and logistics sector in 2024. There are 37 stocks included in the transportation and logistics sector. However, 9 of them are still under special monitoring, so only 28 stocks are taken into account. The data used are the 2023 annual financial statements of each company obtained from the Indonesia Stock Exchange website (https://www.idx.co.id/) and daily closing stock prices for the period January 2, 2023 - December 29, 2023 obtained from (https://www.investing.com/).

3.2. Methods

1) Gathered information for 15 evaluation metrics to be used as criteria for each company. Fifteen metrics are used as criteria in Multi-Criteria Decision Making (MCDM). Companies that did not have enough information for all fifteen metrics were excluded from the MCDM.
2) Examinating company with TOPSIS method.
3) Calculate return, expectation, variance, and covariance of return with equation (1), (2), (3), and (4). Then form the $\boldsymbol{\mu}$, $\mathbf{e}$, $\sum$.
4) Perform portfolio optimization by determining the initial ρ value of $\rho = 0$ and then calculating the composition of the portfolio stock weight using equation (15). If using $\rho = 0$, the stock weight has a negative value, change the value of ρ by adding the previous ρ with Δ and then recalculating the stock weight. The process is repeated until there are no negative values in the stock weights.
5) Calculate the expected and variance of portfolio returns using equations (11) and (13). Then, calculate the portfolio ratio by dividing the portfolio return by the portfolio variance at the same ρ value.
6) Obtained the composition of the optimal portfolio stock weight by selecting the highest ratio

4. Results and Discussion

After gathering information for the criteria, out of the 28 stocks in the transportation and logistics sector, there are only 9 stocks that meet all 15 criteria needed for this research. Subsequently, these 9 stocks were examinated using TOPSIS. The result is shown in Table 1.

Table 1. TOPSIS method ranking result

Alternatives	Relative closeness coefficient (C)	*Rank*
ASSA	0.2900107	9
BIRD	0.594083445	1
HATM	0.508103575	4
TMAS	0.517728887	3
PPGL	0.418276734	6
RCCC	0.376662822	8
BPTR	0.405764068	7
JAYA	0.446812198	5
MITI	0.568719837	2

C shows how close an alternative is to the ideal solution. The higher the C, the closer the alternative is to the ideal solution and the better the alternative. There is a significant difference between the C of the best alternative (BIRD) and some other alternatives, such as ASSA and RCCC. This shows that some alternatives perform much better than others. ASSA stock has the weakest or least Net Profit Margin, ROA, and ROE criteria compared to other alternatives. Meanwhile, RCCC is weak in EPS, Operating Margin, and slow Accounts Receivable Turnover. Using the TOPSIS method resulted in BIRD or Blue Bird Tbk. is the first alternative choice for investment followed by MITI or Mitra Investindo Tbk. and TMAS or Temas Tbk.

The next step is to calculate the returns of the 9 stocks resulting from TOPSIS. Then, calculate the expected return, variance of return, and covariance of return for each stock and then form the $\boldsymbol{\mu}$, $\mathbf{e}$, $\boldsymbol{\sum}$.

$$\boldsymbol{\mu} = \begin{bmatrix} 0.00072 \\ 0.00120 \\ 0.00014 \\ 0.00038 \\ 0.00133 \\ 0.00103 \end{bmatrix}, \mathbf{e} = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}, \Sigma = \begin{bmatrix} 0.00123 & 0.00012 & 0.00006 & 0.00006 & 0.00008 & 0.00027 \\ 0.00012 & 0.00060 & -0.00003 & 0.00006 & -0.00001 & 0.00004 \\ 0.00006 & -0.00003 & 0.00133 & -0.00004 & 0.00005 & 0.00001 \\ 0.00006 & 0.00006 & -0.00004 & 0.00047 & 0.00007 & 0.00002 \\ 0.00008 & -0.00001 & 0.00005 & 0.00007 & 0.00188 & -0.00004 \\ 0.00027 & 0.00004 & 0.00001 & 0.00002 & -0.00004 & 0.00258 \end{bmatrix}.$$

$\boldsymbol{\mu}$ illustrate the expected returns of ASSA, BIRD, HATM, JAYA, MITI, and RCCC sequentially. The remaining 3 stocks, BPTR, PPGL, and TMAS have negative expected returns so, the three stocks are excluded from the portfolio calculation.

In determining the composition of portfolio weights with Mean-Variance Risk Aversion, the first thing is to determine ρ or risk aversion worth $\rho=0$ using equation (15). As a result, negative allocation weights are still found, so, the value of ρ is increased by a number until there is no longer a negative weight value. In this calculation, when the value of $\rho = 5.87$, there is no negative allocation weight. After that, the expected return and variance of portfolio is calculated using equations (11) and (13). The ratio between the expected portfolio return and the portfolio return variance is also calculated.

