



## Analyzing Profitability Performance with the Integrated MEREC-COBRA Method: The Case of BIST Retail Companies

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**Abstract:** The purpose of this study is to evaluate the financial performance of retail trade enterprises whose shares are traded on Borsa Istanbul by using profitability ratios. Within the scope of the study, the data of ten retail trade enterprises covering the period 2021-2022 were used. The weight of the performance criteria used in the study was determined by the MEREC method. COBRA method was used to determine the performance ranking among the firms. A two-stage sensitivity analysis was conducted to determine the consistency of the analysis results. In the first stage, seven different multi-criteria decision-making methods were used to rank the firms according to their performance. The consistency between the results of the study and the results of other methods was determined by Spearman correlation coefficients. In the second stage, scenarios with different criteria weights were tested. Sensitivity analysis showed that the results were stable and consistent. According to the results of the study, MIPAZ ranked first in profitability performance for both years.

**Keywords:** Financial Performance, Profitability Ratios, Retail Firms, MEREC, COBRA

**JEL:** M10, M21

**Received :** 08 November 2023

**Revised :** 11 December 2023

**Accepted :** 18 January 2024

**Type :** Research

### 1. Introduction

The existence of the retail sector has persisted globally for centuries. However, the global recognition of retailing has emerged in the last century. Retailing is the process of selling consumer goods or services through multiple distribution channels for profit. Thus, retailers aim to meet identified needs through a supply chain. Retail businesses, in fulfilling this defined activity, strive to understand their customers as the key to success and efficiency (Grewal et al., 2009: 3; Jagadeesha, 2012: 1). The significance of the retail trade sector is evident from its contribution to employment and the share in consumer spending in both developed and developing economies. This sector represents approximately 60% of the total Gross Domestic Product (GDP) in OECD member countries. Therefore, retail trade sector statistics are considered a valuable indicator of short-term developments in national economies (OECD Statistics, 2002: 43; Varley, 2001: 9).

To assess the development of the retail trade sector in Turkey, the retail trade index is utilized. This index is crucial for obtaining information about the structure of the sector in international comparisons and enabling various research opportunities. With the development of manufacturing industries, sustainable retail trade sector has been introduced into the economy. In Turkey, especially since the early 1990s, the

**Cite this article as:** Oğuz, A., & Satır, H. (2024). Analyzing profitability performance with the integrated MEREC-COBRA method: The case of BIST retail companies. *Business and Economics Research Journal*, 15(1), 33-50. <http://dx.doi.org/10.20409/berj.2024.433>

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opening of supermarkets, hypermarkets, and shopping centers has significantly contributed to the growth of this sector (Kaya et al., 2018: 503).

Financial performance measurement is the activity of determining the extent to which a business has achieved previously defined success goals derived from its strategic objectives (Doğan & Akyurt, 2022: 916). Performance evaluation aims to implement and monitor strategic choices. The actual results obtained through various measurements reflect how successful the business is in achieving these strategic choices. Business management should review performance measurement results to assess whether activities are efficient and effective and if the strategy is successfully implemented. The selection and use of many performance measures are not a one-time application. A business should establish financial performance measurement processes that allow continuous evaluation of the system, and it should be noted that a criterion can be deleted or changed, or the goal may change (El-Baz, 2011: 6682).

Businesses can evaluate their financial results through financial performance measurement. The first priority in measurement is the objective measurement of performance. The data set used in the measurement must be accurate. The method by which the measurement will be carried out should also be determined in advance. This solution-oriented analytical approach will provide a healthy evaluation opportunity. With these accurate results, businesses can make accurate financial decisions for the future (Mazman İtik & Sel, 2021: 2772).

The determination of criteria used in financial performance measurement is crucial. There are many criteria that determine performance, and among them, profitability ratios are considered one of the most important. As in many sectors, especially in the retail trade sector, effective and successful management of retail trade businesses is necessary due to increasing costs and competitive conditions. Therefore, determining the financial performance measured using profitability criteria is important (Baydaş & Eren, 2021: 665).

There are many criteria in determining profitability performance. These criteria are financial ratios calculated using companies' financial data. These ratios are used when comparing the performance of companies. The process of determining criteria and ranking between companies in the performance evaluation process falls into the field of Multi-Criteria Decision Making (MCDM) methods. MCDM is a research methodology that allows the evaluation of problems with limited or infinite options. Therefore, it is frequently used to determine the optimal option among alternatives (Hacıfettahoğlu & Perçin, 2020: 545; Oğuz, 2023: 3).

Considering both the importance of retail sector businesses and the importance of financial performance evaluation, the aim of the study is to determine the profitability performance of companies in this sector traded on Borsa İstanbul. In line with this goal, ratios related to profitability performance have been identified. The importance weight of the determined five ratios was determined using the MEREC (Method Based on the Removal Effects of Criteria) method. The performance ranking of companies in the sector was made using the COBRA (Comprehensive Distance Based Ranking) method. The results of the COBRA method were compared with the results obtained from other MCDM methods, and the sensitivity was investigated with scenarios where the weights of criteria were different.

The rest of the study is structured as follows: In the second section, literature on financial performance measurement of companies operating in the retail trade sector is examined. In the third section, explanations regarding data and the method are provided. In the fourth section, the findings obtained at the end of the study are presented. In the fifth section, sensitivity analysis conducted to determine the validity of the study results is presented. The study is concluded in the sixth section with result and recommendation explanations.

## **2. Literature Review**

Table 1 summarizes national and international studies related to financial performance evaluation focusing on the retail trade sector.

