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Financial Performance Measurement of Companies in the BIST Sustainability 25 Index with LBWA and MEREC-based CRADIS Methods

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Abstract

Financial performance refers to the assessment of a firm's capacity to generate profits and manage its financial assets effectively during a specific period of time. This study addresses the evaluation of financial performance of companies in the BIST Sustainability 25 Index using a hybrid MCDM method. For this investigation, nine criteria, namely, acid-test ratio, asset turnover, current ratio, debt ratio, EBITDA, net profit margin, return on equity, stock return and stock turnover are used to determine the financial performance of companies. In this study, the weight of criteria is calculated using both subjective (LBWA) and objective (MEREC) weighting approaches. After the weight of criteria is determined, the financial performance of companies is ranked using the CRADIS method. The results showed that EBITDA and Stock turnover are the most and least important criteria, respectively. According to results obtained from the CRADIS method, Ereğli Iron-Steel, Enka construction and Ford Otosan have the highest financial performance, while Vestel, Arçelik and Çimsa have the lowest financial performance in the period of 2018 and 2022. Additionally, the robustness and validity of the results are tested by various MCDM methods, namely, ARAS, COPRAS, EDAS, MABAC, MAIRCA, MARCOS, TOPSIS, CoCoSo and MAUT.

Keywords: Financial performance, Sustainability, BIST, MCDM.

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1. INTRODUCTION

In today's competitive environment, financial performance evaluation of company holds significant importance not only for managers, creditors, and current/potential investors but also for companies operating within the same sector. Company performance measurement typically occurs within the framework of financial analyses. The concept of financial performance encompasses various aspects such as return, productivity, output, and economic growth. Utilizing financial ratios in the performance evaluation process can be suitable for both companies and related sectors. Financial ratios derived from data in income statements and balance sheets, serve as crucial measurement tools in evaluating the performance and financial assets of companies. Furthermore, the importance of financial ratios also lies in their ability to reveal the strengths and weaknesses of companies in terms of liquidity, growth, and profitability. (Yalcin et al., 2012, p. 350). Financial ratio analysis has been pivotal over the years in offering a comprehensive perspective on a company's financial position at any moment or period of time (Muresan & Wolitzer, 2004). Assessing firm performance through financial ratios has been a conventional yet effective method for decision-makers, business analysts, creditors, investors, and financial managers. Instead of relying solely on the total amounts recorded in financial statements, these analyses were conducted using various financial ratios to derive more meaningful results. Ratio analysis serves as a valuable tool for stakeholders to assess the financial well-being of a company. By utilizing these financial ratios, comparisons can be made among companies within the same industry, across different industries, or even within the same firm over time. Additionally, this tool enables the comparison of the relative performance of companies of varying sizes (Delen et al., 2013, p. 3970).

Financial performance measurement encompasses numerous evaluation criteria, rendering it a form of Multi-Criteria Decision-Making (MCDM) problem. MCDM analysis identifies the optimal alternative by taking into account multiple criteria or factors that affect the other options (Dong et al., 2018, Wen et al., 2020; Lam et al., 2021). Kara et al. (2024) highlighted that MCDM techniques offer the chance to aggregate and assess different perspectives and criteria within a single framework. Over the last decades, many studies have reported that MCDM techniques are extensively employed in the evaluation of financial performances of companies using various ratio indicators (Akbulut & Rençber, 2015; Aytekin, 2019; Aldalou & Perçin, 2020; Pala, 2022; Isık et al., 2024). Several financial ratios, including the acid-test ratio, asset turnover, current ratio, debt ratio, EBITDA, net profit margin, return on equity, stock return, and stock turnover, are regarded as primary indicators in financial performance measurement (Kaya et al., 2024). Correspondingly, this study aims to evaluate the financial performances of companies in the BIST Sustainability 25 Index using hybrid MCDM methods. To achieve this goal, a new model was proposed which includes both subjective (LBWA) and objective (MEREC) weighting approaches with new ranking-based method (CRADIS). Objective approaches involve determining the weights of criteria based on information contained in a decision-making matrix using specific mathematical formulations. It typically disregards the decision-maker's opinion. In a

subjective approach, the decision-maker or experts provide their opinions on the significance of criteria for a particular decision-making process, aligned with their system of preferences (Pamučar et al., 2018, p. 3). According to Paramanik et al. (2022), the objective and subjective criteria weights should be integrated to leverage the advantages of both approaches. Subsequently, the companies in the BIST Sustainability 25 Index are ranked using the recent ranking method called CRADIS. Furthermore, the reliability and robustness of the proposed model are tested through comparative analysis, including MAIRCA, SPOTIS, MABAC, RSMVC, MAUT, MARCOS, ARAS and TOPSIS. To the best of the author's knowledge, this is the first study to evaluate the financial performance of companies in the BIST Sustainability 25 Index using the LBWA and MEREC-based CRADIS methods. The rest of this paper is structured as follows: The second section summarizes the literature review in the relevant field. The third section is associated with the methodology. The fourth section presents the findings of the research. Finally, the fifth section concludes the paper with a brief summary and discuss the future work.

2. LITERATURE REVIEW

In this section, a comprehensive literature review is conducted to understand trends regarding financial performance measurement. Evaluating financial performance is crucial for companies operated in various industry, as it serves as a fundamental tool for assessing the effectiveness of management strategies, identifying areas for enhancement, make well-informed decisions and maintaining competitiveness in the marketplace. Correspondingly, in the last decades, the amount of research has increased significantly on relevant field. Table 1 and 2 provides a summary of previous research on financial performance measurement and overview of the methods applied in this study, respectively.

Table 1. Overview of previous research on financial performance

Author(s)	Year	Methods	Topic	Period
Akbulut and Rençber	2015	TOPSIS	Financial performance measurement of BIST Manufacturing industry	2010-2012
Önder and Altıntaş	2017	GRA-ANP	Performance measurement of BIST Construction industry	2012-2015
Şit et al.	2017	TOPSIS	Analysis of the financial performance of BIST Main Metal industry	2011-2015
Üçüncü et al.	2018	TOPSIS	Investigation of financial performance of BIST Paper industry	2016
Tayyar et al.	2018	RIM	Financial performance analysis of BIST Insurance industry	2015-2017
Kayalı and Aktaş	2018	TOPSIS	Performance measurement of BIST Automotive industry	2010-2015
Karaoğlan and Şahin	2018	AHP-VIKOR-TOPSIS-GRA-MOORA	Examining the financial performance of BIST Chemical, Petroleum Plastic industry	2015
Aytekin	2019	CRITIC-MAUT-PROMETHEE-TOPSIS	Investigation of financial performance of BIST Tourism industry	2014-2018
Şahin and Karacan	2019	GRA-TOPSIS	Financial performance measurement of BIST Construction industry	2017
Özçelik and Küçükçakal	2019	TOPSIS	Analysis of the financial performance of BIST Leasing and Factoring industry	2009-2016

