ORIGINAL PAPER

DOI: 10.26794/2587-5671-2026-30-3-1664-01
JEL G10, G17, G32

Sector Financial Performance Analysis with Integrated SOWIA-ELECTRE III Methods: The Case of Turkish Real Sector

Z. Şenol, S. Şener, T. Gülcemal
Sivas Cumhuriyet University, Sivas, Turkey

ABSTRACT

The **aim** of this study is to determine the financial performance of the corporate sector employing the integrated SOWIA-ELECTRE III method. In this **framework**, the data of 10 real sectors operating in Borsa Istanbul over the period 2016–2022 are utilized. It was **observed** that the financial performance indicators affecting the sector performance varied over the years and that current liability rate, price to earning ratio, firm value/EBITA and return on equity ratios were important determinants of financial performance. According to the **results** of the performance rankings of the sectors obtained by the ELECTRE III method, it is understood that the highest performance was realized by retail trade in 2017, 2018, 2019, 2021 and 2022, construction and public works in 2016 and food, beverage and tobacco in 2020. In addition, the study compared sector performance rankings with sector index return rankings and the degree of the relationship was determined by the Spearman's rank correlation coefficient. Accordingly, the correlation coefficients are positive, high and significant in 2017 and 2018. Accordingly, it can be said that there is a partial relationship between sector performances and sector returns. The study results show that portfolio managers and investors should give importance to financial performance analysis when making sector analysis, and economic managers that general economic conditions are important determinants in the development of sectors.
Keywords: Electre III Method; SOWIA Method; Financial Performance; Stock Market; Sector Performance

For citation: **Şenol Z., Şener S., Gülcemal T. Sector financial performance analysis with ıntegrated SOWIA-ELECTRE III methods: The case of Turkish real sector.** ***Finance: Theory and Practice.*** **2026;30(3). DOI: 10.26794/2587-5671-2026-30-3-1664-01**

ОРИГИНАЛЬНАЯ СТАТЬЯ

Анализ финансовой эффективности компаний реального сектора с помощью интегрированных методов SOWIA-ELECTRE III: на примере Турции

З. Шенол, С. Шенер, Т. Гюльчемал
Университет Сивас Кумхуриет, Сивас, Турция

АННОТАЦИЯ

Целью данного исследования является определение финансовых показателей компаний корпоративного сектора с использованием интегрированного метода SOWIA-ELECTRE III. В рамках данного исследования были использованы данные 10 реальных секторов, работающих на Стамбульской бирже Borsa Istanbul в период 2016–2022 гг. Отмечено, что показатели финансовой эффективности, влияющие на результаты деятельности сектора, варьируются по годам, и важными детерминантами финансовой эффективности являются ставка текущих обязательств, соотношение цены и прибыли, соотношение стоимости фирмы к EBITA и рентабельность капитала. Согласно результатам рейтинга эффективности секторов, полученным с помощью метода ELECTRE III, можно сделать вывод, что наиболее высокие показатели были достигнуты в розничной торговле в 2017–2019, 2021 и 2022 гг., в строительстве и общественных работах в 2016 г. и в производстве продуктов питания, напитков и табачных изделий в 2020 г. Кроме того, проведено сравнение рейтингов эффективности секторов с рейтингами доходности отраслевых индексов, а степень взаимосвязи определялась с помощью коэффициента ранговой корреляции Спирмена. Соответственно, коэффициенты корреляции положительны, высоки и значимы в 2017 и 2018 гг. Сделан вывод, что существует частичная связь между отраслевыми показателями и доходностью секторов. Показано, что портфельные менеджеры и инвесторы должны придавать значение анализу финансовых показателей при исследовании секторов, а руководители экономических служб

учитывать то, что общие экономические условия являются важными факторами, определяющими развитие секторов.
Ключевые слова: Метод Electre III; Метод SOWIA; финансовые показатели; фондовый рынок; сектор

Для цитирования: **Şenol Z., Şener S., Gülcemal T. Sector financial performance analysis with ıntegrated SOWIA-ELECTRE III methods: The case of Turkish real sector. *Финансы: теория и практика*. 2026;30(3). DOI: 10.26794/2587-5671-2026-30-3-1664-01**

INTRODUCTION

Performance is the determination and management of causal models related to the achievement of targets set by firms [1]. Financial performance is an evaluation process that occurs as a result of the use of financial ratios, which are considered in terms of profitability, productivity, growth, and are valid for both firms and sectors [2]. Financial performance measurements provide a general and concise conclusion about the business as a whole [3]. Interest in financial performance analysis has increased over time. The most important reason for this increase is the increasing demand of investors and analysts for information on firm financial performance [4].

Performance metrics including liquidity, financial structure, efficiency, profitability, and value may alter as a result of the various factors that can impact a sector's growth and performance. Since the performance of sectors can be monitored with a large number of indicators, Multi Criteria Decision Making (MCDM) methods can be used to evaluate sector performances. Determining the weights of importance criteria is an important issue in MCDM problems. While determining the criteria weights, which significantly affect the decision-making process, the suitability of the criteria weights to the multi-criteria model to be used should be taken into consideration. Various methods have been developed in the literature to determine the criteria weights [5]. Commonly used weighting methods fall into three categories: objective weighting methods, subjective weighting methods, and combinatorial weighting methods [6]. Objective approaches are based on the determination of criteria weights with the help of various mathematical models, taking into account the information in the decision matrix [5]. Subjective approaches, on the other hand, are based on determining the criteria weights using the knowledge, intuition or judgment of experts and academics. Objective methods have eliminated the potential bias in subjective methods as they do not require additional information provided by experts [7]. Combinative approaches are approaches based on determining criteria weights by considering subjective and objective information simultaneously [6]. It is stressed in the literature that subjective weights should be computed in addition to objective weights when determining the ELECTRE III approach. In order to determine appropriate expert weights, Tu et al. [8] suggested an optimization model that combines subjective and objective weights. While objective weights are obtained by the entropy method, subjective weights are determined by experts.

In this study, a combined methodology consisting of SOWIA (Subjective and Objective Weight Integrated Approach) and ELECTRE III methods is proposed. In the study, a reasonable set of weights that takes into account both subjective and objective information is obtained by using a unifying weighting method. The CRITIC method, one of the MCDM methods, was used to determine the objective criteria weights. This method is a method that takes into account the intensity of contrast and conflict in the structure of decision problems [9]. These characteristics increase the method's value [7]. The subjective weights of the criteria were determined according to the knowledge, experience and intuition of experts in the field. Two sets of subjective weights were obtained by consulting with ten academic finance specialists and fourteen financial experts. In determining the weights of the decision criteria, the SOWIA method helps the decision maker to make a decision based on the objective weights of importance of the attributes or subjective preferences, or by considering both objective weights and subjective preferences [10]. One of the MCDM approaches, ELECTRE III, was employed to assess the sectors' performance. The ELECTRE III method is a ranking method designed to eliminate the uncertainty of the decision maker in preference modeling by using indifference and preference thresholds [11]. This method attempts to establish an outranking relation between pairs of alternatives without the need for normalization. It also acknowledges the incomparability between alternatives, which occurs when there is no sufficient or clear evidence in favor of any preference or indifference in either alternative *a* or *b* [12].

The study also compares with Spearman's rank correlation the return rankings of the sectors with the financial performance rankings of the sectors. Spearman's rank correlation analysis is a widely used method in the literature to determine whether there is a statistical relationship between the rankings obtained in MCDM [13–17]. Using the Spearman's rank correlation coefficient, Akbulut [18] investigated the relationship between the performance rankings of companies in the BIST cement sector and their stock return rank-

ings, while Orçun [19] investigated the relationship between the financial performance of companies in the BIST electricity index and their stock return rankings.

This study is expected to contribute to the literature for certain reasons. In the literature, firm performance data are generally used in MCDM analyses and firm performance rankings are made. The number of studies that make performance rankings based on sectors is quite few. In the literature review conducted for this study, it was observed that Yalçın et al. [20] and Yavuz et al. [21] made performance rankings based on sectors. Yalçın et al. [20] examined 7 sub-sectors of the Turkish manufacturing industry, whereas Yavuz et al. [21] studied 4 sub-sectors of the chemical industry. This study uses data from ten real sectors registered in BIST. Compared to Yalçın et al. [20] and Yavuz et al. [21], this study conducted a sectoral analysis and performance study on Turkish sectors, with the exception of finance. Sectoral research will also help to draw conclusions for the overall economy. Besides the performance indicators commonly used in the literature, cost of sales rate, sales growth, and price to earnings ratios are used in the study, whereas financial expense ratio and firm value/EBITA ratios, which have not yet been found to be used in the literature and can generally be seen in the research reports of financial institutions, are also used. Thus, the goal was to provide a comprehensive perspective in performance rating metrics. In addition to finance academics, financial specialists working in brokerage companies were recruited for expert opinions, ensuring diversity and variation in expert perspectives. The literature [18, 19, 22, 23] examines the relationship between sector financial performance and returns, as well as whether market prices reflect financial performance. Furthermore unlike the literature, the integrated SOWIA-ELECTRE III method was employed for the first time in the evaluation of sector performances.

LITERATURE REVIEW

The literature review consists primarily of studies in which business and portfolio performance is evaluated and ranked using MCDM approaches such as ELECTRE III and CRITIC methodologies.