**Table 1.** Literature on Financial Performance Studies of Retail Trade Sector Businesses

Author (Year)	Performance Criteria	Methodology	Scope and Outcome of the Research
Ersoy (2017)	Current Ratio, Quick Ratio, Debt/Equity Ratio, Leverage Ratio, Gross Profit Margin, Asset Profitability Ratio, Accounts Receivable Turnover, and Asset Turnover Ratio were used.	TOPSIS, MAUT, and SAW	Data for 8 retail companies listed in the "Fortune TURKEY" magazine's top 500 companies for the period 2010-2014 were taken. The study compared the rankings provided by TOPSIS, MAUT, and SAW methods, revealing significant differences across years and methods.
Soy Temur et al. (2017)	A total of 13 financial ratios, including Liquidity Ratios, Activity Ratios, Financial Structure Ratios, and Profitability Ratios, were used.	TOPSIS	Data for 10 retail companies listed on BIST for the period 2011-2016 were used. The study found that Bim Inc. was the most successful company in financial scoring when the averages of the years were considered.
Deste and Halifeoğlu (2019)	A total of 12 financial ratios, including Liquidity Ratios, Activity Ratios, Financial Structure Ratios, and Profitability Ratios, were used.	TOPSIS	Data for 5 retail trade companies operating as supermarket chains and active in 2017-2018 on BIST were used. According to the study, Migros Inc. ranked first, Bim Inc. second, and Bizim Inc. third.
Sarıay and Bağcı (2020)	Net Profit, Total Assets, Sales, and Market Value were used.	WSM and Panel Regression	Data for 9 retail companies listed on BIST for the period 2014-2018 were used. Findings indicated that as asset consumption increased, the financial performance of companies operating in the sector increased. Carrefoursa was identified as having the highest financial performance, while Teknosa and Milpa were the lowest-performing companies.
Nguyen et al. (2020)	A total of 18 financial ratios, including Growth Rates, Profitability Ratios, Valuation Ratios, Liquidity Ratios, Efficiency Ratios, and Leverage Ratios, were used.	GRA	Data for 12 retail companies trading on the Vietnam Securities Market for the years 2019-2020 were used. According to the study, Taseco Aviation Services JSC (AST), Mobile World Investment Corporation (MWG), and Cam Ranh International Airport Services JSC (CIA) were the top three efficient companies, while Viglacera Corporation (VGC), Saigon General Service Corporation (SVC), and HocMon Trade JSC (HTC) were identified as the least successful companies.
Pramono et al. (2020)	Current Ratio, Gross Profit Margin, and Investment Return were used.	Paired Sample T-Test	Financial performance comparison of 9 retail companies in Indonesia listed on the Indonesia Stock Exchange for the years 2016-2017, before and after the emergence of e-commerce, was examined. Results showed no significant differences in current ratio, gross profit margin, and investment return before and after the emergence of e-commerce.
Yıldırım and Meydan (2021)	A total of 10 financial ratios, including Liquidity Ratios, Activity Ratios, Financial Structure Ratios, and Profitability Ratios, were used.	Intuitive Fuzzy EDAS	Financial performance of 7 retail trade companies listed on BIST was measured for the years 2017-2019. The study found that Bim Inc. and Bizim Inc. ranked first and second, respectively, over the years.

**Table 1.** Literature on Financial Performance Studies of Retail Trade Sector Businesses (Continue)

Author (Year)	Performance Criteria	Methodology	Scope and Outcome of the Research
Mazman İtik and Sel (2021)	Quick Ratio, Cash Ratio, Leverage Ratio, Financing Ratio, Fixed Assets/Equity Ratio, Asset Turnover, Equity Turnover, Asset Profitability Ratio, and Equity Profitability Ratio were used.	CILOS and TOPSIS	Data for 9 retail sector companies listed on BIST for the period 2013-2019 were included in the study. The results showed that Mipaz, Casa, and Vakko were the top three companies in performance rankings for the respective years.
Gül and Erdem (2022)	A total of 20 financial ratios, including Liquidity Ratios, Activity Ratios, Financial Structure Ratios, and Profitability Ratios, were used.	Entropy and TOPSIS	Data for 4 companies in the food retail sector registered on BIST were used for the years 2013-2020. The study found that companies with high return on equity, a high number of branches, and good inventory management maintain their profitability and continue their activities more efficiently. Bim Inc. ranked first in performance rankings over the years.
Kondak and Ergül (2022)	A total of 13 financial ratios, including Liquidity Ratios, Activity Ratios, Financial Structure Ratios, and Profitability Ratios, were used.	VIKOR	Data for 11 retail companies trading on BIST for the period 2017-2021 were used. Findings indicated that Bizim Inc. was the most successful company in 2017-2019, Bim Inc. in 2020, and Vakko Inc. in 2022.
Sakarya and Budak (2022)	A total of 14 cash flow ratios, including Liquidity Ratios, Activity Ratios, Financial Structure Ratios, and Profitability Ratios, were used.	Entropy and TOPSIS	Data for 5 retail trade companies registered on BIST were used for the years 2017-2020. Findings indicated that Migros Inc., Şok Inc., and Bizim Inc. ranked top three in terms of financial performance success over the years.
Eyceyurt Batır (2022)	Current Ratio, Leverage Ratio, Asset Turnover, Asset Profitability Ratio, Sales Profitability Ratio, Earnings Per Share Ratio, and Sales Growth Ratio were used.	SWARA and TOPSIS	Data for 5 companies in the food retail sector trading on BIST were used for the years 2019-2021. The study found that Bim Inc. ranked first in financial performance in 2019, while Migros ranked first in 2020 and 2021.
İç et al. (2022)	A total of 9 financial ratios, including Liquidity Ratios, Financial Structure Ratios, and Profitability Ratios, were used.	AHP, VIKOR, TOPSIS, and MOORA	Data for 6 retail and wholesale companies operating in various sub-markets, including retail marketing and regional or international marketing with over 500 branches in Turkey, were used. The study concluded that the AHP-modified VIKOR integrated model has a flexible structure. The AHP-modified VIKOR approach was suggested as a tool to measure a firm's financial performance against its competitors and develop new strategies for future actions.
Pala (2022)	Current Ratio, Net Operating Capital Ratio, Net Profit Margin, Return on Equity, Asset Turnover, and Debt Ratio were used.	MSY and WSM	Data for 10 retail trade companies trading on BIST for the period 2018-2021 were used. The study found that the financial performance rankings of companies varied over the years. Casa Inc., Bim Inc., and Vakko Inc. ranked top three in terms of the period's average performance.

**Table 1.** Literature on Financial Performance Studies of Retail Trade Sector Businesses (Continue)

Author (Year)	Performance Criteria	Methodology	Scope and Outcome of the Research
Benli and Özdemir (2023)	Liquidity Ratio, Profitability Ratio, Activity Ratio, Financial Structure Ratio, and Turnover Ratio were used.	TOPSIS	The study examined the financial performance of thirteen companies in the retail trade sector listed on BIST for the period 2018-2022 in the context of the Covid-19 pandemic. Findings indicated that pandemic conditions did not negatively impact every company, with non-food sectors standing out positively.
Ersoy (2023)	Liquidity Ratio, Profitability Ratio, Activity Ratio and Financial Structure Ratio were used.	LOPCOW and RSMVC	In the study, the financial performance of companies traded in the BIST retail and trade index for the 2017-2021 period was investigated. Gimat A.Ş. in five-year performance average. ranked first.