Yıldırım and Altan	2019	Entropy-TOPSIS	Evaluation of the financial performance of Insurance industry	2012-2016
Atukalp	2019	MULTIMOORA	Performance measurement of BIST Cement industry	2013-2017
Ayçin and Güçlü	2020	Entropy-MAIRCA	Analysis of the financial performance of BIST Trade industry	2018
Karcıoğlu et al.	2020	Fuzzy logic and Entropy	Examining the financial performance of BIST Energy industry	2013-2017
Orhan et al.	2020	CRITIC-TOPSIS	Financial performance analysis of BIST Transportation industry	2011-2018
Bağcı and Yerdelen Kaygın	2020	Entropy-ARAS-WASPAS	Assessment of the financial performance of BIST Holding and Investment industry	2000-2017
Aldalou and Perçin	2020	FSE-FEDAS	Financial performance measurement of BIST Food and Beverage industry	2015-2017
Yıldırım et al.	2021	GRA	Investigation of financial performance of BIST Iron and Steel industry	2011-2019
Demir	2021	SWARA-COPRAS-MAUT	Financial performance analysis of BIST Cement industry	2014-2019
Gürkan and Aldoury	2021	TOPSIS	Examining the financial performance of BIST Technology industry	2017-2019
Baydaş and Elma	2021	Entropy, TOPSIS-WSA-PROMETHEE	Financial performance measurement of BIST Manufacturing industry	2014-2018
Elmas and Özkan	2021	SWARA-OCRA	Investigation of financial performance of BIST Transport and Storage industry	2015-2019
Yıldırım and Meydan	2021	IF-EDAS	Assessment of the financial performance of BIST Retail and Trade industry	2017-2019
Özkan and Ağ	2021	CRITIC-ARAS	Investigation of corporate sustainability performance of manufacturing companies in the BIST Sustainability Index.	2019
Babacan and Tuncay	2022	SWARA-AHP-TOPSIS	Analysis of the financial performance of BIST Energy industry	2014-2020
Özdemir and Parmaksız	2022	TOPSIS-EDAS	Comparison of the financial performance of BIST Energy industry	2019-2020
Pala	2022	CRITIC-MULTIMOOSRAL	Financial performance analysis of BIST Insurance industry	2019-2020
Bektaş	2023	MEREC-MABAC-CoCoSo	Examining the financial performance of BIST Insurance industry	2021
Doğan and Karaçayır	2023	CRITIC-TOPSIS-MABAC	Assessment of the financial performance of BIST Technology industry	2019-2022
Kara and Şeyranlıoğlu	2023	Entropy-GRA	Comparison of the performance of companies in the BIST Sustainability Index	2020-2022
Ersoy	2023	LOPCOW-RSMVC	Performance measurement of BIST Retail and Trade industry	2017-2021
Uğuz Arsu and Arsu	2023	MEREC-CoCoSo	Analyze the performance of Manufacturing industry in the BIST Sustainability Index	2020
Coşkun	2023	TOPSIS	Evaluation of financial performance of BIST Sustainability Index companies	2010-2022
Isık et al.	2024	DEMATEL-CRITIC-EDAS-WASPAS-TOPSIS	Stock market performance analysis of BIST Food and Beverage industry	2021-2022
Güçlü and Muzac	2024	Grey MULTIMOORA	Financial performance analysis of BIST Iron and Steel industry	2017-2021
Kaya et al.	2024	FUCOM- Nine MCDM methods	Determining the financial performance of companies traded in BIST Sustainability Index.	2019-2020

Note: Technique for Order Preference by Similarity to Ideal Solution (TOPSIS); Grey Relational Analysis (GRA); Analytic Network Process (ANP); Reference Ideal Method (RIM); Analytic Hierarchy Process (AHP); Vise Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR); Multi-Objective Optimization on the basis of Ratio Analysis (MOORA); Criteria Importance Through Intercriteria Correlation (CRITIC); Multi Attribute Utility Theory (MAUT); Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE); Multi-Objective Optimization by Ration Analysis plus Full Multiplicative Form (MULTIMOORA); MultiAtributive Ideal-Real Comparative Analysis (MAIRCA); Additive Ratio Assessment (ARAS); Weighted Aggregated Sum Product Assessment (WASPAS); Fuzzy Shannon Entropy (FSE); Fuzzy Evaluation Based on Distance from Average Solution (FEDAS); Stepwise Weight Assessment Ratio Analysis (SWARA); Complex Proportional Assessment (COPRAS); Operational Competitiveness Rating (OCRA); Evaluation Based on Distance from Average Solution (EDAS); Multi-Multi-Objective Optimization on the basis of Simple Ratio Analysis (MULTIMOOSRAL); MEthod based on the Removal Effects of Criteria (MEREC); Multi-Attributive Border Approximation Area Comparison (MABAC); A Combined Compromise Solution (CoCoSo); Logarithmic Percentage Change-driven Objective Weighting (LOPCOW); Ranking the Solutions based on the Mean Value of Criteria (RSMVC); Decision Making Trial and Evaluation Laboratory (DEMATEL), Full Consistency Method (FUCOM)

Table 2. Overview of previous research on methods

Author(s)	Year	Method	Topic
Božanić et al.	2020	LBWA	Selection of a location of a camp
Torkayesh et al.	2021	LBWA	Evaluation of healthcare sectors in Eastern Europe
Jokić et al.	2021	LBWA	Selection of fire position of mortar units
Torkayesh and Torkayesh	2021	LBWA	Evaluation of information and communication technology development in G7 countries
Adali et al.	2022	LBWA	Assessment of European cities from a smartness perspective
Božanić et al.	2023	LBWA	A decision support tool for oil spill response strategy selection
Özekenci	2024	LBWA	Personnel Selection: A Case Study on Foreign Trade Company
Author(s)	**Year**	**Method**	**Topic**
Ulutaş et al.	2022	MEREC	Pallet truck selection in the textile workshop
Ecer and Zolfani	2022	MEREC	Evaluating economic freedom: The case of OPEC countries
Ulutaş et al.	2023a	MEREC	Identifying the Most Efficient Natural Fibre for Common Commercial Building Insulation
Ecer and Aycin	2023	MEREC	Measuring Innovation Performance: The Case of G7 Countries
Lukić	2023	MEREC	Analysis of the performance of the Serbian economy
Kara et al.	2024	MEREC	Determining sustainable competitiveness levels: A case study for Turkey
Mastilo et al.	2024	MEREC	Assessing the Banking Sector of Bosnia and Herzegovina
Author(s)	**Year**	**Method**	**Topic**
Puška et al.	2022	CRADIS	Market Assessment of Pear Varieties in Serbia
Ulutaş et al.	2023b	CRADIS	Optimizing energy usage and environmental effect in production focus
Puška et al.	2023	CRADIS	Selection of an Insurance Company in Agriculture
Krishankumar and Ecer	2023	CRADIS	Selection of IoT service provider for sustainable transport
Xu et al.	2023	CRADIS	Assessment of Mountain Tourism Sustainability
Krishankumar et al.	2024	CRADIS	Selection of a viable blockchain service provider for data management within the internet of medical things
Aytekin et al.	2024	CRADIS	Determining the factors affecting transportation demand management

Note: Level Based Weight Assessment (LBWA); MEthod based on the Removal Effects of Criteria (MEREC); Compromise Ranking of Alternatives from Distance to Ideal Solution (CRADIS)

It can be seen above; a considerable amount of research has been published on financial performance measurement of companies traded in BIST using different MCDM methods. For instance,

manufacturing (Akbulut & Rençber, 2015; Baydaş & Elma, 2021), construction (Önder & Altıntaş, 2017; Şahin & Karacan, 2019), insurance (Tayyar et al., 2018; Yıldırım & Altan, 2019; Pala, 2022), energy (Karcıoğlu et al., 2020; Özdemir & Parmaksız, 2022), technology (Gürkan & Aldoury, 2021; Doğan & Karaçayır, 2023), food and beverage (Aldalou & Perçin, 2020; Işık et al., 2024), cement (Atukalp, 2019; Demir, 2021), retail and trade (Yıldırım & Meydan, 2021; Ersoy, 2023), iron and steel (Yıldırım et al., 2021; Güçlü & Muzac, 2024) industries have been investigated by many researchers. In recent years, due to the increase awareness and concerned on environmental issues, several researchers have focused on analyzing the financial and corporate performances of companies traded in the BIST Sustainability Index (Özkan & Ağ, 2021; Kara & Seyranlıoğlu, 2023; Coşkun, 2023; Uğuz Arsu & Arsu, 2023; Kaya et al., 2024). Much of the current literature on evaluation of financial performance was carried out either with a subjective or objective approach. However, no studies have been found which evaluate the financial performance of companies using both objective and subjective approach. The fact that the use of objective and subjective approach in MCDM studies provides more reliable and comprehensive results (Parameshwaran et al., 2015; Marković et al., 2020; Özekenci, 2023). Accordingly, this study aims to contribute to existing literature by proposing a new model that includes both subjective (LBWA) and objective (MEREC) approach with new ranking-based MCDM method (CRADIS).

3. METHODOLOGY

This study investigated firms' financial performances using different MCDM methods. This research used 11 MCDM methods together. The LBWA and MEREC methods are conducted to determine the weight of the criteria, CRADIS method is used to rank the alternatives, and finally eight methods, namely, ARAS, COPRAS, EDAS, MABAC, MAIRCA, MARCOS, TOPSIS, CoCoSo and MAUT are used to comparison of the results. Additionally, in this study, Artificial Intelligence (AI) tools are utilized to enhance the quality of manuscript regarding the proofreading and editing. Table 3 demonstrates the financial performance indicators and MCDM techniques used in this study.