Lima & Soares [24], Boonjing & Boongasame [25] and Chavira et al. [12] used the ELECTRE III method in their studies. Lima & Soares [24] used the ELECTRE III method to create defensive portfolios with a buy-sell strategy in which all criteria and alternatives are equally weighted using financial ratios for stocks traded on the Portuguese Stock Exchange. In the study, among shares traded in the Portuguese stock index (PSI), the ELECTRE III method was found to provide good results for investing in a buy-and-hold perspective and constructing defensive portfolios. Using data from Thailand's stock exchange (SET), Boonjing and Boongasame [25] discovered that the portfolio chosen using the ELECTRE III method outperformed the portfolio chosen using the fix-percentage allocation method. Chavira et al. [12] used the ELECTRE III approach to evaluate a small-scale financial institution in the agricultural sector. The results indicate that the ranking models fit the credit ratings, and the ranking results are appropriate for interpreting the relative relevance of the evaluation criteria.

Safaei Ghadikolaei et al. [26], Shaverdi et al. [2], İç et al. [27] and Aduba [28] used Analytical Hierarchy Process (AHP) and Fuzzy Analytical Hierarchy Process (FAHP) methods. Safaei Ghadikolaei et al. [26] analyzed the financial performance of six automobile companies listed on the Tehran Stock Exchange using a hybrid and hierarchical evaluation model that included both accounting-based and value-based variables. In this approach, FAHP was applied to weight the criteria. The firms were then simultaneously ranked using Fuzzy VIKOR, Fuzzy Additive Ratio Assessment (F-ARAS) and Fuzzy Complex Proportional Assessment (FCOPRAS). The results of these three ranking methods are combined using average rankings. The findings reveal that economic value-based indicators are much more important than accounting indicators in the financial performance evaluation of firms. Shaverdi et al. [2] developed a new financial performance evaluation strategy based on Fuzzy MCDM approach to rank seven firms operating in the petrochemical sector in Iran. Fuzzy AHP was used to determine the financial ratio weights and Fuzzy TOPSIS was used to rank the firms. The ranking results generated using these methodologies are similar to the sector's performance rankings.

İç et al. [27] analyzed 3-year data from 6 retail and wholesale enterprises using the AHP and modified VIKOR methods. AHP and the modified VIKOR method enable the data to be monitored annually or periodically. In the study, a comparison was made with TOPSIS and MOORA methods. Compared to other MCDM methods, it was observed that the ranking results with the modified VIKOR method changed significantly. Aduba [28] evaluated the performance of 18 Japanese firms for the period 2010–2020 using FAHP and TOPSIS methods with financial ratios. The study found that the most important financial performance evaluation criteria were economic value added (EVA), earnings before interest and taxes (EBIT), gross margin ratio, net operating profit after tax (NOPAT), return on asset (ROA), and return on equity (ROE), and firms were ranked based on value creation and profitability criteria.

The majority of MCDM studies are undertaken for firms. Yalçın et al. [20] and Yavuz et al. [21] ranked performance in sectors. In the study by Yalçın et al. [20], they ranked the financial performance of firms belonging to 7 sub-sectors of the Turkish manufacturing industry with 2017 data. A new hierarchical financial performance ranking method was used in which the main criteria are based on traditional accounting-based financial performance (AFP) measures and sub-criteria are based on value-based financial performance (VFP) measures. FAHP was used to determine the weights of the criteria. The ranking results show that there are similarities in the results of both methods. In another sector-level study, Yavuz et al. [21] used the VIKOR method with the data of four sub-sectors in the chemical industry in Turkey for the period 2010–2016 and discovered that the most important criteria are current ratio, net profit margin, and cost of sales ratio, with sector rankings varying by year.

When the research and conclusions collected for the examination of the financial performance of companies operating in different sectors registered in BIST are examined, it is found that the analysis methods utilized are generally TOPSIS, VIKOR, CRITIC, EDAS, ARAS, COPRAS, MOORA, Gray Relational Analysis methods. Karaoğlan and Şahin [29] used VIKOR, TOPSIS, MOORA and Gray Relational Analysis methods to rank 24 companies included in the BIST chemicals, petroleum, plastics index based on 2015 data. According to the results obtained from the analysis methods, it was determined that the enterprises with high financial performance were almost the same in all four methods. In Kayahan Karakul and Özaydın's [30] study, TOPSIS and VIKOR methods were used with the 2017 financial data of 8 companies registered in the BIST electricity index, and financial performance ranking was made according to different situations by comparing between the two methods. In his study, Ekizler [31] used VIKOR and TOPSIS methods with the data of 19 companies operating in the weaving, clothing and leather sectors for the period 2011–2018 and determined that the rankings made according to both methods show similarities. Söylemez [32] analyzed the data of 18 firms operating in the BIST metal main industry for the years 2010–2019 using TOPSIS and Gray Relational Analysis methods. The study ranked the companies based on their financial performance, and there were no significant changes in ranking amongst the methodologies used.

Bozdoğan et al. [33] analyzed the financial performance of international banks that opened branches in Turkey using TOPSIS and ELECTRE methodologies with annual financial indicators from 2014–2018. Over time, both techniques of evaluating financial performance have produced broadly similar results. Akgün [34] analyzed the financial performance of energy companies using CRITIC and CODAS methods with data from 2020 and 2021. The study found that the parameters with the highest financial valuation weight were equity turnover, asset turnover, long-term liabilities/total assets ratio, and working capital turnover. Soy Temur [23] ranked the firms according to their financial performance using ARAS, COPRAS and TOPSIS methods with the data of eight firms registered in the BIST tourism index for the period 2016–2020. The study also found no similarities between performance ranking and stock returns. Öndeş & Özkan [35] analyzed the financial performance of firms in the BIST IT sector with three-quarter data for 2020. In the study using CRITIC and EDAS methods, it was observed that the performance rankings of the firms changed over the periods. Türegün [36] executed a performance review using TOPSIS and VIKOR techniques with data from ten tourism enterprises traded on BIST between 2018 and 2020. The study found that the results for 2018 and 2019 were comparable, but the findings for 2020 were different, and firms with a higher price/sales ratio rose to the top of the ranking.

Liao et al. [6] proposed a mixed weighting technique that uses both subjective and objective expert views to determine the weights of the criteria used for the analysis. Chen et al. [37] used the Bayesian BWM method to integrate the subjective weighting method BWM (best-worst method) and the objective weighting method Entropy.

The integrated SOWIA-ELECTRE III method, a relatively new method in financial performance evaluation and ranking and sector performance evaluation, is used in this study to benefit decision makers, investors, financial analysts, economic managers, and the related sector from more detailed and different perspectives, and the results are interpreted in a comparative manner.

MATERIALS AND METHODS

This study proposes a novel evaluation approach by examining 10 real sectors listed on BIST based on 11 financial performance metrics. The analysis makes use of annual data from the sectors for the period 2016–2022 gathered from the Central Securities Depository (CSD) and the Public Disclosure Platform (PDP).

The study's approach involved determining objective and subjective weights for the indicators, which were then merged with the SOWIA method. While the objective weights of the indicators were calculated with the CRITIC method using the Excel program, the

subjective weights were determined by consulting with finance experts and academics. The performances of the sectors were evaluated with the ELECTRE III method using Matlab 2017 programming language and the sectors were ranked from best to worst based on their results.

Evaluation Indicators of Sectors

The 10 sectors registered in BIST are evaluated based on the 11 financial performance indicators in *Table 1*. The literature was taken into consideration in determining the financial ratios used in the study. However, in addition to the literature, variables such

Table 1

Evaluation Indicators, Abbreviations and Literature

Symbol	Variable	Statement	Literature
CO	Current ratio	Current assets / Current liabilities	Akgün [34], Karaoğlan & Şahin [29], Soy Temur [23], Yavuz et al. [21], Öndeş & Özkan [35], Söylemez [32], Ömürbek & Eren [38], Kayahan Kayahan Karakul & Özaydın [30], İç et al. [27], Türegün [36], Shaverdi et al. [2]
LEV	Leverage ratio	Total liabilities / Total assets	Akgün [34], Karaoğlan & Şahin [29], Soy Temur [23], Yavuz et al. [21], Öndeş & Özkan [35], Ekizler [31], Söylemez [32], Ömürbek & Eren [38], Kayahan Karakul & Özaydın [30], İç et al. [27], Türegün [36], Shaverdi et al. [2]
CR	Current liability ratio	Current liabilities / Total assets	Akgün [34], Karaoğlan & Şahin [29], Söylemez [32], İç et al. [27]
ATR	Asset turnover ratio	Net sales / Total assets	Akgün [34], Karaoğlan & Şahin [29], Soy Temur [23], Yavuz et al. [21], Öndeş & Özkan [35], Ekizler [31], Söylemez [32], Kayahan Karakul & Özaydın [30], Türegün [36]
ROE	Return on equity	Net income / Stockholder's equity	Yalçın et al. [20], Akgün [34], Karaoğlan & Şahin [29], Soy Temur [23], Yavuz et al. [21, Öndeş & Özkan [35], Ömürbek & Eren [38], Kayahan Karakul & Özaydın [30], Türegün [36], Aduba [28], Shaverdi et al. [2]
NPM	Net profit margin	Net income / Net sales	Akgün [34], Karaoğlan & Şahin [29], Soy Temur [23], Yavuz et al. [21], Ekizler [31], Ömürbek and Eren [38], Kayahan Karakul & Özaydın [30], İç et al. [27], Türegün [36], Shaverdi et al. [2]
CS	Cost of sales rate	Cost of sales / Total income	Soy Temur [23], Yavuz et al. [21]
FE	Financial expenses rate	Financial expenses / Net sales	It was not found in the literature search
SG	Sales growth	$Sales_t - Sales_{t-1} / Sales_{t-1}$	İç et al. [27], Türegün [38], Shaverdi et al. [2]
PE	Price to Earnings ratio	Market price per Share / Earnings per Share	Yalçın et al. [20], Ömürbek & Eren [38], Türegün [36]
FE	Firm value / EBITA rate	Firm value / Earnings before interest, tax and amortization	It was not found in the literature search

Source: It was created by the authors, taking into account the literature.