Note: BIST (Borsa İstanbul); TOPSIS (Technique for Order Preference by Similarity to Ideal Solution); MAUT (Multi-Attribute Utility Theory); SAW (Simple Additive Weighting; WSM refers to Weighted Sum Model); GRA (Grey Relational Analysis); SWARA (Step-wise Weight Assessment Ratio Analysis); AHP (Analytic Hierarchy Process); VIKOR (VlseKriterijumska Optimizacija I Kompromisno Resenje); MOORA (Multi-Objective Optimization by Ratio Analysis); MSY (Modified Synthetic Measure); LOPCOW (Linear Ordering Production Coordination With Centroid Method); RSMVC (Robust Sorting Method With Variable Criteria), and CILOS (Composite Indicators Linear Ordering Scores).

Upon reviewing the literature, it is observed that there are numerous studies investigating financial performance using various Multi-Criteria Decision Making (MCDM) methods. While there is a study utilizing the integrated MEREC-COBRA method (Popović et al., 2022), no other research employing this model in financial performance studies has been identified. Therefore, this study is expected to contribute to the literature in this regard. MEREC, being an objective weighting method, is relatively new compared to other objective methods like Entropy, CRITIC, etc. The application of this method in the study could potentially expand its scope. The COBRA method, used for ranking alternatives, is a distance-based method, distinguishing itself from other distance-based methods. It incorporates positive and negative distances from the ideal solutions (TOPSIS, VIKOR and MARCOS), distances to the average solution (EDAS), square root distance to the reference point (MOORA), and two types of distances from the negative ideal solution (CODAS) to rank alternatives. The COBRA method incorporates positive and negative distances from both the average solution. Furthermore, by using Euclidean and Manhattan distances, the COBRA method may provide more reliable results compared to other methods (Krstić et al., 2022). Given its less frequent application in the literature and the positive aspects mentioned, this study is expected to contribute to expanding the COBRA literature.

In recent years, there has been increasing interest in financial performance studies. While various ratios are used in these studies, the focal point is generally on overall financial performance. However, this study specifically concentrates on profitability performance. Profitability performance provides faster feedback compared to other financial performance indicators. In this context, the importance of profitability ratios in determining changes in the business or share value of companies can be emphasized. By narrowing down the focus, all profitability ratios are attempted to be included in the study. Profitability data for the years 2021 and 2022 are analyzed to investigate the profitability performance of retail firms. With its specified aspects, the study is considered to contribute to the literature and is deemed original.

### 3. Data and Method

#### 3.1. Data

In the study, information related to companies was obtained from the Borsa İstanbul Public Disclosure Platform (KAP). There are fifteen companies in the Borsa İstanbul (BIST) retail and trade sector. Four companies were not included in the study as they did not have data for both the years 2021 and 2022. Negative values were identified in the profitability ratios of CRFSA (Carrefoursa Carrefour Sabancı Ticaret

Merkezi A.Ş) company. Since negative values in the MEREC application convert the criterion values to zero, CRFSA was excluded from the analysis as it pushed two of the five profitability criteria outside the scope of the analysis. The Z-score standardization method, which allows the inclusion of negative values in the analysis, resulted in significant differences in criterion weights. Therefore, this method was not used in the study. All criteria were applied to the remaining ten companies. The information for the companies included in the study is presented in Table 2.

**Table 2.** Information on Companies

Abbreviation	Company Name
BIMAS	BİM Birleşik Mağazalar A.Ş.
BIZIM	Bizim Toptan Satış Mağazaları A.Ş
CASA	Casa Emtia Petrol Kimyevi ve Türevleri Tic. A.Ş
MAVI	Mavi Giyim Sanayi ve Ticaret A.Ş.
MEPET	Mepet Metro Petrol ve Tesisleri Sanayi Ticaret A.Ş.
MGROS	Migros Ticaret A.Ş.
MIPAZ	Milpa Ticari ve Sınai Ürünler Pazarlama Sanayi ve Ticaret A.Ş.
SOKM	Şok Marketler Ticaret A.Ş.
TKNSA	Teknosa İç ve Dış Ticaret A.Ş
VAKKO	Vakko Tekstil ve Hazır Giyim Sanayi Vakko İşletmeleri A.Ş

Profitability is a net result formed as a result of many implemented policies and decisions. Profitability ratios, on the other hand, are ratios that examine the overall performance of companies more broadly and express the combined effect of these ratios. Profitability ratios are the most well-known and closely monitored ratios in the analysis of financial performance. This is because profitability ratios provide the most effective and prompt response in terms of enterprise value or share value. (Cornett et al., 2016: 57; Satır, 2022: 57). Information on the profitability performance criteria to be used in ranking companies is indicated in Table 3.

**Table 3.** Profitability Ratios Used in the Research

Profitability Ratios	Symbol	Formula	Target
Return on Assets	ROA	Net Income / Average Total Assets	Maximize
Return on Equity	ROE	Net Income / Average Total Equity	Maximize
Gross Profit Margin	GPM	Gross Profit / Net Income	Maximize
Operating Profit Margin	OPM	Operating Profit / Net Income	Maximize
Net Profit Margin	NPM	Net Income / Net Income	Maximize

As seen in Table 3, five ratios commonly found in the literature are used to determine profitability performance. All of these ratios are defined in a benefit-oriented (Maximize) manner.

### 3.2 Method

The performance among companies has been analyzed using the integrated MEREC-COBRA method. The MEREC method was utilized for determining the degrees of importance of criteria. The weights of criteria were calculated separately for each year. Following this stage, alternatives were ranked using the COBRA method. The calculation steps for the MEREC and COBRA methods are outlined below.

### 3.2.1. MEREC

The MEREC method was introduced by Keshavarz-Ghorabae et al. (2021) for the objective determination of criterion weights. The steps for implementing the MEREC method are listed below (Bektaş, 2022; Ghosh & Bhattacharya, 2022).

**Step 1.** Create the decision matrix.

$$D = [d_{ij}]_{m \times n} = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1n} \\ d_{21} & d_{22} & \cdots & d_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ d_{m1} & d_{m2} & \cdots & d_{mn} \end{bmatrix} \quad i = 1, 2, \dots, m; \quad j = 1, 2, \dots, n \quad (1)$$

Here,  $d_{ij}$  represents the performance degree of alternative  $i$  with respect to criterion  $j$ . Additionally, there are  $m$  alternatives and  $n$  criteria.

