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Measuring the Financial Performance of Transportation and Warehousing Companies Traded on the BIST

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Measuring the Financial Performance of Transportation and Warehousing Companies Traded on The BIST	**BIST'de İşlem Gören Ulaştırma ve Depolama Şirketlerinin Finansal Performanslarının Ölçümü**
Abstract Since the transportation sector is the first and important part of investment decisions and the production process and has an important place in the economic structures of countries in terms of its economic impact, the financial performance of BIST Transportation and Warehousing Index companies for the 2019-2023 periods was analyzed in the study. Net Profit Margin, Operating Profit Margin, Return on Assets, Return on Equity and Economic Efficiency are used as criteria for analyzing the financial performance of the companies. After weighting the criteria with ENTROPI method, financial performance was evaluated with ELECTRE and Grey relational analysis method. As a result of the comparison of the analyzes made with the MCDM methods, the best performance according to both methods is TLMAN in 2019, 2020, 2021 and 2022, THYAO in 2023, and the worst performance is GSDDE and RYSAS in 2019 according to the ELECTRE method, RYSAS according to the GRA method, PGSUS and CLEBI according to the ELECTRE method, CLEBI according to the GRA method in 2020, PGSUS according to both methods in 2021, BEYAZ according to both methods in 2022, and GSDDE according to both methods in 2023.	**Öz** Ulaştırma sektörü, yatırım kararlarının ve üretim sürecinin ilk ve önemli bir parçası olması, ekonomik etkisi açısından ülkelerin ekonomik yapıları içerisinde önemli bir yere sahip olması nedeniyle çalışmada BIST Ulaştırma ve Depolama Endeksi şirketlerinin 2019-2023 dönemlerine ait finansal performansı analiz edilmiştir. Şirketlerin finansal performans analizi yapılırken kriter olarak Net Kar Marjı, Faaliyet Kar Marjı, Aktif Karlılığı, Özkaynak Karlılığı ve Ekonomik Verimlilik kullanılmıştır. Kriterlerin ağırlıklandırılması ÇKKV yöntemlerinden ENTROPİ yöntemi ile yapıldıktan sonra finansal performans değerlendirilmesi ELECTRE ve GRİ ilişkisel analiz yöntemi ile yapılmıştır. ÇKKV yöntemleri ile yapılan analizlerin karşılaştırması sonucunda iki yönteme göre de en iyi performansı 2019, 2020, 2021 ve 2022 yıllarında TLMAN, 2023 yılında THYAO, en kötü performansı ise 2019 yılında ELECTRE yöntemine göre GSDDE ve RYSAS, GİA yöntemine göre RYSAS, 2020 yılında ELECTRE yöntemine göre PGSUS ve CLEBI, GİA yöntemine göre CLEBI, 2021 yılında iki yönteme göre de PGSUS, 2022 yılında iki yönteme göre de BEYAZ, 2023 yılında iki yönteme göre de GSDDE şirketlerinin elde ettiği tespit edilmiştir.
Keywords: Financial Performance, MCDM, BIST, XULAS	**Anahtar Kelimeler:** Finansal Performans, ÇKKV, BIST, XULAS
JEL Codes: G10, C61, M40.	**JEL Kodları:** G10, C61, M40.

Araştırma ve Yayın Etiği Beyanı	Bu çalışma bilimsel araştırma ve yayın etiği kurallarına uygun olarak hazırlanmıştır.
Yazarların Makaleye Olan Katkıları	Cem Kartal'ın makaleye katkısı %50, Zafer Özdil'in makaleye katkısı %50'dir.
Çıkar Beyanı	Yazarlar açısından ya da üçüncü taraflar açısından çalışmadan kaynaklı çıkar çatışması bulunmamaktadır.

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1. Introduction

The rapid development of trade worldwide has led countries and companies to invest in logistics. One of the most important main actors in the logistics concept is the transportation sector.

The transportation sector has an important place in countries' economic structures in terms of its economic impact as it is the first and important part of investment decisions and the production process (Gerçek, 2001). The fact that the transportation sector, which has an important place in the economic development of countries, is in close connection with the agricultural and industrial sectors and has military, economic and social dimensions makes this sector more important for countries (Erdoğan, 2016).