Table 2. portfolio optimization result

ρ	$\mathbf{w}^T$						$\mathbf{w}^T\mathbf{e}$	μ_P	σ_P^2	ratio
	ASSA	BIRD	HATM	JAYA	MITI	RCCC				
5.87	0.06132	0.57372	0.00018	0.04762	0.21407	0.10310	1	0.00114	0.00034	3.37988
6	0.06179	0.56712	0.00347	0.05428	0.21122	0.10213	1	0.00113	0.00033	3.41605
6.2	0.06248	0.55749	0.00828	0.06397	0.20706	0.10071	1	0.00112	0.00032	3.46860
6.4	0.06313	0.54847	0.01278	0.07307	0.20317	0.09939	1	0.00111	0.00031	3.51761
6.6	0.06374	0.54000	0.01701	0.08161	0.19951	0.09814	1	0.00109	0.00031	3.56328
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
16	0.07515	0.38067	0.09656	0.24218	0.13073	0.07472	1	0.00087	0.00021	4.12857
16.2	0.07525	0.37929	0.09725	0.24357	0.13013	0.07451	1	0.00087	0.00021	4.12881
16.4	0.07535	0.37794	0.09792	0.24493	0.12955	0.07432	1	0.00086	0.00021	4.12893
16.6	0.07544	0.37663	0.09858	0.24625	0.12898	0.07412	1	0.00086	0.00021	4.12894
16.8	0.07553	0.37534	0.09922	0.24754	0.12843	0.07393	1	0.00086	0.00021	4.12884
17	0.07562	0.37409	0.09984	0.24881	0.12789	0.07375	1	0.00086	0.00021	4.12865
17.2	0.07571	0.37287	0.10045	0.25004	0.12736	0.07357	1	0.00086	0.00021	4.12836
17.4	0.07580	0.37167	0.10105	0.25125	0.12684	0.07339	1	0.00085	0.00021	4.12799
17.6	0.07588	0.37050	0.10164	0.25242	0.12634	0.07322	1	0.00085	0.00021	4.12754
17.8	0.07596	0.36936	0.10221	0.25358	0.12584	0.07305	1	0.00085	0.00021	4.12701
18	0.07604	0.36824	0.10276	0.25470	0.12536	0.07289	1	0.00085	0.00021	4.12641

Based on Table 2, an efficient portfolio is obtained when the value of ρ is in the interval $[5.87;\ \infty)$ whereas, for $\rho < 5.87$ there is still a negative weight composition. From the efficient portfolios above, determining the optimal portfolio is to choose the portfolio with the highest ratio, so that investors can get the maximum portfolio return with the smallest risk. Figure 1 is a ratio comparison chart with risk aversion to see the movement of the ratio.

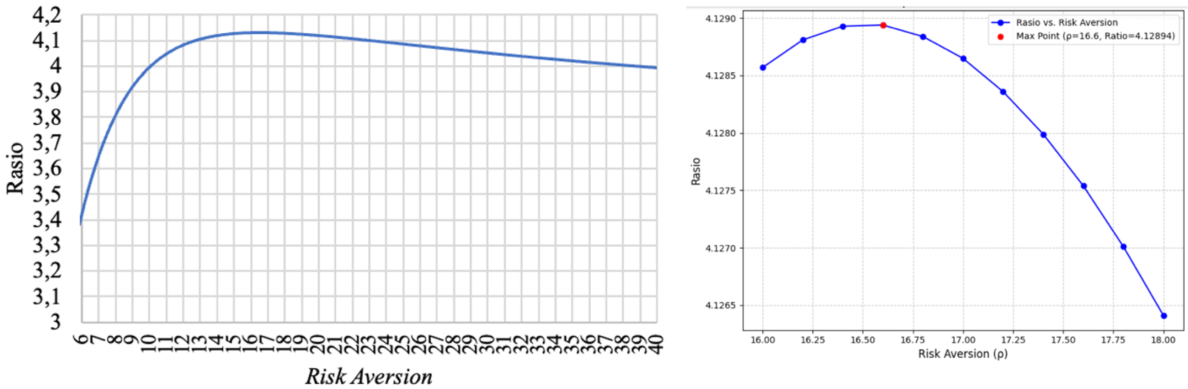

Figure 1: Comparison of Ratio with Risk Aversion

In Figure 1, it can be seen that the greater the risk aversion, until it reaches its maximum value, will produce a greater ratio as well, after reaching its maximum value, the ratio slowly decreases. In Figure 1, the ratio value continues to increase until the value of $\rho = 16.6$ with the highest ratio of 4.12894 then, the ratio value decreases at $\rho > 16.6$. Therefore, the maximum ratio obtained is 4.12894 with risk aversion or $\rho = 16.6$.

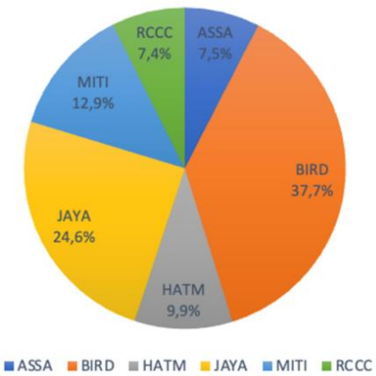

Figure 2: Optimal portfolio weight composition

Based on Figure 2, the optimal portfolio weight composition percentage for the 6 stocks in the transportation and logistics sector is 37.7% for BIRD; 24.6% for JAYA; 12.9% for MITI; 9.9% for HATM; 7.5% for ASSA; and 7.4% for RCCC with an expected portfolio return value of 0.00086 and a portfolio variance of 0.00021.

5. Conclussion

Based on the results of research and discussion, it is concluded that with the TOPSIS method, the stocks that can be considered in the investment portfolio of transportation and logistics sector stocks in order are BIRD, MITI, TMAS, HATM, JAYA, PPGL, BPTR, RCCC, and ASSA. Then, by considering the positive expected return value of each stock, ASSA, BIRD, HATM, JAYA, MITI, and RCCC can be considered for the formation of an investment portfolio. The weight of each share of the optimal investment portfolio with the Mean-Variance risk aversion model on transportation and logistics sector stocks is 37.7% for BIRD; 24.6% for JAYA; 12.9% for MITI; 9.9% for HATM; 7.5% for ASSA; and 7.4% for RCCC with a portfolio return expectation value of 0.00086 and a portfolio variance of 0.00021.

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