**Step 2.** The normalized decision matrix is created using Equation 2.

$$D = [d_{ij}]_{m \times n} = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1n} \\ d_{21} & d_{22} & \cdots & d_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ d_{m1} & d_{m2} & \cdots & d_{mn} \end{bmatrix} \quad i = 1, 2, \dots, m; \quad j = 1, 2, \dots, n \quad (2)$$

Here,  $n_{ij}^x$  represents each element of the normalized matrix  $N$ .

**Step 3.** The total performance of alternatives ( $S_i$ ) is calculated using Equation 3.

$$S_i = \ln \left( 1 + \left( \frac{1}{n} \sum_{j=1}^n |\ln(n_{ij}^x)| \right) \right) \quad (3)$$

**Step 4.** Excluding each alternative, alternative performances are calculated using Equation 4.

$$S'_{ij} = \ln \left( 1 + \left( \frac{1}{n} \sum_{j=1, k \neq j}^n |\ln(n_{ik}^x)| \right) \right) \quad (4)$$

Here,  $S'_{ij}$  represents the overall performance of alternative  $i$  with the exclusion of criterion  $j$ .

**Step 5.** The sum of absolute deviations is calculated using Equation 5.

$$E_j = \sum_{i=1}^m |S'_{ij} - S_i| \quad (5)$$

Here,  $E_j$  represents the effect of excluding the  $j$  criterion.

**Step 6.** Overall criterion weights are calculated using Equation 6.

$$w_j = \frac{E_j}{\sum_{k=1}^n E_k} \quad (6)$$

Here,  $w_j$  represents the weight of criterion  $j$ .

### 3.2.2. COBRA

COBRA, relatively a new method compared to other comparison methods (Popović et al., 2022). The calculation steps of the method introduced by Krstić et al. (2022) are listed below.

**Step 1.** Decision matrix is formed. The step related to the decision matrix is shown in the first step of the MEREC method.

**Step 2.** The normalized decision matrix is formed using Equation 7.

$$\Delta = [a_{ij}]_{m \times n} \quad (7)$$

$$a_{ij} = \frac{a_{ij}}{\max_i a_{ij}} \quad (8)$$

**Step 3.** The weighted normalized matrix  $\Delta_w$  is created using Equation 9.

$$\Delta_w = [w_j \times a_j]_{m \times n} \quad (9)$$

Here,  $w_j$  represents the relative weight of the  $j$  criterion.

**Step 4.** Positive ideal solution ( $PIS_j$ ), negative ideal solution ( $NIS_j$ ) and average solution ( $AS_j$ ) for each criterion are determined using Equations 10-12.

$$PIS_j = \max_i (w_j \times a_{ij}), \quad \forall j = 1, \dots, m \text{ for } j \in B \quad (10a)$$

$$PIS_j = \min_i (w_j \times a_{ij}), \quad \forall j = 1, \dots, m \text{ for } j \in C \quad (10b)$$

$$NIS_j = \min_i (w_j \times a_{ij}), \quad \forall j = 1, \dots, m \text{ for } j \in B \quad (11a)$$

$$NIS_j = \max_i (w_j \times a_{ij}), \quad \forall j = 1, \dots, m \text{ for } j \in C \quad (11b)$$

$$S_j = \frac{\sum_{i=1}^n (w_j \times a_{ij})}{n}, \quad \forall j = 1, \dots, m \text{ for } j \in B, C \quad (12)$$

Here,  $B$  represents the benefit set, and  $C$  represents the cost set.

**Step 5.** In this step, the distances from the positive ideal ( $d(PIS_j)$ ) and negative ideal ( $d(NIS_j)$ ) are determined. Additionally, distances from the average solution to positive ( $d(AS_j^+)$ ) and negative ( $d(AS_j^-)$ ) are identified.

$$d(S_j) = dE(S_j) + \sigma \times dE(S_j) \times dT(S_j), \quad \forall j = 1, \dots, m \quad (13)$$

Here, for any solution  $S_j$  (either  $PIS_j, NIS_j$  or  $AS_j$ ), the correction coefficient  $\sigma$  is calculated using Equation 14.

$$\sigma = \max_i dE(S_j)_i - \min_i dE(S_j)_i \quad (14)$$

In Equation 13,  $dE(S_j)_i$  and  $dT(S_j)$  represent Euclidean and Taxicab distances, respectively. Accordingly, differences from the positive and negative ideal solutions are shown in Equations 15-18.

$$dE(PIS_j)_i = \sqrt{\sum_{j=1}^m (PIS_j - w_j \times a_{ij})^2}, \forall i=1, \dots, n, \forall j=1, \dots, m \quad (15)$$

$$dT(PIS_j)_i = \sum_{j=1}^m |PIS_j - w_j \times a_{ij}|, \forall i=1, \dots, n, \forall j=1, \dots, m \quad (16)$$

$$dE(NIS_j)_i = \sqrt{\sum_{j=1}^m (NIS_j - w_j \times a_{ij})^2}, \forall i=1, \dots, n, \forall j=1, \dots, m \quad (17)$$

$$dT(NIS_j)_i = \sum_{j=1}^m |NIS_j - w_j \times a_{ij}|, \forall i=1, \dots, n, \forall j=1, \dots, m \quad (18)$$

Euclidean and Taxicab distances for positive and negative deviations from the average solution are calculated in Equations 19-24.

$$dE(AS_j)_i^+ = \sqrt{\sum_{j=1}^m \tau^+ (AS_j - w_j \times a_{ij})^2}, \forall i=1, \dots, n, \forall j=1, \dots, m \quad (19)$$

$$dT(AS_j)_i^+ = \sum_{j=1}^m \tau^+ |AS_j - w_j \times a_{ij}|, \forall i=1, \dots, n, \forall j=1, \dots, m \quad (20)$$

$$\tau^+ = \begin{cases} 1 & AS_j < w_j \times a_{ij} \\ 0 & AS_j > w_j \times a_{ij} \end{cases} \quad (21)$$

$$dE(AS_j)_i^- = \sqrt{\sum_{j=1}^m \tau^- (AS_j - w_j \times a_{ij})^2}, \forall i=1, \dots, n, \forall j=1, \dots, m \quad (22)$$

$$dT(AS_j)_i^- = \sum_{j=1}^m \tau^- |AS_j - w_j \times a_{ij}|, \forall i=1, \dots, n, \forall j=1, \dots, m \quad (23)$$

$$\tau^- = \begin{cases} 1 & AS_j > w_j \times a_{ij} \\ 0 & AS_j < w_j \times a_{ij} \end{cases} \quad (24)$$

**Step 6.** Alternatives are ranked based on comprehensive distances ( $dC_i$ ) in Equation 25.

$$dC_i = \frac{d(PIS_j)_i - d(NIS_j)_i - d(AS_j)_i^+ + d(AS_j)_i^-}{4}, \forall i=1, \dots, n \quad (25)$$

#### 4. Findings

In the study, a decision matrix has been formed before the analysis. The decision matrix contains data related to the performance criteria used to evaluate companies. The decision matrix, which includes the 2021-2022 profitability performance data used in the integrated MEREC-COBRA method, is presented in Table 4.