Table 2

Sectors and Sector Assessment Indicators

Sector	Sector Assessment Indicator
A_1 : Informatics	g_1 : Current ratio
A_2 : Electricity, Gas, Water and Steam	g_2 : Leverage ratio
A_3 : Food, Beverage and Tobacco	g_3 : Current liability ratio
A_4 : Construction and Public Works	g_4 : Asset turnover ratio
A_5 : Metal Main Industry	g_5 : Return on equity
A_6 : Metal Goods, Machinery, Electrical Devices and Transportation Vehicles	g_6 : Net profit margin
A_7 : Retail Trade	g_7 : Financial expenses rate
A_8 : Stone and Soil	g_8 : Cost of sales rate
A_9 : Textile Clothing and Leather	g_9 : Sales growth
A_{10} : Transportation and Storage	g_{10} : Price to Earning ratio
	g_{11} : Firm value / EBITA rate

Source: It was created by the authors.

as financial expense ratio and firm value/EBITA ratio used by brokerage houses in their financial research reports were added.

In identifying the 11 real sectors, the availability of sector data was a crucial determinant (*Table 2*).

Criteria Weighting by Subjective and Objective Weight Integrated Approach (SOWIA)

Since combined weighting methods take into account both the recommendations of experts and the information presented in the decision matrix when determining the weights of the criteria, these methods are expected to provide a more accurate evaluation than independent methods [39].

Upon determining the weights of importance of the criteria with the SOWIA method, the following three paths are followed [10]:

1) Objective weights of importance of criteria O_j is determined.

2) Subjective preferences of criteria S_j is determined.

3) Integrated weights, W_j, based on a combination of objective weights and subjective preferences is determined.

With the SOWIA method, the integration of objective and subjective weights is achieved with the help of Equation (1).

$$W_j = \alpha x O_j + (1-\alpha) S_j . \quad (1)$$

There α is the objective factor decision weight within the range of (0.1) . The objective factor decision weight, α , guides decision makers on the level of objective weight dominance while analyzing performance scores. Usually this value (α = 0.5) is taken as α of (0.1) range offering flexibility to the decision maker and within these ranges. The dominance of the objective weight will be greater for a larger α value. On the other hand, the dominance of the subjective weight components will be larger for a lower α value.

Objective Weight Determination Method: CRITIC Method

The CRITIC method (Criteria Importance Through Intercriteria Correlation), which belongs to the class of correlation methods, is based on analytical testing of the decision matrix to determine the information contained in the criteria by which alternatives are evaluated [5]. The CRITIC method is a method that determines the objective weights of criteria, taking into account the contrast intensity and the conflict between criteria inherent in the structure of decision problems [9]. The contrast intensity is determined by standard deviation, while the conflict between criteria is determined by correlation analysis. Criteria with a high difference between the scores of alternatives have a high contrast intensity. Similarly, as the correlation between decision criteria approaches –1, the conflict between the two criteria will become stronger. A criterion with a higher contrast intensity and a higher degree of conflict with other criteria will be assigned a higher weight [7].

The CRITIC method includes the following steps: Krishnan et al [7]; Zhong et al [40]:

Step 1. Creating the Decision Matrix: Firstly, a decision matrix consisting of evaluation criteria, namely *m* alternative and *n* evaluation, is determined.

$$X = \begin{bmatrix} x_{11} & x_{12} \cdots x_{1n} \\ x_{21} & x_{22} \cdots x_{2n} \\ \vdots & \vdots \quad \ddots \quad \vdots \\ x_{m1} & x_{m2} \cdots x_{mn} \end{bmatrix}, \quad (2)$$

$i = 1,2,\ldots,m$ and $j = 1,2,\ldots,n$.

Here x_{ij} is the performance value of the alternative i in the criterion j.

Step 2: Creating the Normalized Matrix: Positive normalization (3) is used for benefit criteria and negative normalization (4) is used for cost criteria.

$$r_{ij} = \frac{x_{ij} - \min\left(x_j\right)}{\max\left(x_j\right) - \min\left(x_j\right)}, \quad (3)$$

$i = 1,2,\ldots,m$ and $j = 1,2,\ldots,n$.

$$r_{ij} = \frac{\max\left(x_j\right) - x_{ij}}{\max\left(x_j\right) - \min\left(x_j\right)}, \quad (4)$$

$i = 1,2,\ldots,m$ and $j = 1,2,\ldots,n$.

Step 3: Creating the Correlation Matrix and Calculating the Degree of Conflict: A conflict between criteria represents a type of relationship that may exist between criteria. To take into account such conflicting relationships, the Pearson's correlation coefficient is used.

$$\rho_{jk} = \frac{\sum_{i=1}^{m}\left(r_{ij} - \bar{r}_j\right)\left(r_{ik} - \bar{r}_k\right)}{\sqrt{\sum_{i=1}^{m}\left(r_{ij} - \bar{r}_j\right)^2 \sum_{i=1}^{m}\left(r_{ik} - \bar{r}_k\right)^2}},$$

$j, k = 1,2,\ldots,n.$ (5)

ρ_{jk}, any j with criterion k is the correlation value between the criteria. As the correlation coefficient converges to –1, the conflict becomes stronger and the difference between the two criterion values becomes larger.

Using the correlation coefficient, the degree of conflict is calculated as follows:

$$R_j = \sum_{k=1}^{n}\left(1 - \rho_{jk}\right), j = 1,2,\ldots,n. \quad (6)$$

The degree of conflict reflects the amount of similar information between different criteria. The criterion with a higher degree of conflict is assigned a higher weight.

Step 4. Calculation of contrast intensity: The contrast intensity of each criterion is measured by standard deviation.

$$\sigma_j = \sqrt{\frac{\sum_{i=1}^{m}\left(r_{ij} - \bar{r}_j\right)^2}{m}}. \quad (7)$$

Step 5. Calculation of the total amount of information contained in any criterion *j*:

$$C_j = \sigma_j x R_j, \quad j = 1,2,\ldots,n. \quad (8)$$

Step 6. Obtaining Criteria Weights:

$$w_j = \frac{C_j}{\sum_{k=1}^{n} C_k}, \; j, k = 1,2,\ldots,n. \quad (9)$$

Subjective Weighting Method: Opinions of Finance Experts and Academicians

Subjective weights are weights obtained by experts who compare the criteria against each other and score each criterion according to its relative importance. The weights of importance of the calculated criteria contain subjective opinions based entirely on the knowledge and intuition of the experts.

ELECTRE III METHOD

The ELECTRE III method is an outranking approach method that makes pairwise comparisons of available alternatives to derive the degree of preference of one alternative over the other among pairs of alternatives [41]. With the outranking relationship between two alternatives, four different preference situations emerge such as, *aIb* indifference; *aPb* (*bPa*) strong preference; *aWb* (*bWa*)

weak preference; and aRb incomparability [42, 43]. The ELECTRE III methodology requires three input data [44]:

1. A performance matrix that reports the scores of alternatives according to criteria.
2. Weights for each identified criterion.
3. Indifference, preference, and veto thresholds.

Figure shows that the ELECTRE III approach consists of two stages. First, each pair of options is compared, and an outranking relationship is determined. The outranking results are then analyzed using a distillation process algorithm [44].

Construction of the Outranking Relation: In the ELECTRE III method, firstly, a $A=\{a_1,a_2,a_3,\ldots,a_n\}$ set of alternatives and a $G=\{g_1,g_2,g_3,\ldots,g_m\}$ a performance matrix is created by determining the criteria set. For each criterion q_j, p_j, and v_j ($q_j < p_j < v_j$) threshold values and w_j weights of importance are determined. Indicating the importance of a criterion w_j the criterion weight concordance index and v_j veto threshold affects the discordance index.

