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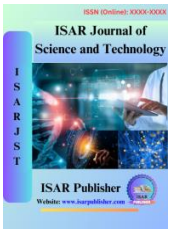

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Application of The TOPSIS Approach in A Company's Stock Investment Ranking Decision Support System Based On Value Investing

I Gede Iwan Sudipa[1*], I Komang Hare Prananda[2], I Made Subrata Sandhiyasa[3], Ketut Jaya Atmaja[4], Made Leo Radhitya[5]

Faculty of Technology and Informatics, Study Program of Informatics Engineering, Institute of Business and Technology Indonesia (INSTIKI), Denpasar, Bali, Indonesia.

***Corresponding Author**

I Gede Iwan Sudipa

Faculty of Technology and Informatics, Study Program of Informatics Engineering, Institute of Business and Technology Indonesia (INSTIKI), Denpasar, Bali, Indonesia.

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Abstract: The objective of this study is to determine the most advantageous stock investment choices for a company by employing the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) methodology. The study centres on the Indonesian stock market, specifically examining the top 10 businesses that have had the highest performance on the LQ45 index. The TOPSIS approach is employed to assess the appropriateness of individual companies by considering many parameters, including as market capitalization, current ratio, earnings stability, dividend history, growth rate, price-to-earnings ratio, and price-to-book value. According to the TOPSIS research, the study has identified PT Waskita Karya (Persero) Tbk (WSKT) and PT Waskita Beton Precast Tbk (WSBP) as the two most favourable investment options. Investors can utilise the findings of this study to create well-informed assumptions regarding their stock investments in the Indonesian market.

Keywords: Value investing approach; TOPSIS method; Investment criteria; Ranking of the best stock alternatives.

Introduction

The stock market is where investors can buy or sell shares. The movement of the stock market is very random, making it very difficult to predict. To get profits with minimal risk requires in-depth knowledge and analysis (V. Gupta et al., 2023). In the world of investment, the right stock selection is the main key in achieving optimal profits (Hassan et al., 2019). Investors are often faced with a wide selection of stocks available in the capital market, where each stock has different characteristics and profit potential. The value investing approach is one of the popular investment strategies, where investors focus on buying stocks whose market price is considered lower than their intrinsic value (Prdic, 2021). However, the main challenge in this approach is how to identify risky stocks from the many options available.

The only risk that no investor can eliminate is the risk of making a mistake, no matter how careful he is. Only by being faithful to what Graham calls a “safety margin” which means not paying too much, no matter how attractive an investment, can you minimize unnecessary mistakes. This concept of "safety margin" is the basis of value investing. In 2018, shares coded TAXI which were calm at 50 then became "wild" due to market enthusiasm which believed in the issue of GOJEK's backdoor listing without knowing the truth of the information and the company's poor financial condition. It touched its highest point at 264 then continued to fall, until 14 months later it returned to calm again at the price of 50, understanding value investing is one way to avoid incidents like that, which means this problem can be solved with a decision support system based on value investing.(Kumar et al., 2021).

The urgency of this problem is related to the need for investors to choose company shares that have high investment value and acceptable risk. Value investing is an investment strategy that prioritizes a company's intrinsic value as the main factor in selecting shares(Ihsan et al., 2023; Sudipa et al., 2023). This approach prioritizes company value which can be found by analyzing low average price per share (P/E), high net profit, and high net profit. An efficient and effective decision support system that aids investors in the evaluation and prioritisation of stocks in accordance with value investing principles is required (Musfidah et al., 2022). Method for Order of Preference by Similarity to Ideal Solution (TOPSIS) is a multi-criteria approach to decision making in which alternative options are ranked according to their proximity to the ideal solution (Dash et al., 2019; Rony et al., 2023; Venugopal et al., 2024). By incorporating TOPSIS into a decision support system designed to rank stock investments, investors may be able to identify shares that most closely align with the criteria of value investing.