**Table 4.** Decision Matrix

	2021					2022				
	ROA	ROE	GPM	OPM	NPM	ROA	ROE	GPM	OPM	NPM
BIMAS	0.110	0.394	0.190	0.058	0.042	0.172	0.491	0.181	0.064	0.055
BIZIM	0.045	0.446	0.123	0.021	0.011	0.091	0.788	0.143	0.022	0.020
CASA	0.154	0.259	0.065	0.089	0.041	0.145	0.201	0.107	0.076	0.058
MAVI	0.124	0.490	0.513	0.151	0.092	0.229	0.743	0.529	0.191	0.138
MEPET	0.129	0.235	0.069	0.079	0.110	0.034	0.055	0.051	0.010	0.014
MGROS	0.021	1.260	0.241	0.024	0.010	0.095	1.115	0.239	0.037	0.035
MIPAZ	0.186	0.219	0.120	51.908	41.114	1.047	1.143	0.432	134.11	131.71
SOKM	0.036	0.851	0.234	0.034	0.011	0.167	1.416	0.238	0.052	0.040
TKNSA	0.053	3.395	0.168	0.049	0.017	0.113	1.045	0.167	0.055	0.030
VAKKO	0.159	0.487	0.575	0.203	0.131	0.400	0.899	0.656	0.322	0.255

The criterion values in the decision matrix are calculated based on the profitability ratios listed in Table 3. The data used for profitability ratios are obtained from KAP (KAP, 2023).

#### 4.1. Determination of Criterion Weights with the MEREC Method

In the analysis section of the study, criterion weights were initially determined using the MEREC method. The alternatives used in determining criterion weights and the criterion values associated with these alternatives are presented in the decision matrix in Table 3. The values in the decision matrix were transformed into the normalized decision matrix using Equation 2, and the average overall performance ( $S_i$ ) of the alternatives was calculated from the obtained normalized values using Equation 3. In the next step, the alternative performances, excluding each alternative, were calculated using Equation 4. The values for overall and alternative performances are shown in Table 5.

**Table 5.** Performance Values

	2021						2022					
	$S_i$	$S^{ROA}$	$S^{ROE}$	$S^{GPM}$	$S^{OPM}$	$S^{NPM}$	$S_i$	$S^{ROA}$	$S^{ROE}$	$S^{GPM}$	$S^{OPM}$	$S^{NPM}$
BIMAS	0.767	0.603	0.711	0.662	0.666	0.624	0.977	0.846	0.796	0.877	0.829	0.868
BIZIM	0.370	0.262	0.267	0.277	0.370	0.349	0.767	0.671	0.483	0.666	0.696	0.735
CASA	0.696	0.477	0.679	0.696	0.539	0.542	0.868	0.738	0.752	0.804	0.685	0.740
MAVI	1.018	0.882	0.958	0.856	0.863	0.843	1.227	1.108	1.061	1.080	1.040	1.084
MEPET	0.758	0.574	0.751	0.752	0.624	0.502	0.000	0.000	0.000	0.000	0.000	0.000
MGROS	0.494	0.494	0.254	0.319	0.478	0.494	0.936	0.852	0.666	0.807	0.832	0.863
MIPAZ	1.566	1.471	1.566	1.540	1.170	1.138	1.863	1.751	1.764	1.795	1.515	1.529
SOKM	0.564	0.502	0.397	0.407	0.506	0.550	1.034	0.913	0.770	0.918	0.911	0.956
TKNSA	0.791	0.705	0.505	0.700	0.710	0.738	0.937	0.838	0.674	0.840	0.797	0.876
VAKKO	1.089	0.944	1.033	0.930	0.922	0.897	1.343	1.205	1.185	1.200	1.145	1.179

Afterwards, the sum of absolute deviations ( $E_j$ ) was calculated using Equation 5, and in the final step, the importance degrees of the criteria, represented by  $w_j$ , were determined using Equation 6. The values for  $E_j$  and  $w_j$  are presented in Table 6.

**Table 6.** Importance Degrees of Criteria

	2021					2022				
	ROA	ROE	GPM	OPM	NPM	ROA	ROE	GPM	OPM	NPM
$E_j$	1.199	0.991	0.973	1.264	1.436	1.031	1.800	0.966	1.501	1.122
$w_j$	0.204	0.169	0.166	0.216	0.245	0.161	0.280	0.151	0.234	0.175

When examining Table 6, it is observed that for the year 2021, the criterion with the highest weight is NPM (0.245), while the least important criterion is GPM (0.166). For the year 2022, ROE (0.280) is the most important criterion, while GPM (0.151) remains the least important criterion, as in the previous year.

#### 4.2. Ranking Alternatives Using the COBRA Method

The decision matrix used in the initial step of the COBRA method is presented in Table 4. The values in the decision matrix have been transformed into the normalized decision matrix using Equation 7. The values in the normalized decision matrix, when weighted by the criteria weights determined through MEREC, have been used to create the weighted normalized matrix through Equation 9. Based on Equations 10-12, positive ideal ( $PIS_j$ ), negative ideal ( $NIS_j$ ), and average solution ( $AS_j$ ) for each criterion have been determined. The weighted normalized matrix, along with  $PIS_j$ ,  $NIS_j$  and  $AS_j$  values, is illustrated in Table 7.