After setting the parametres, a concordance fuzzy *aSb* outranking relation is established with the claim "*a* is at least as good as *b*". This outranking relation is established with the help of two indexes called $C(a,b)$ concordance and $d_j(a,b)$ discordance [45]. The concordance index $C(a,$ b) represents the strength of the coalition of criteria in favor of the hypothesis whereas the discordance index $d_j(a,b)$ represents the set of opposing criteria that are incompatible with the hypothesis [46]

$$c_j(a,b)=\begin{cases}1, & g_j(a)+q_j\left(g_j(a)\right)\geq g_j(b)\\ 0, & g_j(a)+p_j\left(g_j(a)\right)\leq g_j(b)\\ \dfrac{g_j(a)-g_j(b)+p_j\left(g_j(a)\right)}{p_j\left(g_j(a)\right)-q_j\left(g_j(a)\right)}, & \textit{if otherwise}\end{cases} \tag{10}$$

$$C(a,b)=\frac{1}{w}\sum_{j=1}^{n}w_j c_j(a,b),\ w=\sum_{j=1}^{n}w_j,\ 0\leq C(a,b)\leq 1 \tag{11}$$

$$d_j(a,b)=\begin{cases}0, & \textit{if } g_j(a)+p_j\left(g_j(a)\right)\geq g_j(b),\\ 1, & \textit{if } g_j(a)+v_j\left(g_j(a)\right)\leq g_j(b)\\ \dfrac{g_j(b)-g_j(a)-p_j\left(g_j(a)\right)}{v_j\left(g_j(a)\right)-p_j\left(g_j(a)\right)}, & \textit{if otherwise}\end{cases} \tag{12}$$

By comparing the hypothesis tests established with the help of these two indexes, the credibility index $\sigma(a,b)$ is established.

$$\sigma(a,b)=\begin{cases}C(a,b),\forall j\ for\ d_j(a,b)\leq C(a,b)\\ C(a,b).\prod\limits_{j\in J(a,b)}\dfrac{1-d_j(a,b)}{1-C(a,b)},\exists j\ for\ d_j(a,b)>C(a,b)\end{cases} \tag{13}$$

Exploitation of the Outranking Relation: Lastly, using an algorithm named the distillation process, an overall ranking of alternatives is obtained. The ranking algorithm relies on the reliability degree of each alternative. Within the distillation process, utilizing the values of the credibility matrix $\sigma(a,b)$ calculated in Equation

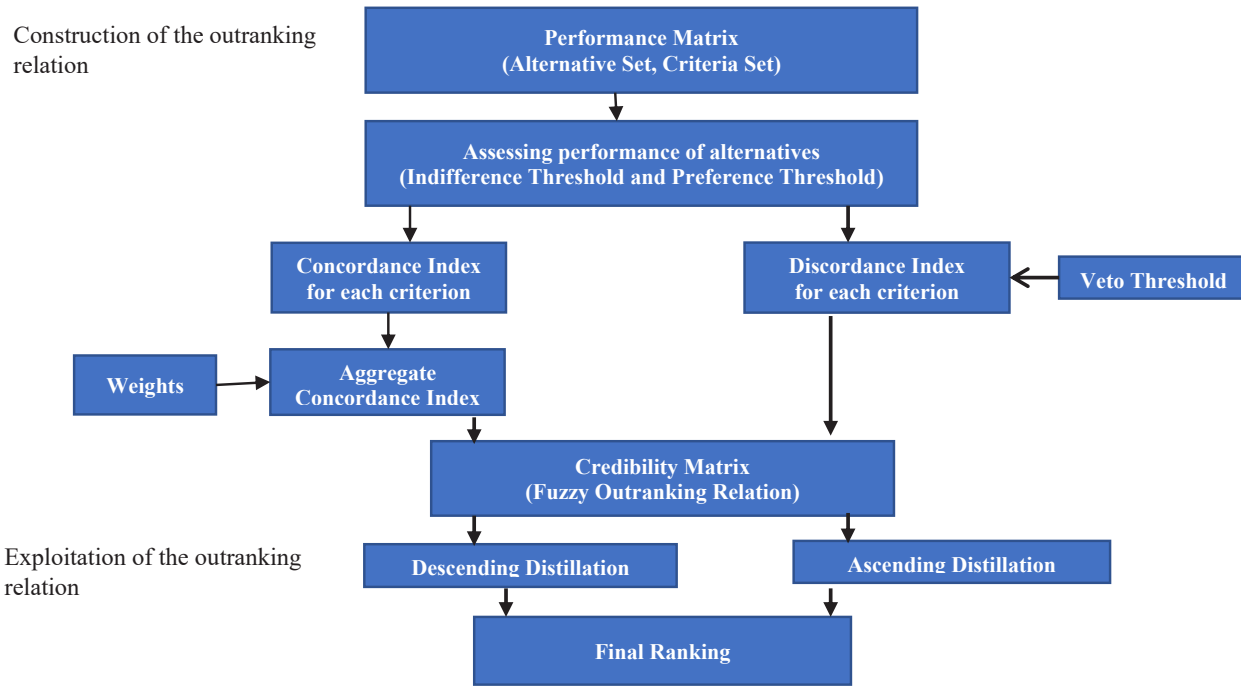

Fig. **Flowchart of the ELECTRE III Method**

Source: Micale et al. [44]; Leyva-López et al. [45].

(13), two partial pre-rankings are obtained. One of these rankings arranges the alternatives from best to worst (descending distillation), while the other arranges the alternatives from worst to best (ascending distillation). These partial preliminary rankings are based on the calculation of an adequacy score for each alternative. The intersection of the descending and ascending distillation rankings results in a final ranking.

Spearman's Rank Correlation Coefficient

The Spearman's rank correlation coefficient is a non-parametric method that measures the similarity between two sets of rankings. The rank correlation coefficient between Spearman's p^{th} and t^{th} rankings are calculated using Equation (14).

$$\rho_{pt} = 1 - \frac{6\sum d_t^2}{m\left(m^2 - 1\right)}. \quad (14)$$

There, m is the number of alternatives and d_t indicates the difference in the ranking obtained by the two methods for an alternative [13].

Positive ρ_{pt} values indicate a positive relationship among the variables, whereas negative ρ_{pt} values indicate a negative relationship among the variables [16].

RESULTS

In the study, the performance of the sectors in the last seven years has been tried to be determined by an integrated MCDM method by considering the data obtained over the period 2016 and 2022. First, a decision matrix was obtained by determining the financial performance values of 10 sectors according to 11 indicators between 2016 and 2022, and then the objective and subjective weights of importance of the indicators were determined using these decision matrixes prepared by years.

Objective Weights: Determining the Weights of Importance of Indicators with CRITIC Method

First, the decision matrix given in equation (2) was normalized in terms of utility indicators and cost indicators using Equations (3) and (4), respectively. Then, a correlation matrix was created using Equation (5) and the degree of conflict and contrast intensity were calculated using Equation (6) and Equation (7), respectively. Finally, the total amount of information of each indicator was calculated with Equation (8) and the weights of importance of each indicator were determined using this amount of information. The weights of importance of the indicators obtained by the method are given in *Table 3*.

Sales growth data is obtained from the Central Securities Depository (CSD). CSD sector data starts in 2016. In order to calculate the sales growth rate data, data for the previous year (2015) is needed. Since CSD did not have 2015 data, sales growth data for 2016 could not be calculated (*Table 3*). Therefore, 10 indicators were considered for 2016. In 2016, 2019, and 2022, the current liabilities rate had the greatest impact on sector performance, followed by the price to earnings ratio (PE) in 2017 and 2018, the firm value/EBITA ratio in

Table 3

CRITIC Indicator Weights of Importance by Year

Indicator	2016	2017	2018	2019	2020	2021	2022
Current ratio	0.07966	0.070095	0.070174	0.080407	0.086857	**0.075068**	0.088286
Leverage ratio	0.077806	0.102982	0.095637	0.095738	0.080845	0.079293	0.095685
Current liability ratio	**0.139233**	0.101857	0.089861	**0.107343**	0.102237	0.081615	**0.106927**
Asset turnover ratio	0.12968	0.096744	0.088545	0.092679	0.096758	0.101301	0.095312
Return on equity	0.092932	0.077987	**0.060835**	0.086803	**0.070344**	0.10067	0.09411
Net profit margin	**0.068117**	**0.064164**	0.062481	**0.070284**	0.082483	0.079496	0.083505
Financial expenses rate	0.125742	0.086988	0.076931	0.099502	0.093991	0.09967	0.09476
Cost of sales rate	0.070642	0.068059	0.087933	0.096936	0.105191	**0.108315**	0.092107
Sales growth	–	0.098135	0.121719	0.08534	0.073789	0.101845	0.0821
Price to Earning rate	0.116472	**0.128961**	**0.137289**	0.093356	0.075246	0.084339	0.087941
Firm value / EBITA rate	0.099715	0.104028	0.108595	0.091614	**0.132259**	0.088389	0.079266

Source: Authors' calculations.

2020, and the cost of sales rate in 2021. The indicators with the least impact on sector performance were net profit margin in 2016, 2017, and 2019, return of equity in 2018 and 2019, current ratio in 2021, and firm value/EBITA ratio in 2022.

Subjective Weights: Determining the Weights of Importance of Indicators with the Opinions of Finance Experts and Finance Academicians

Subjective indicator weights were obtained from a survey conducted separately with a group of finance experts and finance academics. Finance experts and academics were asked to rate 11 decision indicators that affect the performance of sectors separately on a scale of 1 to 10. Years were ignored in the scoring with the same weights of importance applied to each year. The weights of importance of the indicators were calculated by dividing the total weight given to each indicator by the overall weight, taking into account the ratings given by the finance experts and finance academics participating in the survey separately. The indicator weights obtained by taking the opinions of experts and academicians are shown in *Table 4*.

Table 4 shows that according to the opinions of finance experts and academicians, the indicator that affects sector performance the most is the return of equity indicator, while the indicator that affects sector performance the least is the financial expense ratio. It is understood that finance experts attach more importance to the value indicators consisting of price to earnings rate and firm value/EBITA and current liability ratios than finance academics, whereas finance academics attach more importance to current rate and leverage ratios than finance experts.