The approach utilised by this stock ranking decision support system is the TOPSIS procedure. The geometric principle underlying the TOPSIS algorithm states that the selected alternative must be located at the maximum distance from the negative ideal solution and the closest to the positive ideal solution. To ascertain the relative proximity of an alternative to the optimal solution, the Euclidean distance is utilised. This approach is utilised due to its suitability for computing data consisting of numerical values (unlike the AHP method, which requires data comparisons) (Lakshmi & Kumara, 2024). Additionally, unlike the SMART method, which converts data from the range 0 to 100, this method does not require data conversion to a specified range of values (Aristamy et al., 2021; Palczewski & Sałabun, 2019). This

***Corresponding Author: I Gede Iwan Sudipa**

enables the obtained data to be calculated directly, eliminating the necessity to generate a range of values. Furthermore, it offers several other benefits, including an intuitive concept, streamlined computation, and the capability to assess the comparative effectiveness of decision alternatives using a straightforward mathematical notation [8], [14], [15.

The TOPSIS method approach can help investors in selecting company shares that have high investment value and acceptable risk. This method helps in identifying the most optimal alternative based on predetermined criteria, such as the company's intrinsic value, market conditions, and investment risk (Palczewski & Sałabun, 2019; Türegün, 2022). With the TOPSIS approach, investors can choose company shares that have high investment value and acceptable risk, so they can obtain optimal investment results. The implication of this research is that the TOPSIS approach can be used as a tool to assist investors in selecting company shares that have high investment value and acceptable risk (Dash et al., 2019; Johri et al., 2023). This method helps in identifying the most optimal alternative based on predetermined criteria, such as the company's intrinsic value, market conditions, and investment risk.

Method

Literature Review

In the context of a decision support system for ranking company stock investments based on value investing, the TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) approach can be a valuable tool. TOPSIS is a method of multi-criteria decision making that ranks potential solutions according to their degree of similarity to the optimal solution. Several studies have highlighted the applicability of TOPSIS in various domains, including financial performance evaluation(Tan et al., 2023), group decision making(S. Gupta et al., 2023), stock portfolio selection(Jing et al., 2023), and stock portfolio investment(Vásquez et al., 2021).

By integrating TOPSIS into the decision-making process, companies can effectively evaluate and rank investment opportunities based on a variety of criteria. This method allows for systematic comparison of stocks, thereby enabling the identification of stocks that are outperforming from stocks that are underperforming(Martinkutė-Kaulienė et al., 2021). Additionally, TOPSIS has been used in the financial sector for applications such as bankruptcy prediction and stock selection for portfolio construction(Rezaei & Vaez-Ghasemi, 2020). In addition, the flexibility of TOPSIS has been demonstrated in various industries, such as the cement industry(Omrani et al., 2019), insurance sector(Vuković et al., 2020), and agricultural companies(Nguyen et al., 2020). These applications demonstrate TOPSIS' flexibility in assisting decision-making processes in various sectors.

Technique for Order Preference by Similarity to Ideal Solutions (TOPSIS) Method

The TOPSIS technique is a multicriteria decision-making methodology that selects alternative solutions based on their geometric distance from the positive ideal solution and the negative ideal solution, using the Euclidean distance(Lakshmi & Kumara, 2024). Nevertheless, it is important to acknowledge that the alternative that is closest to the positive ideal solution does not necessarily be the alternative that is closest to the negative ideal solution. The TOPSIS approach (Dash et al., 2019) takes into account both the distance to the positive ideal solution and the distance to the negative ideal solution concurrently. The optimal solution is determined by the TOPSIS approach, which involves assessing the proximity of an option to the positive ideal solution. The TOPSIS method assesses the relative proximity of choices to a positive optimal solution in order to ascertain their order of significance (Venugopal et al., 2024).