Evaluating the financial performance of a sector that is so important for countries is also important for developing countries. For this reason, the study evaluates the financial performance of companies in the BIST Transportation and Warehousing Index XULAS between 2019 and 2023. Since 5 of the 12 companies traded in the XULAS Index as of October 2024 and 5 started trading after 2021, 7 companies that started trading earlier were selected for financial performance evaluation in this study.

A literature review on the transportation sector and the MCDM methods is given in the second part of the study. The third section gives information about the data and methods to be used in the study. In the fourth section, the values obtained from the financial data of the companies selected from the BIST XULAS Index between 2019 and 2023 are first weighted with the ENTROPI method. Then, financial performance analyses were performed using the ELECTRE and Grey relational analysis methods. In the fifth and final section, the financial performance of the companies is evaluated by comparing the results of the analyzes by years.

2. Literature

As a result of the literature review, the studies on the transportation sector and the MCDM methods are mainly as follows;

In their 2024 study, Aksu & Bayramoğlu ranked the performance of 7 firms in the BIST Transportation and Warehousing Index by evaluating their financial ratios between 2018 and 2020. The performance ranking compared ROA, ROIC, ROCE and FD/NS values of the firms for 2021 and 2022. Eight financial performance criteria were used as evaluation criteria. CRITIC method was used to determine the weights of the criteria. After determining the weights of the criteria, the financial performance ranking of the companies with these criteria was determined using the ELECTRE III method. As a result of the financial performance ranking, TLMAN, BEYAZ, CLEBI=RYSAS, GSDDE=PGSUS, and THYAO firms achieved the best performance, respectively. As a result of the study, when the financial performance ranking and ROA, ROIC, ROCE and FD/NS indicator values were compared, it was concluded that the rankings of TLMAN were compatible, the rankings of BEYAZ were partially compatible, the rankings of CLEBI were partially compatible, and the other companies gave different results.

In their 2018 study, Başdeğirmen & Işıldak evaluated the performance of the enterprises operating in the transportation sector in the top 500 largest enterprises list published by Capital magazine in 2017 with Grey relational analysis. Turnover, exports, profit before tax, number of employees, total assets and equity were selected as evaluation criteria. During the evaluation, the criteria were first analyzed with equal importance. Then, the criteria' importance levels were analysed using expert opinions. According to the analysis with equal

importance of the criteria, the first three enterprises showing the best performance were Enterprise A, Enterprise D and Enterprise C, respectively. The last three enterprises with the worst performance were Enterprise E, Enterprise B and Enterprise F. According to the analysis in which the criteria have different degrees of importance, the first three enterprises with the best performance were Enterprise A, Enterprise D and Enterprise C, respectively. The last three enterprises with the worst performance were Enterprise E, Enterprise H and Enterprise F.

Elmas & Özkan, 2021 evaluated the financial performance of transportation and storage sector enterprises with the SWARA-OCRA model. The current ratio, acid-test ratio, equity/total assets, revenue/total assets, return on assets, return on equity and financial leverage ratio were selected as evaluation criteria. After determining the weighting of the criteria with the SWARA method, the financial performance analysis of 8 companies in the BIST transportation and storage sector for the 2015-2019 period was conducted with the OCRA method. According to the analysis results, it was determined that BEYAZ showed the best performance in all analyzed periods. Although DOCO also had different rankings in the analyzed periods, it was determined to be among the top three companies in each period. RYSAS and THYAO, on the other hand, have different rankings in the analyzed periods but are the companies with the lowest performances as of the analyzed periods.

In his 2020 study, Ersoy evaluated the financial performance of companies in the Borsa Istanbul Transportation Index with the Grey relational analysis method. Within the scope of the study, 8 companies in the Transportation Index were analyzed. The analysis used 13 ratios selected among liquidity, financial structure, activity and profitability ratios as evaluation criteria. The degree of importance of the criteria was accepted as equal. With grey relational analysis, the financial performance of 8 companies was evaluated using 13 criteria. According to the evaluation results, it was determined that TLMAN performed the best in 2016 and 2017, and BEYAZ in 2018. The worst performance was determined to be GSDDE in 2016 and 2017 and RYSAS in 2018.