Integrated Weights: Determination of the Weights of Importance of Indicators by SOWIA Method

Using the SOWIA method, which combines the objective importance weights and subjective preferences of decision makers, the weights of importance of the indicators were obtained with the help of Equation (1). α, the objective factor decision weight in this study, is obtained as $\alpha = 0.5$. SOWIA weights of importance combining CRITIC importance weights and finance expert weights are given in *Table 5* (SOWIA-1) and SOWIA weights of importance combining CRITIC weights of importance and finance academician weights are given in *Table 6* (SOWIA-2).

According to the SOWIA-1 weighting results, the indicator that most affected the performance of the sectors was the current liability rate in 2016, 2019, and 2022, the price-to-earnings rate in 2017 and 2018, the firm value/EBITA rate in 2020, and the return of equity in 2021 (Table 5). The least influential indicator

was the cost of sales rate in 2016, whereas it was the current rate in all other years.

According to the SOWIA-2 weighting results, the indicator that most affected the performance of the sectors was asset turnover rate in 2016, price to earning rate in 2017 and 2018, leverage ratio in 2019, firm value/EBITA ratio in 2020, and return of equity indicator in 2021 and 2022. The least influential indicators were cost of sales rate in 2016 and 2017, financial expenses rate in 2018, current rate in 2019, price to earnings rate in 2020, current liability rate in 2021 and firm value/EBITA ratio in 2022.

Table 4

Subjective Indicator Weights

Indicator	Finance Expert Weights	For 2016	Finance Academician Weights	For 2016
Current ratio	0.0794	0.0882	0.0911	0.0999
Leverage ratio	0.091	0.101	0.1024	0.1122
Current liability ratio	0.0902	0.1001	0.0811	0.0889
Asset turnover ratio	0.0852	0.0946	0.0899	0.0985
Return on equity	**0.1017**	**0.1129**	**0.1049**	**0.1149**
Net profit margin	0.0976	0.1084	0.1024	0.1122
Financial expenses rate	0.0769	0.0854	**0.0799**	**0.0876**
Cost of sales rate	0.0819	0.0909	0.0899	0.0985
Sales growth	0.0993	–	0.0874	–
Price to Earnings ratio	0.0959	0.1065	0.0836	0.0917
Firm value / EBITA rate	0.1009	0.112	0.0874	0.0958

Source: Authors' calculations.

Table 5

SOWIA-1 Indicator Weights of Importance by Year*

Indicator	2016	2017	2018	2019	2020	2021	2022
Current ratio	0.08393	**0.074748**	**0.074787**	**0.079904**	**0.083129**	**0.077234**	**0.083843**
Leverage ratio	0.089403	0.096991	0.093319	0.093369	0.085923	0.085147	0.093343
Current liability ratio	**0.119667**	0.096029	0.090031	**0.098772**	0.096219	0.085908	**0.098564**
Asset turnover ratio	0.11214	0.090972	0.086873	0.08894	0.090979	0.093251	0.090256
Return on equity	0.102916	0.089844	0.081268	0.094252	0.086022	**0.101185**	0.097905
Net profit margin	0.088259	0.080882	0.080041	0.083942	0.090042	0.088548	0.090553
Financial expenses rate	0.105571	0.081944	0.076916	0.088201	0.085446	0.088285	0.08583
Cost of sales rate	**0.080771**	0.07498	0.084917	0.089418	0.093546	0.095108	0.087004
Sales growth	–	0.098718	0.11051	0.09232	0.086545	0.100573	0.0907
Price to Earning rate	0.111486	**0.112431**	**0.116595**	0.094628	0.085573	0.09012	0.091921
Firm value / EBITA rate	0.105858	0.102464	0.104748	0.096257	**0.11658**	0.094645	0.090083

Source: Authors' calculations.

Note: * Combined weights of CRITIC weights and financial expert weights. According to the SOWIA-1 weighting results, the indicator that most affected the performance of the sectors was the current liability rate in 2016, 2019, and 2022, the price-to-earnings rate in 2017 and 2018, the firm value/EBITA rate in 2020, and the return of equity in 2021 (*Table 5*). The least influential indicator was the cost of sales rate in 2016, whereas it was the current rate in all other years.

Table 6

SOWIA-2 Indicator Weights of Importance by Year**

Indicator	2016	2017	2018	2019	2020	2021	2022
Current ratio	0.08978	0.080598	0.080637	**0.085754**	0.088979	0.083084	0.089693
Leverage ratio	0.095003	0.102691	0.099019	**0.099069**	0.091623	0.090847	0.099043
Current liability ratio	0.114067	0.091479	0.085481	0.094222	0.091669	**0.081358**	0.094014
Asset turnover ratio	**0.11409**	0.093322	0.089223	0.09129	0.093329	0.095601	0.092606
Return on equity	0.103916	0.091444	0.082868	0.095852	0.087622	**0.102785**	**0.099505**
Net profit margin	0.090159	0.083282	0.082441	0.086342	0.092442	0.090948	0.092953
Financial expenses rate	0.106671	0.083444	**0.078416**	0.089701	0.086946	0.089785	0.08733
Cost of sales rate	**0.084571**	**0.07898**	0.088917	0.093418	0.097546	0.099108	0.091004
Sales growth	0	0.092768	0.10456	0.08637	0.080595	0.094623	0.08475
Price to Earning rate	0.104086	**0.106281**	**0.110445**	0.088478	**0.079423**	0.08397	0.085771
Firm value / EBITA rate	0.097758	0.095714	0.097998	0.089507	**0.10983**	0.087895	**0.083333**

Source: Authors' calculations.

Note: **Combined weights of CRITIC weights and finance academician weights.

Assessment of the Performance of Sectors with ELECTRE III Method

In order to evaluate the performance of the sectors with the ELECTRE III method, firstly w_j weights of importance are obtained above. Other parameters to be used in the method q_j indifference p_j preference and v_j veto ($q_j < p_j < v_j$) threshold values are obtained separately over years by using the decision matrix given in Equation (2) and *Table 7*. When the data are analyzed column-wise for each indicator, the standard deviation of each column q_j indifference threshold, the difference between the largest and smallest sector performance in each column v_j veto threshold and q_j with the threshold of indifference v_j the average veto threshold is also p_j is taken as the threshold of preference.

In the study, by using the threshold values q_j, p_j and v_j obtained in *Table 7*, the threshold values as well as the indicator weights w_j given in *Tables 3–6*, concordance, aggregate concordance, disconcordance and credibility indexes for each indicator were calculated using Equations (10)–(13). Five different sector performance rankings were obtained as a result of a distillation process using the data in the obtained credibility index.

Analysis 1: Ranking obtained using CIRITIC weights.

Analysis 2: Ranking using subjective weights of financial experts.

Analysis 3: Ranking obtained using subjective weights of finance academics.

Analysis 4: Combined weights of CRITIC and financial expert weights with SOWIA method (SOWIA-1).

Analysis 5: Combined weights of CRITIC and finance academician weights with SOWIA method (SOWIA-2).

The performance rankings and return rankings of the sectors obtained by years using five different indicator weights are given in *Table 8*.

According to *Table 8*, the best performance in 2016 belonged to construction and public works (A_4) sector, whereas the worst performance belonged to textile clothing and leather (A_9) sector. In 2016, construction and public works (A_4) along with electricity, gas, water and steam (A_2) exhibited the best performance in Analysis 1 ranking, whereas electricity, gas, water and steam ranked 9th in the ranking obtained with all other weights (A_2). In 2017, the best performance belonged to transportation and storage (A_{10})(in all analyses) and retail trade (A_7)(except for Analysis 5), whereas stone and soil (A_8)(all analyses), construction and public works (A_4)(except for Analysis 1) and informatics (A_1) (except for Analysis 1, 4, and 5) had the worst performance. In 2018 and 2019, retail trade (A_7) had the best performance while construction and public works (A_4) had the worst performances. In 2020, food, beverage and tobacco (A_3) exhibited the best performance and the electricity, gas, water and steam (A_2) had the worst performance, whereas best performance belonged to retail trade in 2021 (A_7) and A_1 sector had the worst performance. In 2022, retail trade (A_7) had the best performance while food, beverage and tobacco (A_3) had the worst performance in all analyses except for Analysis 1, informatics (A_1) had the worst performance only in Analysis 1 and textile clothing and leather (A_9)