Table 3. Indicators and methods

Performance indicators	Weighting determination	MCDM techniques
Acid-test ratio Asset turnover Current ratio Debt ratio	LBWA (Subjective)	CRADIS
Ebitda Net profit margin Return on equity	MEREC (Objective)	Comparison with other MCDM tools: ARAS, COPRAS, EDAS, MABAC, MAIRCA, MARCOS, TOPSIS, CoCoSo, MAUT
Stock return Stock turnover	AWM (Combined)	

3.1. LBWA

Level Based Weight Assessment (LBWA) method was developed by Žižović and Pamučar in 2019. The LBWA is one of the recent subjective approaches to calculate the weight of criteria. The application steps of the LBWA method are as follows (Žižović & Pamučar, 2019):

Step 1. At first, the most important criterion from the set of criteria is determined.

Step 2. Then, criteria are classified based on significance levels:

Level S_1: At the level S_1 group the criteria from the set S whose significance is equal to the significance of the criterion C_1 or up to twice as less as the significance of the criterion C_1;

Level S_2: At the level S_2 group the criteria from the set S whose significance is exactly twice as less as the significance of the criterion C_1 or up to three times as less as the significance of the criterion C_1;

Level S_3: At the level S_3 group the criteria from the set S whose significance is exactly three times as less as the significance of the criterion C_1 or up to four times as less as the significance of the criterion C_1;

Level S_k: At the level S_k group the criteria from the set S whose significance is exactly k times as less as the significance of the criterion C_1 or up to $k+1$ as less as the significance of the criterion C_1.

According to the rules mentioned above, the decision-maker classifies the observed criteria in rough form using Eq. (1).

$$Si = \{C_{i_1}, C_{i_2} \dots\dots\dots, C_{i_s}\} = \{C_j \in S : i \leq s(C_j) < i+1\} \quad (1)$$

Step 3. Eq. (2) is used to comparison of criteria through their significance within the created subgroups (levels) of the criteria's influence.

$$r = max\{|S_1|, |S_2|, \dots\dots\dots\dots, |S_k|\} \quad (2)$$

Step 4. The elasticity coefficient is defined based on the maximum value of the scale for the comparison of criteria *(r)*.

Step 5. According to Eq. (3), the influence function of the criteria is computed.

$$f\left(C_{i_p}\right) = \frac{r_0}{i \,.\, r_o + I_{i_p}} \quad (3)$$

Step 6. By applying Eq. (4), the optimum values of the weight coefficient of criteria are calculated.

$$w_i = \frac{1}{f(C_2) + \cdots + f(C_n)} \tag{4}$$

Based on Eq. (5), the values of the weight coefficient of the remaining criteria are determined.

$$w_j = f(C_j).w_1 \qquad \text{j=2, 3, ……., n} \tag{5}$$

3.2. MEREC

Method based on the Removal Effects of Criteria (MEREC) method was developed by Keshavarz-Ghorabaee et al. in 2021. It's a new objective weighting method for calculating the criteria weights. It utilizes each criterion's removal effect on the performance of alternatives to calculate the criteria weights. The steps of the MEREC method are as follows (Ghorabaee et al., 2021):

Step 1. The decision matrix is constructed.

Step 2. The decision matrix is normalized using Eqs. (6-7).

$$N_{ij} = \begin{Bmatrix} \frac{min_{x_{kj}}}{k} \\ x_{ij} \end{Bmatrix} if\ j\ \in B \tag{6}$$

$$N_{ij} = \begin{Bmatrix} x_{ij} \\ \frac{}{max_{x_{kj}}} \\ k \end{Bmatrix} if\ j \in B \tag{7}$$

Step 3. The overall performance of the alternatives *(S_i)* is calculated based on Eq. (8).

$$S_i = \ln\left(1 + \left(\frac{1}{m}\sum_j \left|\ln(N_{ij})\right|\right)\right) \tag{8}$$

Step 4. According to Eq. (9), the performance of the alternatives by removing each criterion is computed.

$$S'_{ij} = \ln\left(1 + \left(\frac{1}{m}\sum_{k,k\neq j} \left|\ln(N_{ij})\right|\right)\right) \tag{9}$$

Step 5. The summation of absolute deviations is calculated by Eq. (10).

$$E_j = \sum_i \left|S'_{ij} - S_i\right| \tag{10}$$

Step 6. The final weights of criteria are determined using Eq. (11).

$$w_i = \frac{E_i}{\sum_K E_k} \tag{11}$$

3.3. Aggregated Weighting Method (AWM)

According to Eq. (12), the aggregated weight is calculated (Ighravwe & Babatunde, 2018; Ali et al., 2020]);

$$W_{Aggregated} = \Delta W_{sj} + (1 - \Delta) W_{oj} \tag{12}$$

where W_{sj} and W_{oj} represent the subjective and objective weights of the criteria, respectively and Δ symbolizes the contribution factor. Keshavarz Ghorabaee et al. [2017] suggested using values of Δ from 0 to 1. For this study, Δ = 0.5 was considered.

3.4. CRADIS

Compromise Ranking of Alternatives from Distance to Ideal Solution (CRADIS) method was proposed by Puška et al. in 2021. This method is a combination of steps regarding various MCDM techniques, such as ARAS, MARCOS and TOPSIS. The steps of the CRADIS method are shown below (Puška et al., 2021):

Step 1. The decision matrix is created.

Step 2. The decision matrix is normalized by Eqs. (13-14).

$$n_{ij} = \frac{x_{ij}}{x_{jmax}} \tag{13}$$

$$n_{ij} = \frac{x_{jmin}}{x_{ij}} \tag{14}$$

Step 3. Based on Eq. (15), the aggravated decision matrix is obtained.

$$v_{ij} = n_{ij} \,.\, w_j \tag{15}$$

Step 4. The ideal and anti-ideal solution is determined using Eqs. (16-17).

$$t_i = max v_{ij} \tag{16}$$

$$t_{ai} = min v_{ij} \tag{17}$$

Step 5. The deviations from ideal and anti-ideal solutions are computed based on Eqs. (18-19).

$$d^+ = t_i - v_{ij} \tag{18}$$

$$d^- = v_{ij} - t_{ai} \tag{19}$$

Step 6. According to Eqs. (20-21), the grades of the deviation of individual alternatives from ideal and anti-ideal solutions are determined.

$$s_i^+ = \sum_{j=1}^{n} d^+ \tag{20}$$

$$s_i^- = \sum_{j=1}^{n} d^- \tag{21}$$

Step 7. Based on Eqs. (22-23), the utility function for each alternative is calculated.

$$K_i^+ = \frac{s_0^+}{s_i^+} \tag{22}$$

$$K_i^- = \frac{s_i^-}{s_0^-} \tag{23}$$

Step 8. The final order is obtained using Eq. (24).

$$Q_i = \frac{K_i^+ + K_i^+}{2} \tag{24}$$

The best alternative is the one that has the greatest value Q_i

4. RESULTS

The current study addresses the financial performances of the 10 firms in the BIST Sustainability 25 Index for the period of 2018-2022. This study conducted numerous MCDM techniques to analyze companies' financial performance using several performance indicators. While there has been a significant growth in the number of MCDM techniques in recent years, identifying the most suitable and accurate methods for any decision problem remains challenging (Kiptum et al., 2022; Kaya et al., 2024). Therefore, this study applied various MCDM techniques for calculating the weight of the criteria, and to rank the alternatives. For this investigation, data were gathered from Finnet data platform, and the performance indicators were determined through literature review and expert opinions. Table 4 and 5 provides a brief synopsis of the criteria, and background of the experts involved in this study.