Kınalı, 2022 evaluated the financial structures of 6 firms in the BIST Transportation Index between 2016 and 2020. Six criteria from financial structure ratios were used as evaluation criteria. The weights of the criteria were determined by ENTROPI method. After determining the criteria weights, the companies' financial performance ranking was determined using the TOPSIS method. As a result of the study, it was determined that the most successful companies with the best financial performance between 2016-2020 were ÇLEBI and RYSAS, while the most unsuccessful companies were BEYAZ and GSDDE, respectively. On the other hand, PGSUS and THYAO firms had an average financial performance during the analyzed periods.

Orhan, Altın & Aytekin, 2020 evaluated the financial performance of Istanbul Otobüs İşletmeleri Ticaret A.Ş., an urban transportation company in Istanbul, between 2011-2018. As a result of the literature review, 14 commonly used ratios were selected as evaluation criteria. The criteria were weighted by CRITIC method and their financial performances were analyzed by TOPSIS method. According to the analysis results, it was determined that Istanbul Bus A.Ş. showed the best performance in 2015 and the worst in 2014.

Mansyur & Saban, 2023 evaluated the financial performance of the transportation and storage sector in Turkey between the periods 2009-2021. In the analysis, 8 evaluation criteria frequently used in financial analysis were selected as criteria. After determining the weights

of the criteria by ENTROPI method, the financial performance of the transportation and storage sector was determined by TOPSIS method. According to the analysis results, it was determined that the transportation and storage sector achieved the best performance in 2009 and the worst in 2021.

Sakarya & Saçkes, 2022 evaluated the profit-oriented financial performance of 8 companies in the BIST XULAS Index during the COVID-19 period. In the evaluation, the 2018-2020 period of the companies was evaluated with 15 cash flow-based criteria. After the criteria weights were obtained by AHP method, their financial performance was evaluated by GIA method. According to the evaluation results, it was concluded that TLMAN showed the best performance in 2018, 2019 and 2020, while THYAO showed the worst performance.

Özarı, 2024 analyzed the financial performance of 10 enterprises in the transportation and warehousing sector during the COVID-19 period 2017-2021 with ENTROPI-based EDAS and COPRAS methods. As evaluation criteria, Tobin's Q ratio was used to determine their financial performance, Altman Z-Score, Springate S-Socre, Taffler T-Score, Zmijewski X-Score to measure their financial failures, and current ratio and cash ratio from liquidity ratios were used together. As a result of the study, it was found that financial indicators often give different results regarding the near bankruptcy or financial performance of the enterprises. The Spearman correlation of the findings obtained from the ranking methods was significant and strongly positive except for 2017.

In the literature search, although there are studies conducted with different periods of companies in the transportation sector, no study analyzes and evaluates the financial performance of companies in the transportation sector between 2019 and 2023, which is the COVID-19 period and beyond. To contribute to this gap in the literature, this study's contribution to the literature with ENTROPY-based ELECTRE and GRA methods is important.

3. Data and Methods

This study section provides information about the data set, analysis criteria, and MCDM methods.

3.1. Research Data

The values obtained from the independently audited financial statements of the companies in the BIST Transportation and Warehousing Index between 2019-2023, which is the COVID-19 period and the post-covid-19 period, were used to analyze their financial performance by periods.

3.2. Analysis Criteria

As a result of the literature research on the financial performance evaluation criteria used in the study, commonly used criteria were determined (Wang et al, 2010; Bo & Haidong, 2008; Shaverdi et al, 2014; Moghimi & Anvari, 2014; Farrokh et al, 2016; Rezaie et al, 2014; Kendirli & Kaya, 2016; Akgün & Temur, 2016; Ömürbek & Kınay, 2013). These criteria are Net Profit Margin, Operating Profit Margin, Return on Assets, Return on Equity and Economic Efficiency. The codes and calculation steps of the criteria are shown in Table 1.