The ranking alternatives are thereafter utilised as a point of reference for decision makers in order to select the most optimal solution. The TOPSIS approach consists of the following parts (Palczewski & Sałabun, 2019):

a. Create a normalized decision matrix.
ElementR$_{ij}$The results of normalizing the decision matrix R using the Euclidean length of vector method are:

$$R_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (1)$$

With i=1,2,.....m; and j = 1,2,.....n;

Information :

R_{ij}= Normalization matrix

x_{ij}= Decision matrix

b. Create a weighted normalized decision matrix.
The formula for determining the positive ideal solution (A +) and negative ideal solution (A -) using the normalised weight rating is as follows:

$$y_{ij} = w_i r_{ij} \quad (2)$$

c. Create positive and negative ideal solution matrices
The positive ideal solution A+ can be calculated by the formula:

$$A^+ = (y1^+, y2^+, y3^+, \dots, yn^+) \quad (3)$$

The negative ideal solution A- can be calculated by the formula:

$$A^- = (y1^-, y2^-, y3^-, \dots, yn^-) \quad (4)$$

Negative ideal solution formula:

$$A^- = (y1^-, y2^-, y3^-, \dots, yn^-) \quad (5)$$

Information :

y_j^+ = maxy_{ij}, if j is the benefit attribute
= miny_{ij}, if j is the cost attribute

y_j^- = miny_{ij}, if j is the benefit attribute
= maxy_{ij}, if j is the cost attribute

d. Calculate the disparity between the values assigned to each alternative and the matrices representing the positive and negative ideal solutions. The formula for determining the distance between alternatives A_i with a positive ideal solution is as follows.

$$D_i^+ = \sqrt{\sum_{j=1}^{m} (y_i^+ - y_{ij})^2}, i = 1,2,3, \dots m \quad (6)$$

While the distance between alternatives A_i with a negative ideal solution can be formulated as follows:

$$D_i^- = \sqrt{\sum_{j=1}^{m} (y_{ij} - y_i^-)^2}, i = 1,2,3, \dots m \quad (7)$$

e. Determine the preference value for each alternative
The formula for determining the proximity of each alternative to the optimum solution is as follows:

$$V = \frac{Di^-}{Di^- + Di^+}, i = 1,2,3, \dots m$$

The end outcome of the TOPSIS method calculation is the preference value assigned to each choice. A greater preference value indicates that the alternative being considered is the one that the decision maker expects.

Method of collecting data

This research uses data collection by observing official websites providing stock financial report data such as https://idx.co.id and https://analytics2.rti.co.id.Through these observations, researchers obtained an overview of the financial reports and stock data of the 10 best LQ45 issuer shares in Indonesia. Apart from that, there is a data collection process through interviews with capital market practitioners so that data can be obtained related to determining criteria as well as information regarding the weighting of each criterion which researchers have obtained through reference study literature entitled The Intelligent Investor.The data used in this calculation is annual financial report data, starting from the period 2016 to 2023. The data presented was obtained through the official website of the Indonesian Stock Exchange (https://idx.co.id).

Results and Discussion

Analysis of Criteria and the Nature of Criteria for Decision Making

Criteria analysis explains the assessment parameters used in the TOPSIS method ranking calculations. Determination of criteria is determined from interviews with capital market practitioners and considering criteria based on literature studies. In this research there is a formulation of criteria consisting of:

1. Market Cap
   Company size is obtained from calculating the price times the number of shares (units in Rupiah)
2. Current Ratio
   The metric employed to assess the current state of affairs is the current ratio. Current assets or current liabilities (in percent) constitute the formula.
3. Profit Stability (5 years)
   The profit stability used is 5 years. The profit stability figure is obtained by checking the financial statements to see whether there was a profit in that period. For example, in the past 5 years, the company experienced losses in 2 reporting periods, this means the profit stability figure is 3.
4. Dividend record (5 years)
   The dividend record figure is obtained in the same way as profit stability, but the difference here is to check the dividend. For example, if in the past 5 years the company only distributed dividends 4 times, this means the dividend record number is 4.
5. Profit growth (5 years)
   The profit growth figure is calculated by averaging the annual growth in net profit over 5 years (units in percent).
6. Price to earnings ratio (2 years)
   The formulation of the price to profit ratio is obtained by dividing the company's current size by the average annual profit for 2 years.
7. Book value ratio
   The book value ratio (PBV) can be calculated using the company size or equity formula.