Table 4. Overview of performance indicators

Criteria	Abb.	Optimization	Formulas	References
Acid-test ratio	C_1	max	(Current Assets-Inventories)/Current liabilities	Katchova and Enlow (2013) Karimi and Barati (2018) Aras et al. (2018) Yıldırım and Altan (2019) Atukalp (2019) Yıldırım and Meydan (2021) Pala (2022) Baydas and Pamučar (2022) Ersoy (2023) Doğan and Karaçayır (2023) Kaya et al. (2024)
Asset turnover	C_2	max	Net sales revenue/Average total assets	
Current ratio	C_3	max	Current assets/Current liabilities	
Debt ratio	C_4	min	Total debts/Total assets	
Ebitda	C_5	max	Operating profit + Depreciation + Amortization	
Net profit margin	C_6	max	Earnings after taxes/Sales	
Return on equity	C_7	max	Net income/Average shareholders' equity	
Stock return	C_8	max	$R_t = (P_{(t)} - P_{(t-1)})/ P_{(t-1)}$	
Stock turnover	C_9	max	Stock holding period = Avg. level of stock x 12 / Annual sales (turnover)	

Table 5. Background of the Expert Group

No	Gender	Experience	Expertise	Occupation	Educational Status
DM1	Male	15-20 years	Accounting	Private sector / Manager	Master degree
DM2	Female	10-15 years	Finance	Private sector / Manager	Master degree
DM3	Male	25-30 years	Financial Management	Academician / Prof. Dr.	Ph.D.
DM4	Female	15-20 years	International Finance	Academician / Assoc. Prof.	Ph.D.

The indicators used in this study was chosen due to their importance on financial performances. For instance, stock return and return on equity are the most significant ratios for financial performance measurement (Kaya et al., 2024). According to Baydas and Pamučar (2022), the most commonly used ratios for assessing a firm's future risks and financial performance are the current ratio and the acid-test ratio. Ghosh and Bhattacharya (2022) emphasized that financial analysts and investors frequently rely on the current ratio as a crucial measure of liquidity. Furthermore, the net profit margin plays a pivotal role in evaluating of the firm's financial and operational performance (Estiasih & Putra 2021). Aytekin (2019) specified that aforementioned performance indicators have been extensively used to evaluate the financial performance of companies using MCDM methods. Thus, it can be concluded that the indicators used in this study are effective for financial performance measurement. In this study, the financial performances of companies in the BIST Sustainability 25 Index were evaluated. As of March 2024, there are 22 companies listed in the BIST Sustainability 25 Index (excluding banks since the differing nature of their financial statements compared to other firms). Due to the unavailability of data, the analysis was conducted with 10 companies, and the overview of companies are presented in Table 6.

Table 6. BIST Sustainability 25 Index List

No	Code	Company Name	Industry
1	ARCLK	Arçelik Inc.	Manufacturing
2	CIMSA	Çimsa Cement Industry and Trade Inc.	Manufacturing
3	ENJSA	Enerjisa Energy Inc.	Electricity, Gas and Water
4	ENKAI	Enka Construction and Industry Inc	Construction and Public Works
5	EREGL	Ereğli Iron and Steel Factories Co. Inc..	Manufacturing
6	FROTO	Ford Automotive Industry Inc.	Manufacturing
7	PETKM	Petkim Petrochemical Inc.	Manufacturing
8	TOASO	Tofaş Turkish Automobile Factory Inc.	Manufacturing
9	TTRAK	Turkish Tractor and Agricultural Machinery Inc.	Manufacturing
10	VESTL	Vestel Electronics Industry and Trade Inc.	Manufacturing

Upon clarification of the criteria and alternatives, an expert group of four individuals were formed, including two academicians teaching course regarding the finance management and two financial managers from different companies. As stated by Kara (2024), expert opinions play a critical role in determining the sector-specific importance levels of financial ratio indicators. Obtaining expert opinions is essential for the implementation of the first criterion weighting process. As depicted in Table 4, the experts were determined based on their professional experience and knowledge in financial

analyses. Consequently, it is apparent that the selection criteria align with the expertise areas of the participating individuals in the study.

4.1. The results obtained by the LBWA Method

The first step of applying the LBWA method is creating the criterion set. The criteria set which involves nine criteria was formed as follow; S = {C_1, C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9} ({Acid-test ratio, Asset turnover, Current ratio, Debt ratio, EBITDA, Net profit margin, Return on equity, Stock return and Stock turnover}). According to the opinions of the expert group, the most important criterion was determined as C_5 (EBITDA). Indicator C_5 was regarded as most important criteria by more than 80% of the experts. After that, the criterion levels were created by comparing each criterion with the most important criterion. Based on Eq. (1), the criteria were categorized into two levels (S_1 and S_2) through their relative importance and shown as follows: S_1 = {C_3, C_4, C_5, C_6, C_7, C_8} and S_2 = {C_1, C_2, C_9}. After assigning values to each criterion, the r value was computed by Eq. (2). Then, Eqs. (3-5) were used to the elasticity coefficient (r_0), the influence function of the criteria (f) and value of the weight coefficient (w), respectively. According to Žižović and Pamučar (2019), the elasticity coefficient should be $r_0 > r$. For this reason, the value of the elasticity coefficient (r_0) was considered as r_0 = 7. The influence functions of the criteria and the final weights of the criteria are shown in Table 7.

Table 7. The results of LBWA method

Criteria	Assigned Value	The influence function	The weights of the criteria
Level S_1	*I*	*f*	*w*
C_3	1	0.9091	0.1487
C_4	2	0.8333	0.1363
C_5	0	1.0000	0.1636
C_6	5	0.6667	0.1090
C_7	4	0.7143	0.1168
C_8	6	0.6250	0.1022
Criteria	Assigned Value	The influence function	The weights of the criteria
Level S_2	*I*	*f*	*w*
C_1	1	0.4762	0.0779
C_2	2	0.4545	0.0743
C_9	3	0.4348	0.0711

Consequently, the vector of the weight coefficient was obtained as follows: w_j = (0.0779; 0.0743; 0.1487; 0.1363; 0.1636; 0.1090; 0.1168; 0.1022; 0.0711). The results of the LBWA method indicated that EBITDA (C_5), current ratio (C_3) and debt ratio (C_4) were the most important criteria, while stock turnover (C_9) asset turnover (C_2) and acid-test ratio (C_1) were the least important criteria, respectively.

4.2. The results obtained by the MEREC Method

Since there are negative values in the decision matrix (App-1), the values should be converted into positive one. In this direction, the negative values were transformed positive using the Z-Score normalization method which is developed by Zhang et al. (2014). As mentioned above, this study

addresses the evaluate the financial performance of companies for 5 years. However, since the calculations are very long and complex, only the findings for 2022 are included in this section. After the decision matrix (Table 8) was formed, the decision matrix was normalized through Eqs. (4-5), and its results shown in Table 9.

Table 8. Decision Matrix (2022)

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.7642	2.4081	1.1766	75.0285	1.62E+10	2.4441	17.4179	1.4745	5.6053
CIMSA	0.9415	2.0988	1.1899	47.3336	1.24E+09	39.9857	83.5969	2.3003	5.9572
ENJSA	0.6514	4.8553	0.7036	63.55	8.66E+09	17.1679	93.7682	2.5749	51.8715
ENKAI	2.0627	0.9212	2.3863	23.7059	1.40E+10	3.1734	1.8680	1.5359	8.2590
EREGL	0.9045	1.7463	2.2462	32.1518	2.67E+10	14.0903	18.1926	2.4214	2.2437
FROTO	0.8135	5.1969	1.1984	70.6600	3.20E+10	8.5969	90.4873	2.5696	19.3125
PETKM	0.9324	1.8101	1.1028	65.1331	3.39E+09	13.4570	41.4542	2.7091	8.9823
TOASO	1.1535	3.4755	1.2835	64.9737	1.81E+10	7.5585	59.3435	2.3524	25.4202
TTRAK	0.7543	3.3943	1.2806	64.4528	4.91E+09	10.4108	76.3109	5.2296	9.5145
VESTL	0.3409	2.3436	0.6156	79.0145	6.18E+09	1.4677	8.0029	1.8323	3.2967

Table 9. Normalized Decision Matrix

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.8524	0.3825	0.5980	0.3160	0.0762	1.0000	0.1072	1.0000	0.4003
CIMSA	0.6919	0.4389	0.5913	0.5008	1.0000	0.0611	0.0223	0.6410	0.3766
ENJSA	1.0000	0.1897	1.0000	0.3730	0.1427	0.1424	0.0199	0.5726	0.0433
ENKAI	0.3158	1.0000	0.2949	1.0000	0.0884	0.7702	1.0000	0.9600	0.2717
EREGL	0.7202	0.5275	0.3132	0.7373	0.0464	0.1735	0.1027	0.6089	1.0000
FROTO	0.8008	0.1773	0.5871	0.3355	0.0386	0.2843	0.0206	0.5738	0.1162
PETKM	0.6987	0.5089	0.6380	0.3640	0.3645	0.1816	0.0451	0.5443	0.2498
TOASO	0.5648	0.2650	0.5482	0.3649	0.0682	0.3234	0.0315	0.6268	0.0883
TTRAK	0.8636	0.2714	0.5494	0.3678	0.2515	0.2348	0.0245	0.2819	0.2358
VESTL	1.9108	0.3931	1.1430	0.3000	0.1999	1.6653	0.2334	0.8047	0.6806

Eq. (6) was used to calculate the overall performance of each alternative, and shown in Table 10.