Table 1: Analysis Criteria

Criteria	Code	Calculation Steps
Net Profit Margin	N1	Net Profit / Net Sales
Operating Profit Margin	F1	Net Operating Profit / Net Sales
Return on Assets	A1	Net Profit / Total Assets
Return on Equity	O1	Net Profit / Equity
Economic Efficiency	E1	(Profit Before Tax + Finance Expense) / Total Assets

3.3. Z-Score Positivization Method

Since the negative values in the decision matrix created with the values of the companies give errors in the MCDM methods, the Z-Score Positiveization method was applied to the data in the decision matrices. In the Z-Score Positive Transform, $\overline{X_j}$ j. is the criterion mean, σ_j j. is the criterion standard deviation, and A>$\left|min_{zij}\right|$ is the translation width A (Zhang, Wang, Li & Xu, 2014). Positivization was performed using equation (1) and equation (2).

$$Z_{ij} = \frac{(x_{ij} - \overline{X_j})}{\sigma_j} \quad (1)$$

$$Z'_{ij} = Z_{ij} + A \quad (2)$$

3.4. ENTROPI Criteria Weighting Method

The concept of entropy was first defined by Clausius (1865) as a measure of disorder and uncertainty in a system. Shannon (1948) defined the concept of entropy in terms of information theory. The entropy method is an objective evaluation method in revealing the importance levels of the criteria without creating a hierarchical structure of the decision problem and calculating the criteria weights by considering the data without the need for subjective judgments of decision makers such as AHP and Delphi techniques (Çakır & Perçin, 2013; Karaatlı, 2016). Therefore, it is a more advantageous method compared to other MCDM methods.

Nowadays, it is used as an objective criterion weighting method to calculate the criteria weights in MCDM problems (Ayçin, 2019).

In the first stage, a decision matrix consisting of n alternatives and m criteria values, symbolized by D, is constructed as shown in equation (3).

$$D = \begin{matrix} A_1 \\ A_2 \\ \vdots \\ A_m \end{matrix} \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \dots & x_{nm} \end{bmatrix} \quad (3)$$

In the second stage, the normalization of the decision matrix is obtained using equation (4).

$$P_{ij} = \frac{X_{ij}}{\sum_{i=1}^{m} X_{ij}} \quad \forall\, i,j \quad (4)$$

In the third stage, the ENTROPI values (e_j), of each criterion are calculated using equation (5).

The value k in Equation (5) is a constant coefficient defined as k=(ln(m))$^{-1}$ and takes the value 0 ≤ e_j ≤ 1 olacak şekilde değer alır. e_j is defined as the uncertainty measure of the j. criterion, or in other words, the entropy value (Ayçin, 2019).

$$E_j = -\mathrm{k}.\sum_{j=1}^{n} P_{ij}\,.\ln\left(P_{ij}\right) \quad i = 1, 2, \dots, m \; ve \; j = 1, 2, \dots, n \tag{5}$$

In the fourth stage, using the entropy values of each criterion, (d_j) values, which are the degrees of differentiation, are obtained using equation (6).

$$d_j = 1 - e_j \quad j = 1, 2, \dots, n \tag{6}$$

High values of d_j indicate that the distance or differentiation between the alternative scores related to the criteria is high (Ayçin, 2019).

In the fifth and final stage, the weights of each criterion (w_j) are obtained using equation (7).

$$W_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \tag{7}$$

3.5. ELECTRE Performance Evaluation Method

Although the ELECTRE method was first introduced as a report by R. Benayoun in 1966 by applying it to a real life problem, it was published as an article by Roy, 1968. In this paper, the technical details of the method were explained and named ELECTRE I. The method was renamed ELECTRE II, III, IV and ELECTRE TRI by differentiating their preference structures, their different uses of weighting information and the results they produced. All of the methods use the meta-ranking relationship as the basis and result in three ways of identifying the salient elements of a set of alternatives, each of which also defines a problem set:

- The Problem of Choice
- Classification Problem
- Sorting Problem

In the ELECTRE method, a top rating relationship is first created. In the second step, one of the above results is reached by operating the relationship structure on a set of A alternatives according to the situation of the problem (Kabak & Çınar, 2020). The distinguishing feature of the method from other MCDM methods is its ability to manage a dataset affected by a high degree of uncertainty by incorporating various thresholds (Mousseau, Slowinski & Zielniewicz, 1999; Şener & Bircan, 2020). In addition, the method is more advantageous than other methods thanks to its features such as being non-compensatory and handling incomparability, handling quantitative and qualitative data, not making any assumptions, and not being sensitive to outliers (Andriosopoulos, Gaganis, Pasiouras & Zopounidis, 2012; Şener & Bircan, 2020).

In the first stage, a decision matrix with alternatives in rows and criteria in columns is constructed using equation (8).

$$X_{mxn} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad (8)$$

In the second stage, the decision matrix is normalized using Equation (9).