Table 7

Threshold Values of Indicators by Years

Ind.	g_1	g_2	g_3	g_4	g_5	g_6	g_7	g_8	g_9	g_{10}	g_{11}
2016											
q_j	0.54	11.96	8.39	0.8	18.94	7.63	14.76	6.86	-	10.14	6.36
p_j	1.035	23.105	18.135	1.78	39.27	16.57	27.99	15.99	-	21.24	14.575
v_j	1.53	34.25	27.88	2.76	59.6	25.51	41.22	25.12	-	32.34	22.79
2017											
q_j	1.53	11.92	9.02	0.51	8.39	9.06	13.65	4.28	9.48	9.16	4.38
p_j	3.52	23.745	19.89	1.11	17.385	20.62	26.67	10.005	20.31	17.405	9.535
v_j	5.51	35.57	30.76	1.71	26.38	32.18	39.69	15.73	31.14	25.65	14.69
2018											
q_j	1.2	11.76	10.3	0.52	16.62	16.64	28.94	4.36	10.09	9.34	5.55
p_j	2.765	22.63	23.83	1.14	40.085	38.65	60.62	9.25	21.345	17.265	10.825
v_j	4.33	33.5	37.36	1.76	63.55	60.66	92.3	14.14	32.6	25.19	16.1
2019											
q_j	0.96	11.89	9.03	0.61	6.89	5.26	15.26	6.29	16.07	23.06	8.19
p_j	2.06	24.135	19.99	1.37	15.73	11.875	28.04	13.71	35.775	51.395	18.935
v_j	3.16	36.38	30.95	2.13	24.57	18.49	40.82	21.13	55.48	79.73	29.68
2020											
q_j	0.41	9.69	8.4	0.53	12.28	11.97	35.26	7.43	16.56	37.99	14.14
p_j	0.755	20	19.99	1.1	26.96	28.24	71.11	14.525	34.48	86.505	27.125
v_j	1.1	30.31	31.58	1.67	41.64	44.51	106.96	21.62	52.4	135.02	40.11
2021											
q_j	0.6	6.11	9.07	0.6	13.39	16.17	20.31	4.54	25.49	12.95	28.34
p_j	1.39	13.675	19.11	1.32	29.36	36.24	43.285	8.015	48.575	28.73	60.955
v_j	2.18	21.24	29.15	2.04	45.33	56.31	66.26	11.49	71.66	44.51	93.57
2022											
q_j	0.95	4.37	9.08	0.57	11.85	31.59	10.32	7.18	39.47	15.23	8.82
p_j	2.075	8.305	16.04	1.28	24.165	68.21	22.47	15.485	85.18	30.15	20.23
v_j	3.2	12.24	23	1.99	36.48	104.83	34.62	23.79	130.89	45.07	31.64

Source: Authors' calculations.

Table 8

Performance Ranking and Return Ranking of Sectors by Year

2016		Method Rankings				
Sector	Return Rankings	Analysis1	Analysis 2	Analysis 3	Analysis 4	Analysis 5
A1	6	7	8	8	8	8
A2	7	1	9	9	9	9
A3	9	8	8	8	8	8
A4	2	1	1	1	1	1
A5	1	9	8	8	8	8
A6	4	7	7	8	7	7
A7	8	4	5	5	5	5
A8	5	6	6	6	6	6
A9	3	10	10	10	10	10
A10	10	9	9	9	9	9
2017		**Method Rankings**				
Sector	Return Rankings	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5
A1	6	6	10	10	8	8
A2	5	3	5	5	4	3
A3	9	8	7	7	8	8
A4	8	9	10	10	10	10
A5	2	4	5	5	5	4
A6	7	6	5	5	5	5
A7	4	1	1	1	1	2
A8	10	10	10	10	10	10
A9	3	8	7	7	8	8
A10	1	1	1	1	1	1
2018		**Method Rankings**				
Sector	Return Rankings	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5
A1	10	7	8	8	8	8
A2	4	3	5	4	3	3
A3	5	8	8	8	8	8
A4	6	10	10	10	10	10
A5	8	7	5	8	4	4
A6	9	7	8	8	8	8
A7	2	1	1	1	1	1
A8	7	9	9	9	9	9
A9	3	4	5	4	5	5
A10	1	3	2	2	2	2
2019		**Method Rankings**				
Sector	Return Rankings	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5
A1	1	6	4	4	4	6
A2	4	5	5	5	5	5
A3	7	8	9	8	8	8
A4	5	10	10	10	10	10
A5	8	4	9	8	8	6
A6	3	8	9	8	8	8
A7	9	1	1	1	1	1
A8	6	3	3	5	3	3
A9	2	9	9	9	9	9
A10	10	2	2	2	2	2

Table 8 (continued)

2020		Method Rankings				
Sector	Return Rankings	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5
A1	1	8	4	6	4	7
A2	3	10	10	10	10	10
A3	8	1	1	1	1	1
A4	9	8	8	7	8	8
A5	6	8	5	5	7	4
A6	5	8	3	3	3	3
A7	7	2	3	3	2	3
A8	2	8	8	8	7	7
A9	4	9	9	9	9	9
A10	10	8	8	8	7	8
2021		**Method Rankings**				
Sector	Return Rankings	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5
A1	3	10	10	10	10	10
A2	7	4	4	4	5	5
A3	8	8	9	9	9	9
A4	2	5	6	2	5	5
A5	1	5	5	6	6	5
A6	4	6	6	6	6	6
A7	10	1	1	1	1	1
A8	9	4	4	5	5	4
A9	6	9	9	9	9	9
A10	5	7	7	7	7	7
2022		**Method Rankings**				
Sector	Return Rankings	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5
A1	9	10	8	9	8	9
A2	2	5	4	4	4	4
A3	7	9	10	10	10	10
A4	4	5	3	3	3	3
A5	10	6	6	6	6	6
A6	8	6	7	7	7	7
A7	6	1	1	1	1	1
A8	5	5	2	2	2	2
A9	3	9	10	9	10	9
A10	1	7	8	9	8	9

Source: Authors' calculations.

sector exhibited the worst performance in Analysis 1. The sector with the best financial performance in all periods was retail trade. Construction and public works (A_4) sector in 2016 and food, beverage and tobacco (A_3) sector in 2020 were the best performing sectors, although those two sectors underperformed in other years.

Comparison of Return Rankings and Method Rankings

Another significant conclusion of the study are the results of the Spearman's rank correlation analysis of the relationship between sector performance rankings and return rankings. The purpose of this analysis is to determine the extent to which the financial performance indicators determined by the SOWIA-ELECTRE III methods are priced in BIST sector returns and to what extent the financial performance indicators are reflected in pricing behavior.

According to *Table 9*, there is a significant positive relationship between return ranking and five different analysis rankings in 2017 and between return ranking and four other analysis rankings except Analysis 1 in 2018. In 2019, there is a significant negative relation-

Table 9

Spearman's Rank Correlation Results

Year	Cor. Coef. / Analysis	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5
2016	Correlation Coefficient	–.043	.209	.188	.209	.209
	Sig. (2-tailed)	.907	.562	.603	.562	.562
	N	10	10	10	10	10
2017	Correlation Coefficient	.752*	.688*	.688*	.712*	.757*
	Sig. (2-tailed)	.012	.028	.028	.021	.011
	N	10	10	10	10	10
2018	Correlation Coefficient	.603	.652*	.715*	.632*	.632*
	Sig. (2-tailed)	.065	.041	.020	.050	050
	N	10	10	10	10	10
2019	Correlation Coefficient	– .663*	– .394	– .388	– .460	– .573
	Sig. (2-tailed)	.037	.260	.268	.181	.083
	N	10	10	10	10	10
2020	Correlation Coefficient	– .451	– .215	– .311	– .190	– .190
	Sig. (2-tailed)	.191	.550	.382	.599	.600
	N	10	10	10	10	10
2021	Correlation Coefficient	– .390	– .385	– .244	– .333	– .326
	Sig. (2-tailed)	.265	.271	.497	.347	.358
	N	10	10	10	10	10
2022	Correlation Coefficient	.216	.018	.067	.018	.067
	Sig. (2-tailed)	.549	.960	.853	.960	.853
	N	10	10	10	10	10

Source: Authors' calculations.

Note: * Correlation is significant at 0.05 significance level.

ship only with Analysis 1, while there is no significant relationship with all other analyses. As a result, there appears to be a partial relationship between sector financial performance rankings and sector index returns.

According to *Table 10*, the results obtained from the two analyses are generally consistent. Retail trade (A_7) sector has always been in the top two rankings in all years according to the results of the two analyses, while textile clothing and leather (A_9) sector ranked in the last two places in all years except 2018. The retail trade sector is mostly comprised of chain grocery stores. Another noteworthy result in Table 10 is that food, beverage and tobacco, which were in the last three rankings in all years, have been ranked in the bottom three. (A_3) sector ranked first with the best performance in 2020. The food sector performed well during COVID-19, namely in 2020. During COVID-19, when people were confined to their houses, demand for food, the most fundamental essential, surged. Also, the stone and soil (A_8) sector ranked in the top three in 2016, 2019, 2021 and 2022, and in the last rankings in the other years. The stone and soil sector covers cement and construction activities. This sector is highly affected by economic policy and credit expansions. In this respect, the sector gains momentum during periods of monetary expansion and easier credit facilities, while activities in the stone and soil sector decline during periods of monetary contraction and credit costs increase, making it difficult to obtain financing. The results of the analysis are consistent with periods