Table 10. The overall performance values of the alternatives (S_i)

Alternatives	S_i
ARCLK	0.6655
CIMSA	0.7694
ENJSA	0.9452
ENKAI	0.5375
EREGL	0.7487
FROTO	0.9673
PETKM	0.7631
TOASO	0.9241
TTRAK	0.8615
VESTL	0.5813

After the overall performance of alternative was computed, the partial performance of each alternative was determined using Eq. (7), and its results presented in Table 11.

Table 11. The partial performance values of the alternatives (S_{ij})

Alternatives	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.4561	0.3981	0.4309	0.3837	0.2698	0.7931	0.4521	0.7931	0.6670
CIMSA	1.0468	1.0289	1.0406	1.0341	1.0610	0.2372	0.2372	0.2372	0.2372
ENJSA	1.1505	1.0903	1.1505	1.1152	1.0796	1.0790	0.9227	1.1764	0.9873
ENKAI	0.3676	0.4526	0.3623	0.4526	0.2645	0.4862	0.5286	0.5221	0.2965
EREGL	0.7489	0.7324	0.7042	0.7502	0.5933	0.7959	0.7117	0.9726	1.0347
FROTO	0.9764	0.9112	0.9634	0.9393	0.8408	1.3295	1.0406	1.3945	1.2400
PETKM	0.8395	0.8241	0.8351	0.8077	0.8077	0.6143	0.5260	0.6788	0.6335
TOASO	0.8844	0.8491	0.8831	0.8642	0.7824	1.1894	0.9517	1.2478	1.0639
TTRAK	0.9202	0.8676	0.9000	0.8817	0.8640	0.8431	0.6815	0.8551	0.8434
VESTL	0.4369	0.4161	0.4731	0.3961	0.3653	0.5261	0.4209	0.5566	0.5392

Afterwards, the summation of absolute deviations was computed by Eq. (8), and shown in Table 12.

Table 12. The sums of absolute deviations (E_j)

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
E_j	1.1906	1.1366	1.1946	1.1408	1.7817	1.7420	1.4927	1.9968	1.7051

According to Eq. (9), the final weights of criteria were calculated, and its results are shown in Table 13.

Table 13. The results of MEREC method (2018-2022)

MEREC	Year	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
wj	2018	0.1127	0.0985	0.1139	0.1312	0.1643	0.0984	0.0907	0.0849	0.1055
Ranking		4	6	3	2	1	7	8	9	5
wj	2019	0.0951	0.1034	0.0966	0.1146	0.0900	0.1071	0.0721	0.1840	0.1371
Ranking		7	5	6	3	8	4	9	1	2
wj	2020	0.1302	0.1428	0.1136	0.1386	0.1773	0.0914	0.0711	0.0585	0.0766
Ranking		4	2	5	3	1	6	8	9	7
wj	2021	0.0938	0.1134	0.0895	0.0978	0.1735	0.1056	0.0923	0.1318	0.1023
Ranking		7	3	9	6	1	4	8	2	5
wj	2022	0.0890	0.0849	0.0893	0.0853	0.1331	0.1302	0.1116	0.1492	0.1274
Ranking		7	9	6	8	2	3	5	1	4
wj	Overall	0.1042	0.1086	0.1006	0.1135	0.1476	0.1065	0.0876	0.1217	0.1098
Ranking		7	5	8	3	1	6	9	2	4

The results of the MEREC showed that stock return (C_8), EBITDA (C_5) and net profit margin (C_6) were the most important criteria, while return on equity (C_7), current ratio (C_3) and acid-test ratio (C_1) were the least important criteria in 2022, respectively. Besides, the values of the criteria vary from

year to year. Thus, it can be concluded that the importance of the criteria changes over the years. Therefore, the overall ranking was obtained by taking the average of 5 years.

4.3. The results obtained from the AWM

Eq. (10) was used to calculate the aggregated weight of each criterion, and its results are shown in Table 14.

Table 14. The final values and the rankings

Methods	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
LBWA									
w_j	0.0779	0.0743	0.1487	0.1363	0.1636	0.1090	0.1168	0.1022	0.0711
Ranking	7	8	2	3	1	5	4	6	9
MEREC									
w_j	0.1042	0.1086	0.1006	0.1135	0.1476	0.1065	0.0876	0.1217	0.1098
Ranking	7	5	8	3	1	6	9	2	4
AWM									
w_j	0.0911	0.0915	0.1247	0.1249	0.1556	0.1078	0.1022	0.1120	0.0905
Ranking	8	7	3	2	1	5	6	4	9

According to results obtained from the AWM, EBITDA (C_5), debt ratio (C_4) and current ratio (C_3) were determined as the most important criteria, while stock turnover (C_9), acid-test ratio (C_1) and asset turnover (C_2) were determined as the least important criteria, respectively.

4.4. The results obtained by the CRADIS Method

After the criterion weights were computed, the financial performance of companies was ranked using the CRADIS method. At first, the decision matrix was formed (Table 15). Afterwards, the decision matrix was normalized using Eqs. (11-12), and shown in Table 16.

Table 15. Decision Matrix

Optimization	max	max	max	min	max	max	max	max	max
Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.7642	2.4081	1.1766	75.0285	16,220,288,000.00	2.4441	17.4179	1.4745	5.6053
CIMSA	0.9415	2.0988	1.1899	47.3336	1,235,841,355.00	39.9857	83.5969	2.3003	5.9572
ENJSA	0.6514	4.8553	0.7036	63.5534	8,662,705,000.00	17.1679	93.7682	2.5749	51.8715
ENKAI	2.0627	0.9212	2.3863	23.7059	13,986,197,000.00	3.1734	1.8680	1.5359	8.2590
EREGL	0.9045	1.7463	2.2462	32.1518	26,654,507,000.00	14.0903	18.1926	2.4214	2.2437
FROTO	0.8135	5.1969	1.1984	70.6600	31,981,409,000.00	8.5969	90.4873	2.5696	19.3125
PETKM	0.9324	1.8101	1.1028	65.1331	3,390,088,000.00	13.4570	41.4542	2.7091	8.9823
TOASO	1.1535	3.4755	1.2835	64.9737	18,115,118,000.00	7.5585	59.3435	2.3524	25.4202
TTRAK	0.7543	3.3943	1.2806	64.4528	4,913,650,794.00	10.4108	76.3109	5.2296	9.5145
VESTL	0.3409	2.3436	0.6156	79.0145	6,183,352,000.00	1.4677	8.0029	1.8323	3.2967
max	2.0627	5.1969	2.3863	79.0145	31,981,409,000.00	39.9857	93.7682	5.2296	51.8715
min	0.3409	0.9212	0.6156	23.7059	1,235,841,355.00	1.4677	1.8680	1.4745	2.2437

Table 16. Normalized decision matrix

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.3705	0.4634	0.4931	0.3160	0.5072	0.0611	0.1858	0.2819	0.1081
CIMSA	0.4564	0.4039	0.4986	0.5008	0.0386	1.0000	0.8915	0.4399	0.1148
ENJSA	0.3158	0.9343	0.2949	0.3730	0.2709	0.4294	1.0000	0.4924	1.0000
ENKAI	1.0000	0.1773	1.0000	1.0000	0.4373	0.0794	0.0199	0.2937	0.1592
EREGL	0.4385	0.3360	0.9413	0.7373	0.8334	0.3524	0.1940	0.4630	0.0433
FROTO	0.3944	1.0000	0.5022	0.3355	1.0000	0.2150	0.9650	0.4914	0.3723
PETKM	0.4520	0.3483	0.4621	0.3640	0.1060	0.3365	0.4421	0.5180	0.1732
TOASO	0.5592	0.6688	0.5379	0.3649	0.5664	0.1890	0.6329	0.4498	0.4901
TTRAK	0.3657	0.6532	0.5366	0.3678	0.1536	0.2604	0.8138	1.0000	0.1834
VESTL	0.1653	0.4510	0.2580	0.3000	0.1933	0.0367	0.0853	0.3504	0.0636

After the normalized decision matrix was formed, the weighted normalized decision matrix was computed by Eq. (13), and its results are shown in Table 17.