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}} \quad (9)$$

In the third stage, the normalized decision matrix is weighted using equation (10).

$$w = (w_1, w_2, \dots, w_j, \dots, w_n); \sum w_j = 1 \quad (10)$$

In the fourth stage, the clusters of agreement and disagreement are determined using Equation (11) and Equation (12).

$$C\ (x, y) = \{j | x_j \geq y_j\} \quad (11)$$

$$D\ (x, y) = \{j | x_j < y_j\} \quad (12)$$

In the fifth stage, the degrees of agreement and disagreement are determined using Equation (13) and Equation (14).

$$c\ (x, y) = \sum_{j^+ \in C(x,y)} w_j \quad (13)$$

$$d\ (x, y) = \frac{\sum_{j^- \in D(x,y)} |V_{xj^-} - V_{yj^-}|}{\sum_j |V_{xj} - V_{yj}|} \quad (14)$$

3.6 GRA Performance Appraisal Method

GRA is a rating, classification, and decision-making technique developed based on the GRA system theory and put forward based on the GRA degree (Ayçin, 2019). GRA system theory solves uncertainty problems in discrete data and incomplete information cases. One of the essential features of the method is the ability to obtain satisfactory results using a small amount of data. Therefore, it is a more advantageous method than the other MCDM methods.

In the first stage, after determining the m factor series to be evaluated in the decision matrix using equation (15), the decision matrix is created using equation (16) with (m) series.

$$X_i = (X_i(j), \dots, X_i(n)) \quad i = 1, 2, \dots, m \ ; \ j = 1, 2, \dots, n \quad (15)$$

$$X = \begin{bmatrix} x_1(1) & x_1(2) & \cdots & x_1(n) \\ x_2(1) & x_2(2) & \cdots & x_2(n) \\ \vdots & \vdots & \ddots & \vdots \\ x_m(1) & x_m(2) & \dots & x_m(n) \end{bmatrix} \quad (16)$$

In the second stage, firstly, the decision matrix with the added reference series is created using Equation (17) for the alternatives in the decision matrix.

$$X_0 = (X_0(j)) \quad j = 1, 2, \dots, n \quad (17)$$

In the third stage, the criteria are normalized to make them comparable. The normalization process is performed in two different ways according to the maximum and minimum conditions of the criteria. Equation (18) is used if the criteria are maximum values, and Equation (19) is used if the criteria are minimum. After the normalization process, a normalized decision matrix is created using equation (20).

$$X_i^* = \frac{x_i(j) - min_j\, x_i(j)}{max_j\, x_i(j) - min_j\, x_i(j)}$$	(18)
$$X_i^* = \frac{max_j\, x_i(j) - x_i(j)}{max_j\, x_i(j) - min_j\, x_i(j)}$$	(19)
$$X^* = \begin{bmatrix} x_1^*(1) & x_1^*(2) & \cdots & x_1^*(n) \\ x_2^*(1) & x_2^*(2) & \cdots & x_2^*(n) \\ \vdots & \vdots & \ddots & \vdots \\ x_m^*(1) & x_m^*(2) & \dots & x_m^*(n) \end{bmatrix}$$	(20)

In the fourth stage, the absolute difference value between the normalized values of the reference series and the values in the normalized decision matrix is determined using Equation (21) and then the absolute value matrix is created using Equation (22).

$$\Delta_{0i} = x_0^*(j) - x_i^*(j)$$	(21)
$$\Delta_{0i} = \begin{bmatrix} \Delta_{01}(1) & \Delta_{01}(2) & \cdots & \Delta_{01}(n) \\ \Delta_{02}(1) & \Delta_{02}(2) & \cdots & \Delta_{02}(n) \\ \vdots & \vdots & \ddots & \vdots \\ \Delta_{0m}(1) & \Delta_{0m}(2) & \cdots & \Delta_{0m}(n) \end{bmatrix}$$	(22)

In the fifth stage, the GRA coefficient matrix is determined using equations (23), (24) and (25).

$$\gamma_{0i}(j) = \frac{\Delta_{min} + \delta.\Delta_{max}}{\Delta_{0i}(j) + \delta.\Delta_{max}}$$	(23)
$$x_{max} = max_i max_j \Delta_{0i}(j)$$	(24)
$$x_{min} = min_i min_j \Delta_{0i}(j)$$	(25)

In the sixth and final stage, the GRA ratings of the alternatives are determined using equation (26) by adding the weights of the criteria.

$$\Gamma_{0i} = \sum_{j=1}^{n} [w_i(j).\gamma_{0i}(j)]$$	(26)

4. Empirical Analysis

The decision matrix of BIST Transportation and Warehousing Index companies before Z-Score positivization is shown in Table 2.