**Table 7.** Weighted Normalized Matrix

	2021					2022				
	ROA	ROE	GPM	OPM	NPM	ROA	ROE	GPM	OPM	NPM
BIMAS	0.1206	0.0196	0.0549	0.0002	0.0003	0.0263	0.0973	0.0416	0.0001	0.0001
BIZIM	0.0495	0.0222	0.0355	0.0001	0.0001	0.0139	0.1560	0.0329	0.0000	0.0000
CASA	0.1695	0.0129	0.0187	0.0004	0.0003	0.0222	0.0398	0.0246	0.0001	0.0001
MAVI	0.1369	0.0244	0.1482	0.0006	0.0006	0.0351	0.1472	0.1214	0.0003	0.0002
MEPET	0.1421	0.0117	0.0198	0.0003	0.0007	0.0052	0.0108	0.0117	0.0000	0.0000
MGROS	0.0236	0.0628	0.0697	0.0001	0.0001	0.0145	0.2209	0.0548	0.0001	0.0001
MIPAZ	0.2045	0.0109	0.0346	0.2156	0.2450	0.1605	0.2263	0.0992	0.2338	0.1748
SOKM	0.0401	0.0424	0.0675	0.0001	0.0001	0.0256	0.2804	0.0546	0.0001	0.0001
TKNSA	0.0583	0.1691	0.0486	0.0002	0.0001	0.0173	0.2070	0.0382	0.0001	0.0000
VAKKO	0.1755	0.0243	0.1660	0.0008	0.0008	0.0613	0.1779	0.1505	0.0006	0.0003
$PIS_j$	0.2045	0.1691	0.1660	0.2156	0.2450	0.1605	0.2804	0.1505	0.2338	0.1748
$NIS_j$	0.0236	0.0109	0.0187	0.0001	0.0001	0.0052	0.0108	0.0117	0.0000	0.0000
$AS_j$	0.1121	0.0400	0.0664	0.0219	0.0248	0.0382	0.1564	0.0630	0.0235	0.0176

Normalization matrix,  $PIS_j$ ,  $NIS_j$  and  $AS_j$  having been determined, Euclidean and Taxicub distances from the positive, negative, and average have been calculated using Equations 15-24. The values resulting from these calculations are presented in Table 8.

**Table 8.** Positive, Negative, and Average Euclidean and Taxi Distance Values

$\gamma^*$		$dE(PIS_j)_i$	$dT(PIS_j)_i$	$dE(NIS_j)_i$	$dT(NIS_j)_i$	$dE(AS_j)_i^+$	$dT(AS_j)_i^+$	$dE(AS_j)_i^-$	$dT(AS_j)_i^-$
2021	BIMAS	0.148	0.804	0.011	0.142	0.009	0.093	0.040	0.233
	BIZIM	0.169	0.893	0.001	0.054	0.000	0.000	0.079	0.366
	CASA	0.153	0.798	0.021	0.148	0.057	0.240	0.064	0.311
	MAVI	0.132	0.689	0.030	0.257	0.085	0.327	0.036	0.193
	MEPET	0.156	0.825	0.014	0.121	0.030	0.173	0.063	0.311
	MGROS	0.160	0.844	0.005	0.103	0.023	0.161	0.094	0.333
	MIPAZ	0.042	0.289	0.139	0.657	0.307	0.578	0.043	0.247
	SOKM	0.159	0.850	0.004	0.097	0.003	0.059	0.079	0.307
	TKNSA	0.141	0.724	0.027	0.223	0.129	0.359	0.065	0.306
	VAKKO	0.128	0.633	0.045	0.314	0.118	0.404	0.036	0.193
2022	BIMAS	0.148	0.804	0.011	0.142	0.009	0.093	0.040	0.233
	BIZIM	0.169	0.893	0.001	0.054	0.000	0.000	0.079	0.366
	CASA	0.153	0.798	0.021	0.148	0.057	0.240	0.064	0.311
	MAVI	0.132	0.689	0.030	0.257	0.085	0.327	0.036	0.193
	MEPET	0.156	0.825	0.014	0.121	0.030	0.173	0.063	0.311
	MGROS	0.160	0.844	0.005	0.103	0.023	0.161	0.094	0.333
	MIPAZ	0.042	0.289	0.139	0.657	0.307	0.578	0.043	0.247
	SOKM	0.159	0.850	0.004	0.097	0.003	0.059	0.079	0.307
	TKNSA	0.141	0.724	0.027	0.223	0.129	0.359	0.065	0.306
	VAKKO	0.128	0.633	0.045	0.314	0.118	0.404	0.036	0.193

\*Year

After this stage, positive ( $d(PIS_j)$ ) and negative ideal distance ( $d(NIS_j)$ ) were determined using Equation 13, and distances from the average solution for positive ( $d(AS_j)^+$ ) and negative ( $d(AS_j)^-$ ) were calculated. Using these calculated values, dC values were determined using Equation 25. The values of  $(PIS_j)$ ,  $d(NIS_j)$ ,  $d(AS_j)^+$ ,  $d(AS_j)^-$  and dC for both years are provided in Table 9.

**Table 9.** Positive, Negative and Distance from the Average Values

	2021					2022				
	$d(PIS_j)$	$d(NIS_j)$	$d(AS_j)^+$	$d(AS_j)^-$	dC	$d(PIS_j)$	$d(NIS_j)$	$d(AS_j)^+$	$d(AS_j)^-$	dC
BIMAS	0.163	0.011	0.009	0.041	0.046	0.163	0.011	0.009	0.041	0.059
BIZIM	0.188	0.001	0.000	0.081	0.067	0.188	0.001	0.000	0.081	0.046
CASA	0.169	0.022	0.062	0.065	0.038	0.169	0.022	0.062	0.065	0.086
MAVI	0.143	0.031	0.094	0.036	0.014	0.143	0.031	0.094	0.036	0.018
MEPET	0.172	0.014	0.032	0.064	0.048	0.172	0.014	0.032	0.064	0.103
MGROS	0.177	0.005	0.024	0.096	0.061	0.177	0.005	0.024	0.096	0.015
MIPAZ	0.044	0.152	0.362	0.044	-0.107	0.044	0.152	0.362	0.044	-0.136
SOKM	0.176	0.004	0.003	0.081	0.063	0.176	0.004	0.003	0.081	-0.014
TKNSA	0.154	0.028	0.143	0.067	0.012	0.154	0.028	0.143	0.067	0.023
VAKKO	0.138	0.047	0.133	0.036	-0.001	0.138	0.047	0.133	0.036	-0.002

The ranking of alternatives is based on the  $dC$  value. A smaller value indicates a better alternative. The ranking of alternatives is shown in Table 10.

**Table 10.** Profitability Performance Ranking Values for Companies

	BIMAS	BIZIM	CASA	MAVI	MEPET	MGROS	MIPAZ	SOKM	TKNSA	VAKKO
2021	6	10	5	4	7	8	1	9	3	2
2022	8	7	9	5	10	4	1	2	6	3

According to Table 10, MIPAZ has consistently ranked first in both years. When examined on a yearly basis, BIZIM has shown the lowest performance in 2021, while MEPET has shown the lowest performance in 2022. It can be stated that SOKM is the company that has increased its profitability the most among the alternatives.