The financial report used for the above formulation is the 4th quarter financial report. If the company's 4th quarter financial report has not been released, then the report will still be used, but to get the profit value for the calculation above, the profit value will be annualized by means of, profit value divided by the reporting quarter multiplied by 4.

Table 1. Assessment Criteria

Criteria (C)	Criterion Name	Nature of Criteria	Criteria Weight Value
C1	Market Cap	Benefits	4
C2	Current Ratio	Benefits	5
C3	Profit Stability	Benefits	5
C4	Dividend Record	Benefits	3
C5	Profit Growth	Benefits	5
C6	Price to Earning Ratio (PER)	Cost	4
C7	Book value ratio (PBV)	Cost	4

Based on table 1, the nature of the criteria can be explained which can be categorized into types of benefits or costs. Criteria include benefits, if the criterion value is higher, it means it is better, while for cost criteria, if the criterion value is lower, it means it is better. There are criteria C1, C2, C3, C4, C4, C5 which include benefit criteria and criteria C6 and C7 which include cost criteria.

The weighting of the criteria is established according to their respective levels of significance. A value of 5 signifies "very important," a value of 4 represents "important," a value of 3 represents "quite important," a value of 2 represents "not important," and a value of 1 signifies "extremely unimportant."

Alternative Analysis

Alternatives in determining decisions are obtained from the analysis and observation process regarding the 10 Indonesian companies in LQ45, namely.

1. PT Adhi Karya Persero Tbk (ADHI).
2. PT Adaro Energy Tbk (ADRO).
3. PT Akr Corporindo Tbk (AKRA).
4. PT Aneka Tambang Tbk (ANTM).
5. PT Hanjaya Mandala Sampoerna Tbk (HMSP)
6. PT Waskita Karya (Persero) Tbk (WSKT)
7. PT Waskita Beton Precast Tbk (WSBP)
8. PT Unilever Indonesia Tbk (UNVR)
9. PT United Tractor Tbk (UNTR)
10. PT Telekomunikasi Indonesia (Persero) Tbk (TLKM)

TOPSIS Method Calculation Process

Determine the Alternative Suitability Rating for each Criteria

The alternative suitability rating for each criterion contains the value of 10 alternatives based on the assessment criteria used in determining the decision.

Table 2. Suitability Ratings

Alternative	Criteria						
	C1	C2	C3	C4	C5	C6	C7
A1	3.49T	111	5	5	-7.26	10.13	0.63
A2	38.7T	151	5	5	16.69	9.13	0.69
A3	13T	158	5	5	5.22	15.62	1.23
A4	56T	121	5	3	234.1	84.09	2.97
A5	143T	245	5	5	-1.36	12.88	4.75
A6	11T	67	4	4	-154.13	-2.82	0.72
A7	3T	67	4	3	-112.53	-1.87	3.19
A8	168T	66	5	5	5,386	23.17	34.15
A9	70T	211	5	5	16,568	8.41	1.12
A10	328T	67	5	5	7,154	11.51	2.72

Based on table 2, it can be explained that there are 10 alternative values for 7 criteria. This value data was obtained based on the results of the analysis. The alternative value for each criterion becomes the suitability rating value which can then be continued in the matrix normalization process.

Normalized Decision Matrix

In order to compute the normalised Decision Matrix, equation (1) is utilised. Through calculating the suitability rating value of each alternative for each criterion, the normalised decision matrix is generated.

Table 3. Normalized decision matrix

Alternative	Criteria						
	C1	C2	C3	C4	C5	C6	C7
A1	0.009	0.250	0.328	0.346	-0.024	0.110	0.018
A2	0.095	0.340	0.328	0.346	0.055	0.100	0.020
A3	0.032	0.356	0.328	0.346	0.017	0.170	0.035
A4	0.138	0.273	0.328	0.208	0.772	0.916	0.085
A5	0.351	0.552	0.328	0.346	-0.004	0.140	0.136

A6	0.029	0.151	0.263	0.277	-0.508	-0.031	0.021
A7	0.009	0.151	0.263	0.208	-0.371	-0.020	0.091
A8	0.412	0.149	0.328	0.346	0.018	0.253	0.978
A9	0.172	0.475	0.328	0.346	0.055	0.092	0.032
A10	0.804	0.151	0.328	0.346	0.024	0.125	0.078

Weighted normalized Decision Matrix

Equation (2) is used to calculate the weighted normalised decision matrix. This is achieved by multiplying the R matrix with the preference weights acquired. The resulting weighted normalised decision matrix, also known as the Y matrix, is obtained.