Table 17. Weighted normalized decision matrix

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.0338	0.0424	0.0615	0.0395	0.0633	0.0095	0.0200	0.0288	0.0098
CIMSA	0.0416	0.0370	0.0622	0.0626	0.0048	0.1556	0.0961	0.0450	0.0104
ENJSA	0.0288	0.0855	0.0368	0.0466	0.0338	0.0668	0.1078	0.0503	0.0905
ENKAI	0.0911	0.0162	0.1247	0.1249	0.0546	0.0123	0.0021	0.0300	0.0144
EREGL	0.0399	0.0307	0.1174	0.0921	0.1041	0.0548	0.0209	0.0473	0.0039
FROTO	0.0359	0.0915	0.0626	0.0419	0.1249	0.0335	0.1040	0.0502	0.0337
PETKM	0.0412	0.0319	0.0576	0.0455	0.0132	0.0524	0.0477	0.0529	0.0157
TOASO	0.0509	0.0612	0.0671	0.0456	0.0707	0.0294	0.0682	0.0460	0.0444
TTRAK	0.0333	0.0598	0.0669	0.0459	0.0192	0.0405	0.0877	0.1022	0.0166
VESTL	0.0151	0.0413	0.0322	0.0375	0.0241	0.0057	0.0092	0.0358	0.0058
max	0.1556								
min	0.002148								

According to Eqs. (14-15), the ideal and anti-ideal solution was determined, and shown in Table 18 and 19, respectively.

Table 18. Ideal solution

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	0.1218	0.1132	0.0941	0.1161	0.0923	0.1461	0.1356	0.1268	0.1458
CIMSA	0.1140	0.1186	0.0934	0.0930	0.1508	0.0000	0.0595	0.1106	0.1452
ENJSA	0.1268	0.0701	0.1188	0.1090	0.1218	0.0888	0.0478	0.1053	0.0651
ENKAI	0.0645	0.1394	0.0309	0.0307	0.1010	0.1433	0.1535	0.1256	0.1412
EREGL	0.1157	0.1249	0.0382	0.0635	0.0515	0.1008	0.1347	0.1083	0.1517
FROTO	0.1197	0.0641	0.0930	0.1137	0.0307	0.1221	0.0516	0.1054	0.1219
PETKM	0.1144	0.1237	0.0980	0.1101	0.1424	0.1032	0.1079	0.1027	0.1399
TOASO	0.1047	0.0944	0.0885	0.1100	0.0849	0.1262	0.0874	0.1096	0.1112
TTRAK	0.1223	0.0958	0.0887	0.1097	0.1364	0.1151	0.0679	0.0534	0.1390
VESTL	0.1405	0.1143	0.1234	0.1181	0.1315	0.1499	0.1464	0.1198	0.1498
min	0.0645	0.0641	0.0309	0.0307	0.0307	0	0.0478	0.0534	0.0651

Table 19. Anti-Ideal solution

Alternatives/ Criteria	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9
ARCLK	-0.0316	-0.0403	-0.0593	-0.0373	-0.0612	-0.0074	-0.0179	-0.0267	-0.0076
CIMSA	-0.0394	-0.0348	-0.0600	-0.0604	-0.0027	-0.1535	-0.0940	-0.0428	-0.0082
ENJSA	-0.0266	-0.0833	-0.0346	-0.0444	-0.0317	-0.0647	-0.1057	-0.0482	-0.0884
ENKAI	-0.0890	-0.0141	-0.1226	-0.1228	-0.0525	-0.0102	0.0000	-0.0279	-0.0123
EREGL	-0.0378	-0.0286	-0.1152	-0.0899	-0.1019	-0.0527	-0.0188	-0.0452	-0.0018
FROTO	-0.0338	-0.0894	-0.0605	-0.0398	-0.1228	-0.0313	-0.1019	-0.0481	-0.0315
PETKM	-0.0390	-0.0297	-0.0555	-0.0433	-0.0111	-0.0502	-0.0455	-0.0508	-0.0135
TOASO	-0.0488	-0.0590	-0.0649	-0.0434	-0.0686	-0.0273	-0.0661	-0.0438	-0.0422
TTRAK	-0.0312	-0.0576	-0.0648	-0.0438	-0.0170	-0.0384	-0.0856	-0.1001	-0.0145
VESTL	-0.0129	-0.0391	-0.0300	-0.0353	-0.0220	-0.0036	-0.0071	-0.0337	-0.0036
max	-0.0129	-0.0141	-0.0300	-0.0353	-0.0027	-0.0036	0.0000	-0.0267	-0.0018

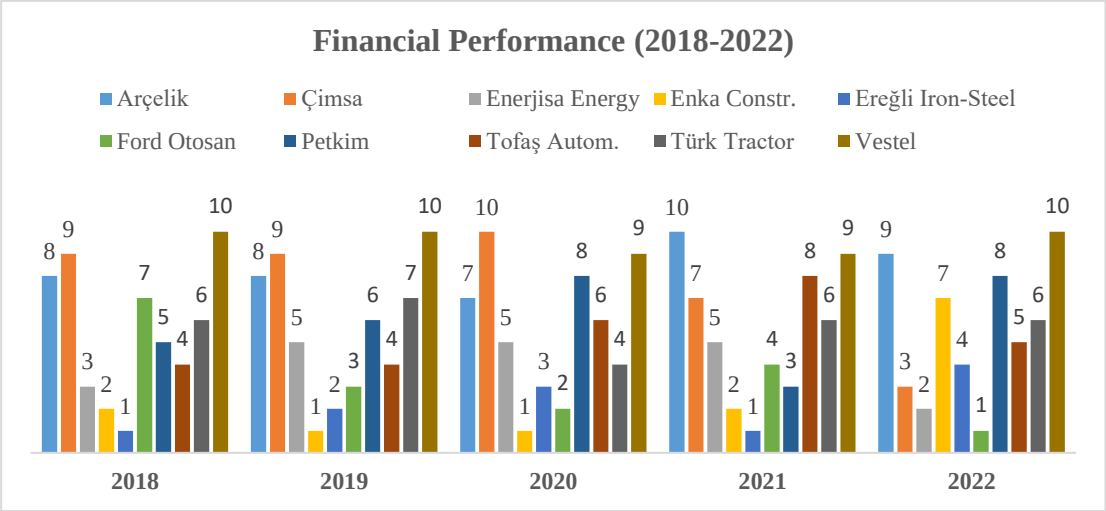
Eqs. (18-19) were used to determine the grades of the deviation of individual alternatives from ideal and anti-ideal solutions. Then, Eqs. (20-21) were applied to calculate the utility function for each alternative. Afterwards, Eq. (22) was used to obtain the final values of alternatives. Table 20 illustrates the results of CRADIS method.

Table 20. The final values and rankings of CRADIS

Alternatives	s_i^+	K_i^+	s_i^-	K_i^-	Q_i	Rank
ARCLK	1.0918	0.3546	-0.2892	2.2775	1.3161	9
CIMSA	0.8853	0.4374	-0.4958	3.9041	2.1707	3
ENJSA	0.8535	0.4536	-0.5275	4.1538	2.3037	2
ENKAI	0.9299	0.4164	-0.4511	3.5522	1.9843	7
EREGL	0.8892	0.4355	-0.4919	3.8732	2.1544	4
FROTO	0.8222	0.4710	-0.5589	4.4009	2.4359	1
PETKM	1.0424	0.3715	-0.3387	2.6668	1.5191	8
TOASO	0.9169	0.4223	-0.4642	3.6547	2.0385	5
TTRAK	0.9282	0.4171	-0.4528	3.5656	1.9914	6
VESTL	1.1938	0.3243	-0.1873	1.4744	0.8994	10
S_0	0.3872		-0.1270			

According to results obtained from the CRADIS method showed that Ford Otosan, Enerjisa and Çimsa were identified as companies with the highest financial performance in 2022. Conversely, Vestel, Arçelik and Petkim were identified as companies with the lowest financial performance in 2022. Additionally, the financial performance of companies between 2018 and 2022 is presented in Figure 1.