## 5. Sensitivity Analysis

Determining the validity of the study results, sensitivity analysis has been conducted in two stages. In the first stage, the alignment between the results obtained using different MCDM methods has been investigated. In the second stage, results obtained under scenarios with different criterion weights were compared.

### 5.1. Results Obtained with Different MCDM Methods

COBRA method is relatively new compared to other MCDM methods. Therefore, to assess the reliability of the obtained results, a comparison was initially made with the results of other MCDM methods. For comparison, commonly used distance-based calculation methods such as TOPSIS, VIKOR, MOORA, and EDAS were employed. The values corresponding to the results of these methods are presented in Table 11.

**Table 11.** Ranking Values According to Different MCDM Methods

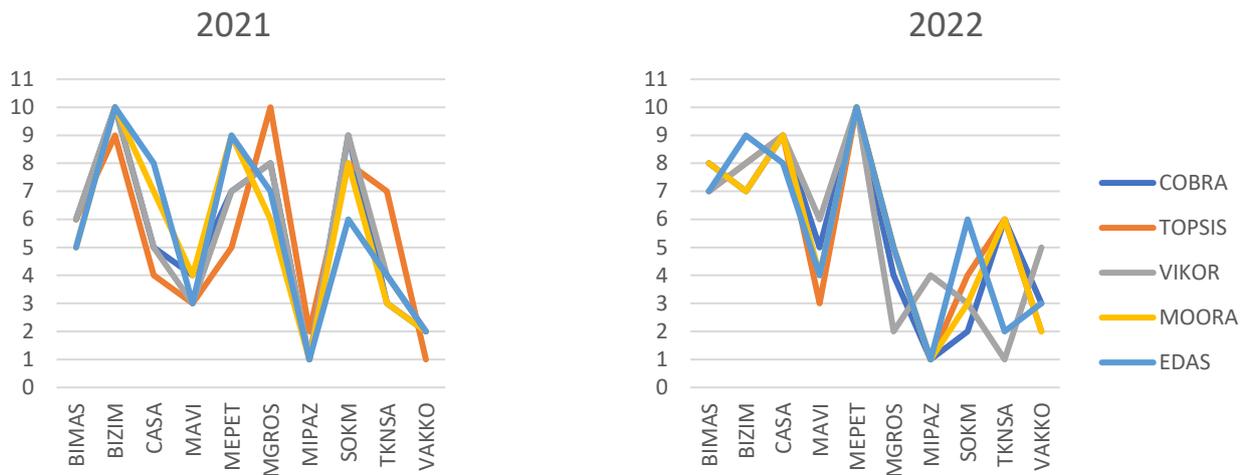
	BIMAS	BIZIM	CASA	MAVI	MEPET	MGROS	MIPAZ	SOKM	TKNSA	VAKKO
COBRA	6/8	10/7	5/9	4/5	7/10	8/4	1/1	9/2	3/6	2/3
TOPSIS	6/7	9/8	4/9	3/3	5/10	10/5	2/1	8/4	7/6	1/2
VIKOR	6/7	10/8	5/9	3/6	7/10	8/2	1/4	9/3	4/1	2/5
MOORA	5/8	10/7	7/9	4/4	9/10	6/5	1/1	8/3	3/6	2/2
EDAS	5/7	10/9	8/8	3/4	9/10	7/5	1/1	6/6	4/2	2/3

\*Ranking values are determined based on the years 2021/2022.

When Table 11 is examined, it can be observed that there are differences in the performance rankings of companies depending on the method, but the rankings are relatively close to each other. Figure 1 illustrates the results of the multiple criteria decision-making methods.

When examining Figure 1, it can be observed that there is similarity in the results of the methods for the years 2021 and 2022. In order to determine the relationship between the results obtained from different MCDM methods, the Spearman correlation test was conducted. The results of this test are presented in Table 12.

**Figure 1.** Ranking Values of Companies According to Different MCDM Methods



**Table 1.** Spearman Correlation Test Results

	Year	TOPSIS	VIKOR	MOORA	EDAS
COBRA	2021	0.818**	0.988**	0.915**	0.842**
	2022	0.927**	0.721*	0.976**	0.758*

\*\* : 0.01; \* : 0.05 significance level.

According to Table 12, the average Spearman correlation value of the COBRA method with other methods is determined as 0.890 for the year 2021 and 0.845 for the year 2022. Based on these values, it can be stated that the COBRA method provides consistent results with other MCDM methods.

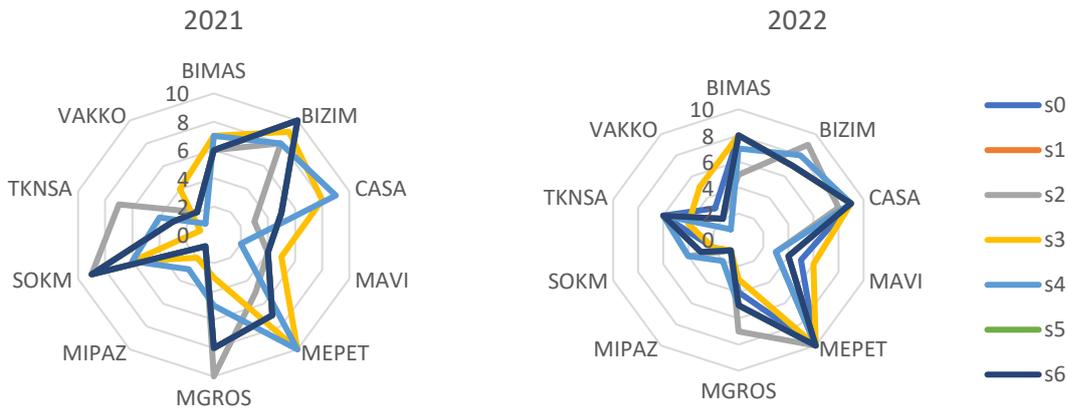
### 5.2. Assigning Different Values to Weights

In the second stage of sensitivity analysis, six scenarios were created by assigning different weights to the criteria. In the first scenario (S1), equal weights ( $K_n=0.2$ ) were assigned to all criteria. In the other scenarios (S2-S6), a value of 0.5 was assigned to the selected criterion, and the rest were assigned a value of 0.125. Thus, the individual impact of each criterion on the results was investigated. The values for each scenario are shown in Table 13.