Table 10

Final Performance Rankings of Sectors by Years

Year	Analysis	Rankings
2016	Analysis 4 Analysis 5	$A_4 > A_7 > A_8 > A_6 > A_1 = A_3 = A_5 > A_2 = A_{10} > A_9$ $A_4 > A_7 > A_8 > A_6 > A_1 = A_3 = A_5 > A_2 = A_{10} > A_9$
2017	Analysis 4 Analysis 5	$A_7 = A_{10} > A_2 > A_5 = A_6 > A_1 = A_3 = A_9 > A_4 = A_8$ $A_{10} > A_7 > A_2 > A_5 > A_6 > A_1 = A_3 = A_9 > A_4 = A_8$
2018	Analysis 4 Analysis 5	$A_7 > A_{10} > A_2 > A_5 > A_9 > A_1 = A_3 = A_6 > A_8 > A_4$ $A_7 > A_{10} > A_2 > A_5 > A_9 > A_1 = A_3 = A_6 > A_8 > A_4$
2019	Analysis 4 Analysis 5	$A_7 > A_{10} > A_8 > A_1 > A_2 > A_3 = A_5 = A_6 > A_9 > A_4$ $A_7 > A_{10} > A_8 > A_2 > A_1 = A_5 > A_3 = A_6 > A_9 > A_4$
2020	Analysis 4 Analysis 5	$A_3 > A_7 > A_6 > A_1 > A_5 = A_8 = A_{10} > A_4 > A_9 > A_2$ $A_3 > A_6 = A_7 > A_5 > A_1 = A_8 > A_4 = A_{10} > A_9 > A_2$
2021	Analysis 4 Analysis 5	$A_7 > A_2 = A_4 = A_8 > A_5 = A_6 > A_{10} > A_3 = A_9 > A_1$ $A_7 > A_8 > A_2 = A_4 = A_5 > A_6 > A_{10} > A_3 = A_9 > A_1$
2022	Analysis 4 Analysis 5	$A_7 > A_8 > A_4 > A_2 > A_5 > A_6 > A_1 = A_{10} > A_3 = A_9$ $A_7 > A_8 > A_4 > A_2 > A_5 > A_6 > A_1 = A_9 = A_{10} > A_3$

Source: Authors' calculations.

of declining interest rates and easier access to credit. Other sectors' rankings have generally altered over the years in response to economic trends.

CONCLUSION

In this study, the integrated SOWIA-ELECTRE III method is used to evaluate the performance of sectors in a more realistic way by using weights that include both subjective and objective opinions about the relative importance of indicators and by taking into account the uncertainties in the decision maker's preference modeling with different thresholds in the structure of the method.

The financial performance metrics that have the greatest impact on sector performance share more similarities than differences. In both SOWIA-1 and SOWIA-2 outcomes, value performance measures (price to earnings ratio and firm value/EBITA ratio) and return on equity have the greatest impact on sector performance. While the current liability rate had the greatest impact on performance in 2016, 2019, and 2022 according to SOWIA-1 results, it was one of the top three critical indicators in SOWIA-2. While the current liability rate was the most influential indicator when financing costs rose, access to financing became difficult, and monetary tightening occurred, value ratios such as the price to earnings ratio and firm value/EBITA ratio were effective when BIST volatility increased and downward or upward trends emerged.

According to the findings, the retail trade industry performed best in 2018, 2019, 2021, and 2022, while the transportation and storage sector did best in 2017, alongside the retail trade sector. Construction and public works performed best in 2016, followed by food, beverage, and tobacco in 2020. Indicators affecting sector performances have changed over the years. Interest rates, periods of monetary expansion and contraction, the COVID-19 pandemic, BIST volatility and trends are considered to be influential in this change. The highest performance of the retail trade sector is attributed to the purchasing power of consumers.

The relationships between the return rankings and performance rankings of the sectors were analyzed by Spearman's rank correlation. As a result of the analysis, considering the results of the integrated method, it was found that there was a positive and high coefficient relationship between these two variables only in 2017 and 2018, whereas no statistically significant

relationship was found in other years. Therefore, it was revealed that there was performance-based pricing in the pricing of BIST sector indices from time to time, as well as behavioral pricing, macroeconomic factor pricing, and technical analysis pricing. The results of this study are useful for investors, financial analysts, sector analysts, portfolio managers and economic managers.

REFERENCES

1. Lebas M. J. Performance measurement and performance management. *International Journal of Production Economics*. 1995;41(1–3):23–35. DOI: 10.1016/0925–5273(95)00081-X
2. Shaverdi M., Ramezani I., Tahmasebi R., Rostamy A. A. A. Combining fuzzy AHP and fuzzy TOPSIS with financial ratios to design a novel performance evaluation model. *International Journal of Fuzzy Systems*. 2016;18(2):248–262. DOI: 10.1007/s40815–016–0142–8
3. Kennerley M., Neely A. Performance measurement frameworks: A review. In: Neely A., ed. Business performance measurement: Theory and practice. Cambridge: Cambridge University Press; 2004:145–155.
4. Clark B. Measuring performance: The marketing perspective. In: Neely A., ed. Business performance measurement: Theory and practice. Cambridge: Cambridge University Press; 2004:22–40.
5. Vujičić M. D., Papić M. Z., Blagojević M. D. Comparative analysis of objective techniques for criteria weighing in two MCDM methods on example of an air conditioner selection. *Tehnika*. 2017;72(3):422–429. DOI: 10.5937/tehnika1703422V
6. Liao H., Wu X., Mi X., Herrera F. An integrated method for cognitive complex multiple experts multiple criteria decision making based on ELECTRE III with weighted Borda rule. *Omega*. 2020;93:102052. DOI: 10.1016/j.omega.2019.03.010
7. Krishnan A. R., Kasim M. M., Hamid R., Ghazali M. F. A modified CRITIC method to estimate the objective weights of decision criteria. *Symmetry*. 2021;13(6):973. DOI: 10.3390/sym13060973
8. Tu Y., Shi H., Chen K., Liang Y., Zhou X., Lev B. Three-reference-point based group ELECTRE III method for urban flood resilience evaluation. *Expert Systems with Applications*. 2022;210:118488. DOI: 10.1016/j.eswa.2022.118488
9. Diakoulaki D., Mavrotas G., Papayannakis L. Determining objective weights in multiple criteria problems: The CRITIC method. *Computers & Operations Research*. 1995;22(7):763–770. DOI: 10.1016/0305–0548(94)00059-H
10. Das M. C., Sarkar B., Ray S. On the performance of Indian technical institutions: A combined SOWIA-MOORA approach. *Opsearch*. 2013;50(3):319–333. DOI:10.1007/s12597–012–0116-z
11. Roy B., Bouyssou D. Comparison of two decision-aid models applied to a nuclear power plant siting example. *European Journal of Operational Research*. 1986;25(2):200–215. DOI: 10.1016/0377–2217(86)90086-X
12. Chavira D. A. G., Lopez J. C. L., Noriega J. J. S., Valenzuela O. A., Carrillo P. A. A. A credit ranking model for a parafinancial company based on the ELECTRE-III method and a multiobjective evolutionary algorithm. *Applied Soft Computing*. 2017;60:190–201. DOI: 10.1016/j.asoc.2017.06.021
13. Kou G., Lu Y., Peng Y., Shi Y. Evaluation of classification algorithms using MCDM and rank correlation. *International Journal of Information Technology & Decision Making*. 2012;11(1):197–225. DOI: 10.1142/S 0219622012500095
14. Orakçı E., Özdemir A. Telafi edici çok kriterli karar verme yöntemleri ile Türkiye ve AB ülkelerinin insani gelişmişlik düzeylerinin belirlenmesi. *Afyon Kocatepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*. 2017;19(1):61–74. DOI: 10.5578/jeas.49652
15. Madhu P., Dhanalakshmi C. S., Mathew M. Multi-criteria decision-making in the selection of a suitable biomass material for maximum bio-oil yield during pyrolysis. *Fuel*. 2020;277:118109. DOI: 10.1016/j.fuel.2020.118109
16. Güler E., Avcı S., Aladağ Z. Türkiye'de illerin deprem hasar görebilirlik sıralamasında çok kriterli karar verme tekniklerinin başarısının copeland yöntemi ile değerlendirilmesi. *Endüstri Mühendisliği*. 2021;32(3):414–437.
17. Top M., Bulut T. Yeni birçok kriterli karar verme yöntemi: Bulut Endeks-Beta (Be-B). *Verimlilik Dergisi*. 2022;3:393–414. DOI: 10.51551/verimlilik.1031366
18. Akbulut O. Y. Finansal performans ile pay senedi getirisi arasındaki ilişkinin bütünleşik CRITIC ve MABAC ÇKKV teknikleriyle ölçülmesi: Borsa İstanbul çimento sektörü firmaları üzerine ampirik bir uygulama. *Pamukkale Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*. 2020;(40):471–488. DOI: 10.30794/pausbed.683330