Figure 1. Financial performance of companies by years



It can be seen above, Ereğli Iron-Steel, Enka construction and Ford Otosan were identified as companies with the highest financial performance, while Vestel, Arçelik and Çimsa were identified as companies with the lowest financial performance in the period of 2018 and 2022. Stanujkić et al. (2013) and Aydin and Gümüs (2022) pointed out that a comparative analysis is necessary to better understand similarities and differences among MCDM methods. Moreover, decision-makers can confirm the robustness and validity of the results obtained from the proposed model using a comparative analysis. Therefore, the proposed model is tested with nine different MCDM methods.

4.5. Sensitivity and Comparative Analysis

As mentioned above, sensitive and comparative analysis are crucial to validate and strengthen the results obtained from the proposed model. Firstly, sensitivity analysis was conducted by changing the value of elasticity coefficient (r_0). Then, comparative analysis was carried out using different MCDM methods, namely, ARAS, COPRAS, EDAS, MABAC, MAIRCA, MARCOS, TOPSIS, CoCoSo and MAUT. Figure 2 and 3 illustrates the sensitivity and comparative results, respectively.

Figure 2. Comparative analysis

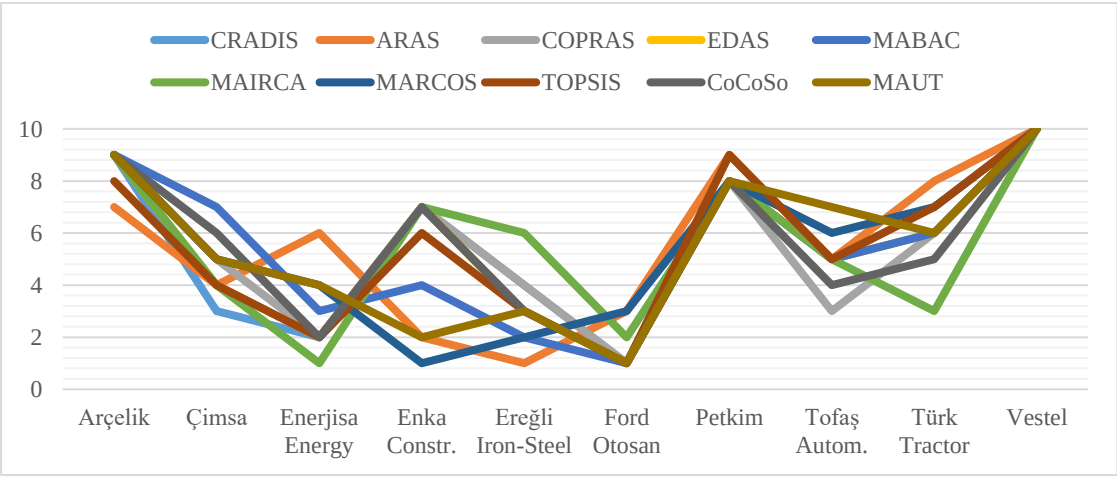
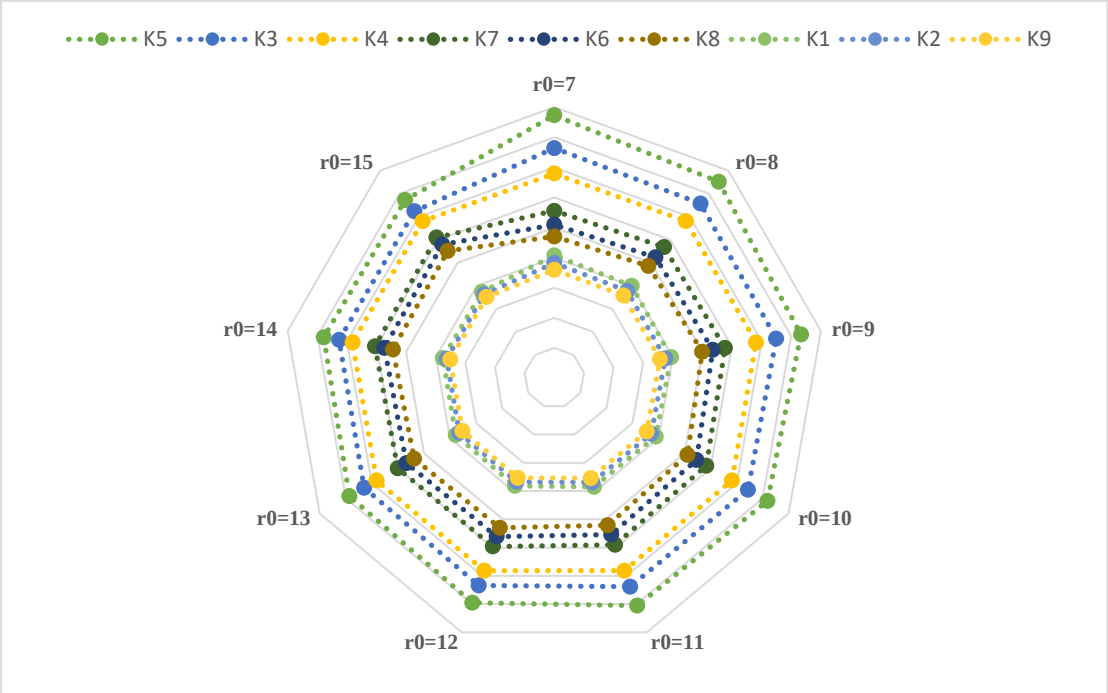


Figure 3. Sensitivity analysis



From the above can be observed that the changes in the elasticity coefficient caused minor changes in the weight coefficients of criteria. Nevertheless, it can be noted that the ranking of the criteria remained constant. Moreover, it can be observed that the company with the highest financial performance according to the CRADIS method aligns exactly with the rankings from the COPRAS, EDAS, MABAC, TOPSIS, CoCoSo, and MAUT methods. Additionally, the results indicate that the rankings derived from the CRADIS method do not differ significantly from those obtained from the other methods. Consequently, it can be inferred that the results of the LBWA and MEREC-based CRADIS methods are consistent with those of other methods. Table 21 demonstrates overall results based on different MCDM methods.

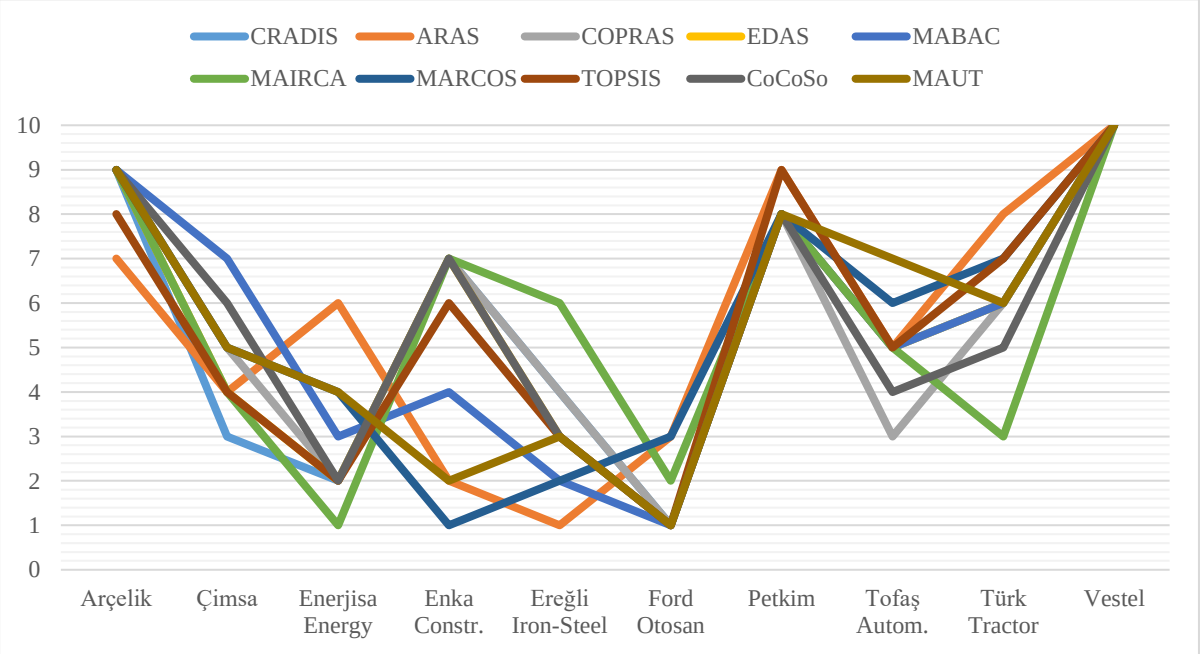
Table 21. Rankings obtained from different MCDM methods