**Table 2.** Values for Scenarios

	2021					2022				
	ROA	ROE	GPM	OPM	NPM	ROA	ROE	GPM	OPM	NPM
S0	0.204	0.169	0.166	0.216	0.245	0.161	0.280	0.151	0.234	0.175
S1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
S2	0.5	0.125	0.125	0.125	0.125	0.5	0.125	0.125	0.125	0.125
S3	0.125	0.5	0.125	0.125	0.125	0.125	0.5	0.125	0.125	0.125
S4	0.125	0.125	0.5	0.125	0.125	0.125	0.125	0.5	0.125	0.125
S5	0.125	0.125	0.125	0.5	0.125	0.125	0.125	0.125	0.5	0.125
S6	0.125	0.125	0.125	0.125	0.5	0.125	0.125	0.125	0.125	0.5

The ranking results for the study outcome (S0) and scenarios (S1-S6) are presented in Figure 2.

**Figure 2.** Results for the Scenarios

When examining the scenarios for the year 2021 in Figure 2, it can be observed that the MIPAZ company generally ranks first. The BIZIM company, except for small deviations, is consistently in the last place. For the year 2022, MEPET company ranks last in all scenarios, while MIPAZ company ranks first in all scenarios except one. Although there are minor differences in performance rankings depending on the scenarios, the results are generally close to each other.

In the first stage of sensitivity analysis, it was determined that the results obtained from different MCDM methods have a high correlation with the study results. In the second stage, scenarios with different criteria weights were applied to the study method. Despite small variations in the results due to the scenarios, it is observed that the overall ranking remains unchanged. Therefore, it can be stated that the study model is stable and consistent.

## 6. Results

The retail sector, due to its high contribution to the economy, requires its businesses to operate efficiently and profitably. The efficiency of business operations is measured by financial performance. How effectively a business utilizes its existing resources and the extent to which it generates profit can be determined through a comparative analysis of financial performance measurements.

In this study, the financial ratios of retail trade businesses traded on the Borsa Istanbul for the years 2021-2022 were examined, and the financial performance of the top ten retail businesses that were found to be profitable was evaluated. Specifically designed for decision-makers such as investors and shareholders, the evaluation focused on profitability ratios rather than analyzing the relationship between all financial ratios commonly used in financial analysis. Profitability ratios, providing an overall and alternative approach, were preferred for assessing the financial performance of businesses since profitability, representing the net results of business operations, offers investors an objective inference and confidence.

The profitability ratios used as performance criteria in the study play a crucial role in showing the success factor that is the expected most important result of financial performance evaluation. Among the profitability ratios used as financial performance indicators, these ratios respond to many important issues in business management processes, such as making accurate decisions, achieving desired budget targets, and future predictions. Additionally, the profitability ratios used in the analysis, as a performance criterion, demonstrate that retail trade businesses can sustain their profitability and continue their operations for a longer period.

Five performance criteria were used in comparing the profitability performance of the included retail and trade businesses. The data for these criteria were obtained from the Public Disclosure Platform. The MEREC method was employed to determine the weights of the performance criteria. This method objectively

determines the weights of criteria. The highest weight for criteria was determined as NPM (0.245) for the year 2021 and ROE (0.280) for the year 2022. Following the determination of the criteria weights, businesses were ranked using the COBRA method. According to the ranking values, MIPAZ ranked first in profitability performance for both years. The high activity and net profit ratios of the MIPAZ company may contribute to its top position. For the year 2021, BIZIM business had the lowest performance. For the year 2022, MEPET business ranked last.

To validate the results of the study, sensitivity analysis was conducted in two stages. In the first stage, performance rankings were redefined using seven MCDM methods. A general result was determined using the BORDA technique. The alignment between the COBRA method and the results of other methods was determined by Spearman correlation value. Based on this value, it can be seen that the COBRA method is highly consistent with other MCDM results for both years. In the second stage of sensitivity analysis, six scenarios were tested with different criteria weights. Although there are slight differences in scenario results, the results are similar. More consistent results were obtained for the year 2022 compared to 2021 based on scenarios. According to the sensitivity analysis results, it can be stated that the results of the study are stable and consistent.

In the literature, there are studies examining the financial performance of Borsa Istanbul retail and trade businesses (Benli and Özdemir, 2023; Ersoy, 2023; Pala, 2022; Sakarya and Budak, 2022). Some of these studies can be compared to the results of this study. In the study conducted by Pala (2022), CASA company ranked first in the evaluation made for the year 2021 using seven financial performance criteria. Benli and Özdemir (2023) researched the financial performance of retail businesses for the years 2018-2022 based on profitability, liquidity, financial structure, and turnover ratios. According to the results obtained, MGROS company had the best performance for the year 2021, while MIPAZ company had the lowest performance for the year 2022. Ersoy (2023) determined that VAKKO company showed the best performance for the year 2021 using seven financial ratios. In this profitability performance study, MIPAZ company ranks first for both years. It should be noted that there are no similar results between the literature and the results of the study. The fundamental reason for the differences may be the criteria used for performance measurement and the weights assigned to these criteria. Additionally, the performance ranking methods used in the analysis may lead to different companies ranking higher. Based on the literature and the results of the study, it can be stated that having a high profitability performance does not necessarily mean that the overall financial performance of a business is high. Since profitability ratios provide returns in the shorter term, evaluating the profitability performance separately might be beneficial for business managers.

In the study, the objective weighting method has been utilized. In future research, weights can be obtained using other objective methods such as Entropy, CRITIC, and SD, and the results can be compared. Additionally, subjective or hybrid methods can be employed to obtain results. The integrated MEREC-COBRA method, encompassing multiple criteria, can be used in general financial performance and various sector studies. Furthermore, the integrated method can be applied in various performance investigations, such as supplier selection.

## Declarations and Disclosures

**Ethical Responsibilities of Authors:** The authors of this article confirm that their work complies with the principles of research and publication ethics.

**Conflicts of Interest:** No potential conflict of interest was reported by the authors.

**Funding:** The authors received no financial support for the preparation and/or publication of this article.

**Author Contributions:** The authors confirm contribution to the article as follows: Conceptualization and design, A. Oğuz and H. Satır; data collection, H. Satır; analysis of data and interpretation of results, A. Oğuz; writing the first draft of the manuscript, A. Oğuz and H. Satır; review and editing, A. Oğuz. The manuscript/article was read and approved by all the authors, and all authors accepted responsibility for their article.

**Plagiarism Checking:** This article was screened for potential plagiarism using a plagiarism screening program.

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