19. Orçun Ç. Enerji sektöründe WASPAS yöntemiyle performans analizi. *Bolu Abant İzzet Baysal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*. 2019;19(2):439–453. DOI: 10.11616/basbed.v19i47045.537839
20. Yalçın N., Bayrakdaroğlu A., Kahraman C. Application of fuzzy multi-criteria decision making methods for financial performance evaluation of Turkish manufacturing industries. *Expert Systems with Applications*. 2012;39(1):350–364. DOI: 10.1016/j.eswa.2011.07.024
21. Yavuz H., Öztel A., Yaşar Ö. Z. Bulanık VIKOR yöntemi ile finansal performans analizi: Türk kimya sektöründe bir uygulama. *Yönetim ve Ekonomi Dergisi*. 2020;27(3):535–555. DOI: 10.18657/yonveek.602919
22. Uygurtürk H., Korkmaz T. Finansal performansın TOPSIS çok kriterli karar verme yöntemi ile belirlenmesi: Ana metal sanayi işletmeleri üzerine bir uygulama. *Eskişehir Osmangazi Üniversitesi İktisadi ve İdari Bilimler Dergisi*. 2012;7(2):59–115.
23. Soy Temur A. Borsa Istanbul Turizm endeksi (XTRZM) firmalarının Entropi temelli ARAS, COPRAS ve TOPSIS yöntemleri ile finansal performans analizi. *Verimlilik Dergisi*. 2022;2:183–212. DOI: 10.51551/verimlilik.907897
24. Lima A., Soares V. Financial ratios applied to portfolio selection: Electre III methodology in buy-and-hold strategy. *Revista Organizações em Contexto*. 2013;9(17):281–319. DOI: 10.15603/1982–8756/roc.v9n17p281–319
25. Boonjing V., Boongasame L. Combinatorial portfolio selection with the ELECTRE III method: Case study of the stock exchange of Thailand. *Afro-Asian Journal of Finance and Accounting*. 2017;7(4):351–362. DOI: 10.15439/2016F228
26. Safaei Ghadikolaei A., Khalili Esbouei S., Antucheviciene J. Applying fuzzy MCDM for financial performance evaluation of Iranian companies. *Technological and Economic Development of Economy*. 2014;20(2):274–291. DOI: 10.3846/20294913.2014.913274
27. İç Y. T., Çelik B., Kavak S., Baki B. An integrated AHP-modified VIKOR model for financial performance modeling in retail and wholesale trade companies. *Decision Analytics Journal*. 2022;3:100077. DOI: 10.1016/j.dajour.2022.100077
28. Aduba J. J. Framework for firm-level performance evaluations using multivariate linear correlation with MCDM methods: Application to Japanese firms. *Asia-Pacific Journal of Regional Science*. 2022;6(1):1–44. DOI: 10.1007/s41685–021–00213–8
29. Karaoğlan S., Şahin S. BIST XKMYA İşletmelerinin finansal perfomanslarının çok kriterli karar verme yöntemleri ile ölçümü ve yöntemlerin karşılaştırılması. *Ege Akademik Bakış*. 2018;18(1):63–80. DOI: 10.21121/eab.2018135912
30. Kayahan Karakul A., Özaydın G. TOPSIS ve VIKOR yöntemleri ile finansal performans değerlendirmesi: XELKT üzerinde bir uygulama. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*. 2019;(60):68–86.
31. Ekizler H. Dokuma, giyim eşyası ve deri sanayi sektöründeki işletmelerin performanslarının değerlendirilmesi: VIKOR ve TOPSIS yöntemleri. *Ömer Halisdemir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi.* 2020;13(1):24–39. DOI: 10.25287/ohuiibf.556233
32. Söylemez Y. Finansal performans değerlendirmesinde TOPSIS ve gri ilişkisel analiz yöntemlerinin karşılaştırılması. *Yönetim ve Ekonomi Araştırmaları Dergisi*. 2020;18(3):61–79. DOI: 10.11611/yead.771575
33. Bozdoğan T., Odabaş A., Shegiwal A. H. Analysis of financial performance of foreign banks having branches in Turkey by TOPSIS and ELECTRE methods. *Alanya Akademik Bakış Dergisi*. 2021;5(2):1049–1067. DOI: 10.29023/alanyaakademik.871031
34. Akgün A. BIST enerji şirketlerinin CRITIC ve CODAS bütünleşik yaklaşımı ile finansal açıdan değerlendirilmesi. *Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*. 2022;(48):338–356. DOI: 10.52642/susbed.1111547
35. Öndeş T., Özkan T. Bütünleşik CRITIC-EDAS yaklaşımıyla Covid-19 pandemisinin bilişim sektörü üzerindeki finansal performans etkisi. Gümüşhane *Üniversitesi Sosyal Bilimler Enstitüsü Elektronik Dergisi*. 2021;12(2):506–522.
36. Türegün N. Financial performance evaluation by multi-criteria decision-making techniques. *Heliyon*. 2022;8(5): e09361. DOI: 10.1016/j.heliyon.2022.e09361
37. Chen Z., Wang X., Peng J., Zhang H., Wang J. An integrated probabilistic linguistic projection method for MCGDM based on ELECTRE III and the weighted convex median voting rule. *Expert Systems*. 2020;37(6): e12593. DOI: 10.1111/exsy.12593

38. Ömürbek N., Eren H. Promethee, Moora ve Copras yöntemleri ile oran analizi sonuçlarinin değerlendirilmesi: Bir uygulama. *Mehmet Akif Ersoy Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*. 2016;8(16):174–187. DOI: 10.20875/sb.69615
39. Narayanamoorthy S., Brainy J.V., Shalwala R.A., Alsenani T.R., Ahmadian A., Kang D. An enhanced fuzzy decision making approach for the assessment of sustainable energy storage systems. *Sustainable Energy, Grids and Networks*. 2023;33:100962. DOI: 10.1016/j.segan.2022.100962
40. Zhong S., Chen Y., Miao Y. Using improved CRITIC method to evaluate thermal coal suppliers. *Scientific Reports*. 2023;13(1):195. DOI: 10.1038/s41598–023–27495–6
41. Roy B. The outranking approach and the foundations of Electre methods. *Theory and Decision*. 1991;31(1):49–73. DOI: 10.1007/BF00134132
42. Fancello G., Carta M., Fadda P. A decision support system based on Electre III for safety analysis in a suburban road network. *Transportation Research Procedia*. 2014;3:175–184. DOI: 10.1016/j.trpro.2014.10.103
43. Şener S. Legatum refah endeksi göstergeleri ve verileri kullanılarak refahın çok kriterli karar verme yöntemleri ile değerlendirilmesi. *Eskişehir Osmangazi Üniversitesi İktisadi ve İdari Bilimler Dergisi*. 2022;17(1):46–70. DOİ: 10.17153/oguiibf.981581
44. Micale R., Giallanza A., Russo G., La Scalia G. Selection of a sustainable functional pasta enriched with *Opuntia* using ELECTRE III methodology. *Sustainability*. 2017;9(6):885. DOI: 10.3390/su9060885
45. Leyva-López J.C., Solano-Noriega J.J., Gastélum-Chavira D.A., Gaxiola-Valenzuela T. A personnel selection model for a software development company based on the ELECTRE III method and a Variant of NSGA-II. *Innovar: Revista de Ciencias Administrativas y Sociales*. 2022;32(85):117–132. DOI: 10.15446/innovar.v32n85.100657
46. Vasegaard A.E., Picard M., Hennart F., Nielsen P., Saha S. Multi criteria decision making for the multi-satellite ımage acquisition scheduling problem. *Sensors*. 2020;20(5):1242. DOI: 10.3390/s20051242

ABOUT THE AUTHORS / ИНФОРМАЦИЯ ОБ АВТОРАХ

Zekai Şenol — PhD, Assoc. Prof., Finance and Banking Departmant, Faculty of Economics and Administrative Sciences, Sivas Cumhuriyet University, Sivas, Turkey
Зекай Шенол — PhD, доцент, кафедра финансов и банковского дела, факультет экономики и административных наук, Университет Сивас Кумхуриет, Сивас, Турция
https://orcid.org/0000–0001–8818–0752
Corresponding Author / Автор для корреспонденции:
zsenol@cumhuriyet.edu.tr

Sibel Şener — PhD, Assoc. Prof., Departmant of Management and Information Systems, Faculty of Economics and Administrative Sciences, Sivas Cumhuriyet University, Sivas, Turkey
Сибель Шенер — PhD, доцент, кафедра менеджмента и информационных систем, факультет экономики и административных наук, Университет Сивас Кумхуриет, Сивас, Турция
https://orcid.org/0000–0001–6299–3712
ssener@cumhuriyet.edu.tr

Tuba Gülcemal — PhD, Assoc. Prof., Departmant of Finance and Banking, Faculty of Economics and Administrative Sciences, Sivas Cumhuriyet University, Sivas, Turkey
Туба Гюльчемал — PhD, доцент, кафедра финансов и банковского дела, факультет экономики и административных наук, Университет Сивас Кумхуриет, Сивас, Турция
https://orcid.org/0000–0003–4806–8568
tgulcemal@cumhuriyet.edu.tr

Author's declared contribution:
Z. Şenol — development of the concept of the article, theoretical part, conceptualization, collection of statistical data, writing — original draft, collection and analysis of literatüre, writing-review & editing, description of results, formation of tables, visualization.
S. Şener — methodology, software, theoretical part, writing-review, description of results, formation of tables and figure, representation of results.
T. Gülcemal — theoretical part, collection and analysis of literatüre, writing-review.

Заявленный вклад авторов:
З. Шенол — разработка концепции статьи, теоретическая часть, концептуализация, сбор статистических данных, написание — первоначальный проект, сбор и анализ литературы, рецензирование и редактирование, описание результатов, формирование таблиц, визуализация.
С. Шенер — методология, программное обеспечение, теоретическая часть, рецензирование, описание результатов, формирование таблиц и рисунков, представление результатов.
Т. Гюльчемал — теоретическая часть, сбор и анализ литературы, написание рецензии.

Conflicts of Interest Statement: The authors have no conflicts of interest to declare.
Конфликт интересов: авторы заявляют об отсутствии конфликта интересов.

The article was submitted on 24.04.2024; revised on 30.05.2024 and accepted for publication on 26.07.2024.
The authors read and approved the final version of the manuscript.
Статья поступила в редакцию 24.04.2024; после рецензирования 30.05.2024; принята к публикации 26.07.2024.
Авторы прочитали и одобрили окончательный вариант рукописи.