Alternatives/ Methods	CRADIS	ARAS	COPRAS	EDAS	MABAC	MAIRCA	MARCOS	TOPSIS	CoCoSo	MAUT
ARCLK	9	7	9	9	9	9	9	8	9	9
CIMSA	3	4	5	4	7	4	5	4	6	5
ENJSA	2	6	2	2	3	1	4	2	2	4
ENKAI	7	2	7	7	4	7	1	6	7	2
EREGL	4	1	4	3	2	6	2	3	3	3
FROTO	1	3	1	1	1	2	3	1	1	1
PETKM	8	9	8	8	8	8	8	9	8	8
TOASO	5	5	3	5	5	5	6	5	4	7
TTRAK	6	8	6	6	6	3	7	7	5	6
VESTL	10	10	10	10	10	10	10	10	10	10

It can be observed that the company with the highest financial performance according to the CRADIS method aligns exactly with the rankings from the COPRAS, EDAS, MABAC, TOPSIS, CoCoSo, and

MAUT methods. Additionally, the results indicate that the rankings derived from the CRADIS method do not differ significantly from those obtained from the other methods. Consequently, it can be inferred that the results of the LBWA and MEREC-based CRADIS methods are consistent with those of other methods. Figure 2 illustrates the comparative results obtained from the different MCDM methods.

Figure 4. Comparison of the rankings



5. DISCUSSION AND CONCLUSION

Financial performance plays a crucial role analyzing a company's current financial situation and potential growth. The evaluation of financial performance is widely regarded as a critical priority in all economic decision-making processes concerning both public and private enterprises (Chashmi & Fadaee, 2016). Financial performance measurement is affected by various indicators, including asset turnover, current ratio, net profit margin, return on equity, stock turnover and many other financial ratios. Additionally, determining the most appropriate indicators for measuring a company's financial performance is very important for decision-makers such as investors, managers, policy-makers and banks. While there are numerous indicators for assessing financial performance, the selection of suitable ratios depends on the characteristics of the study. Previous studies shown that some financial indicators such as liquidity ratios, leverage ratios, profitability ratios, stock ratios are widely used to evaluate the financial performance of companies (Baydaş & Pamučar, 2022; Doğan & Karaçayır, 2023; Kaya et al., 2024). Correspondingly, this study aimed to obtain more comprehensive and reliable results for companies in the BIST Sustainability 25 index using the most frequently used financial indicators and MCDM methods in the literature.

The present study was designed to determine the weight of criteria based on two different approaches including both objective and subjective methods. The MEREC results showed that the

importance level of criteria varied from year to year. For example, while EBITDA was in the top three-ranked in 2018, 2020, 2021 and 2022, it was at the bottom-ranked in 2019. Stock return was in the top three-ranked in 2019, 2021 and 2022, it was in the last-ranked in 2018 and 2020. Hence, it can be observed that there were significant differences in the ranking of criteria over the years. Odu (2019) stated that weights of criteria can significantly influence the outcome of the decision-making process, so it is important to pay particular attention to the determination of criteria weights. Therefore, in this study, the overall ranking result was obtained by taking the average of 5 years. Additionally, the most interesting finding was that EBITDA was the most important criterion in both methods. This finding suggests that EBITDA holds significance as one of the primary financial indicators, both in mathematical equations and according to expert opinions. The findings of the current study similar from the findings of similar research in the literature. For instance, Moghimi and Anvari (2014) found that the current ratio is the most important criteria for evaluation the financial performance of Iranian cement companies. Abdel-Basset et al. (2020) pointed out that the debt ratio and current ratio are considered as key indicators for financial performance measurement. Moreover, Ersoy (2023) found that the current ratio is the most important criterion in certain years. Kaya et al. (2024) discovered that EBITDA and the current ratio are the most important criteria in the BIST Sustainability Index companies. Nevertheless, it is feasible to encounter studies in the literature that yield different results (Ayçin & Güçlü, 2020; Yıldırım & Meydan, 2021; Pala, 2022). Consequently, the findings from this study, as well as prior research, have indicated that the most or least significant indicators influencing financial performance can vary depending on factors such as years, sectors, methodologies, and financial ratios. According to results obtained by the CRADIS method, Ereğli Iron-Steel, Enka construction and Ford Otosan were the companies with the highest financial performance, while Vestel, Arçelik and Çimsa were the companies with the lowest financial performance between 2018 and 2022. When comparing the ranking results obtained from this study with those from previous studies, it is important to take sectoral differences into account. Therefore, the ranking results were analyzed separately for each industry. The present findings seem to be consistent with another research. For instance, Onder and Altıntaş (2017) and Sahin and Karacan (2019) found that Enka was one of the companies with the best financial performance among the construction firms. Furthermore, Uğuz Arsu and Arsu (2023) found that Ford Otosan was one of the companies with the best financial performance among manufacturing companies. Moreover, Arsu (2021) found that Enerjisa was one of the companies with the best financial performance among Electricity, Gas and Steam Sector. Based on these, it can be concluded that companies with high financial performance in the Sustainability 25 Index also show the same performance in their own indexes. Another notable finding from this study is that the financial performance of companies appears to be quite consistent by different MCDM methods. For instance, companies with the highest financial performance across seven MCDM methods, namely, CRADIS, COPRAS, EDAS, MABAC, TOPSIS, CoCoSo and MAUT remained constant. Additionally, it was found that the companies with the lowest financial performance are similar for all methods. The present findings seem to be consistent with other

research which found that the best alternative is the same for all methods. For instance, Özdağoğlu et al. (2021) pointed out that the best alternative is constant for all methods (MOPA, MOOSRA, COPRAS, SAW and WPM) except ROV method. Furthermore, Özbek and Özekenci (2023) found that countries with the highest logistics market performance is similar for all methods (MAUT, TOPSIS, MARCOS, CoCoSo and BORDA). Additionally, Aydin and Gümüs (2024) found that the optimal alternative is the same for all methods (AHP-VIKOR-WASPAS-PROMETHEE 2-GRA-ARAS-COPRAS and BORDA) except TOPSIS, GTMA and MULTIMOORA. Some managerial implications have been suggested for the relevant field based on the findings obtained from this study. Firstly, decision-makers should prioritize strategies aimed at enhancing EBITDA, as it is a crucial measure of cash flow generation and operational performance. Secondly, managers need to carefully oversee working capital elements like inventory levels, accounts receivable and accounts payable to enhance the current ratio. Thirdly, managing the debt ratio effectively is crucial for maintaining financial stability and minimizing financial risk. Thus, managers should analyze the most suitable capital structure considering the firm's risk tolerance and industry dynamics. Overall, the current paper will provide valuable insights to decision-makers in this field, aiding them in forming more comprehensive conclusions regarding the financial performance of companies. Nevertheless, it is important to acknowledge several limitations of this study. Firstly, the study was conducted within the scope of only 10 companies, based on the availability of data from the BIST Sustainability 25 Index. While these companies provide valuable insights, the limited sample size may not fully capture the diversity of the broader market. Therefore, future studies could address this limitation by expanding the number of companies. Secondly, the study's scope is confined to companies listed in the sustainability index of the BIST, which cannot represent the full spectrum of companies operating in other countries. To enhance the generalizability of findings and facilitate cross-country comparisons, future research could incorporate companies included in sustainability index from different countries. Thirdly, although the current study utilized a wide range of MCDM methods, future studies might apply additional MCDM techniques, including fuzzy logic and gray approaches, to provide a more comprehensive understanding of the financial performance.

The study does not necessitate Ethics Committee permission.

The study has been crafted in adherence to the principles of research and publication ethics.

The author declares that there exists no financial conflict of interest involving any institution, organization, or individual(s) associated with the article.

The entire work was carried out by its only, stated author.

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