Table 4. Weighted normalization matrix

Alternative	Criteria						
	C1	C2	C3	C4	C5	C6	C7
A1	0.034	1,250	1,641	1,038	-0.120	0.442	0.072
A2	0.379	1,701	1,641	1,038	0.275	0.398	0.079
A3	0.127	1,779	1,641	1,038	0.086	0.681	0.141
A4	0.552	1,363	1,641	0.623	3,860	3,666	0.340
A5	1,405	2,759	1,641	1,038	-0.022	0.562	0.544
A6	0.117	0.755	1,313	0.830	-2,542	-0.123	0.083
A7	0.036	0.755	1,313	0.623	-1,856	-0.081	0.365
A8	1,649	0.743	1,641	1,038	0.089	1,010	3,912
A9	0.690	2,376	1,641	1,038	0.273	0.367	0.128
A10	3,217	0.755	1,641	1,038	0.118	0.502	0.312

Determine the positive ideal solution and the negative ideal solution

Next there is a process of determining the value of the positive ideal solution and the value of the negative ideal solution for each criterion. This calculation uses equation (3), equation (4) and equation (5).

Table 5. Positive ideal solution and negative ideal solution

Ideal solution	Criteria						
	C1	C2	C3	C4	C5	C6	C7
$\mathbf{A}^+$	3,217	2,759	1,641	1,038	3,860	-0.123	0.072
$\mathbf{A}^-$	0.034	0.743	1,313	0.623	-2,542	3,666	3,912

Determine the distance between the negative ideal solution and the positive ideal solution

To perform this procedure, the Euclidean distance between each alternative and the positive ideal solution (D^+) and negative ideal solutions (D^-) is computed using equation (6).

Table 6. Distance between positive ideal solutions and negative ideal solutions

Alternative	D+	D-
A1	5.344890807	5.616176082
A2	4.722501505	5.883803759
A3	5.040139116	5.60327377
A4	4.863156348	7.38260491
A5	4.364636726	5.792172745
A6	7.400410503	5.391676764
A7	6.868531949	5.204998044
A8	6.064126931	4.106308993
A9	4.432228484	6.041872371
A10	4.297883999	6.360687341

Determine the Final Preference Value for each alternative

After all the alternative values have been determined, what needs to be done next is to rank them by sorting the alternatives that have the highest preference value to the smallest. So the following results are obtained.

Table 7. Preferences and ranking

Alternative	Final score	Ranking
A1	0.512374948	7
A2	0.554745843	5
A3	0.526454609	6
A4	0.60287023	1
A5	0.570274825	4
A6	0.421485302	9
A7	0.431108222	8
A8	0.403749556	10
A9	0.576839239	3
A10	0.596767347	2

Based on table 8, it can be explained that the process of ranking 10 shares of LQ45 issuers using the TOPSIS method can produce the best shares. The results of the best ranking process show that the A4 alternative, namely PT Aneka Tambang Tbk (ANTM), is the best alternative with a value of 0.60287023, becoming the best LQ45 share issuer.

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Conclusion and Suggestions

The research findings indicate that the utilisation of the TOPSIS technique approach can assist investors in selecting firm stocks that possess both substantial investment worth and an acceptable level of risk. This approach facilitates the identification of the most ideal choice by considering specific criteria. The findings indicate that the TOPSIS methodology can serve as a valuable instrument for aiding investors in the process of ranking the top 10 LQ45 stock issuers. Suggestions for further research involve prioritising risk management parameters while making stock investment decisions.

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