Table 2: Decision Matrix

Alternatives	Years	N1	F1	A1	O1	E1
BEYAZ	2019	0.352	0.541	0.050	0.120	0.082
	2020	0.598	0.796	0.093	0.244	0.134
	2021	0.671	0.587	0.087	0.192	0.125
	2022	0.091	0.615	0.009	0.037	0.028
	2023	0.161	0.609	0.039	0.114	0.109
CLEBI	2019	0.354	0.595	0.087	0.336	0.170
	2020	-0.434	0.562	-0.061	-0.379	0.119
	2021	0.641	0.737	0.151	0.319	0.227
	2022	0.498	0.713	0.134	0.332	0.217
	2023	0.455	0.759	0.109	0.320	0.209
GSDDE	2019	-0.973	0.952	-0.023	-0.041	0.026
	2020	10.797	1.570	-0.058	-0.099	-0.018
	2021	1.218	0.997	0.161	0.231	0.181
	2022	0.199	1.001	0.027	0.036	0.036
	2023	-7.414	1.001	-0.140	-0.182	-0.123
PGSUS	2019	0.494	0.759	0.063	0.250	0.102
	2020	1.561	1.225	-0.068	-0.365	-0.040
	2021	-16.782	-4.856	-0.037	-0.290	-0.008
	2022	0.613	0.876	0.074	0.393	0.109
	2023	1.243	0.859	0.104	0.382	0.080
RYSAS	2019	0.030	0.979	0.004	0.101	-0.167
	2020	-0.082	0.988	-0.009	-0.036	0.131
	2021	-0.176	0.963	-0.017	-0.049	0.127
	2022	0.188	0.932	0.037	0.216	0.211
	2023	0.247	0.964	0.075	0.171	0.306
TLMAN	2019	1.736	2.088	0.376	0.564	0.473
	2020	1.239	1.549	0.317	0.425	0.409
	2021	1.200	1.451	0.328	0.442	0.422
	2022	0.960	1.862	0.255	0.326	0.327
	2023	0.853	1.406	0.154	0.197	0.139
THYAO	2019	0.347	0.460	0.031	0.111	0.046
	2020	-2.083	-0.261	-0.030	-0.141	-0.001
	2021	0.371	0.725	0.023	0.091	0.048
	2022	0.627	0.743	0.082	0.261	0.108
	2023	1.365	0.843	0.155	0.357	0.107

4.1. Z-Score Positivization Method

To prevent the negative values in the decision matrix of the companies from causing errors in the methods used in the study, the decision matrix was made positive by applying Equation (1) and Equation (2) to the decision matrix in Table 2. The positivized decision matrix of the companies is shown in Table 3.

Table 3: Positivized Decision Matrix

Alternatives	Years	N1	F1	A1	O1	E1
BEYAZ	2019	5.486	5.192	5.187	5.303	5.075
	2020	5.553	5.434	5.570	5.842	5.450
	2021	5.573	5.235	5.519	5.616	5.382
	2022	5.416	5.262	4.831	4.938	4.689
	2023	5.434	5.257	5.091	5.277	5.266
CLEBI	2019	5.487	5.244	5.514	6.246	5.712
	2020	5.273	5.212	4.208	3.119	5.342
	2021	5.565	5.378	6.081	6.174	6.117
	2022	5.526	5.355	5.933	6.229	6.046
	2023	5.514	5.400	5.714	6.176	5.990
GSDDE	2019	5.127	5.583	4.545	4.598	4.670
	2020	8.316	6.171	4.234	4.344	4.354
	2021	5.721	5.626	6.168	5.786	5.789
	2022	5.445	5.629	4.984	4.934	4.743
	2023	3.383	5.629	3.512	3.983	3.596
PGSUS	2019	5.525	5.400	5.308	5.868	5.219
	2020	5.814	5.842	4.152	3.182	4.199
	2021	0.845	0.058	4.419	3.509	4.427
	2022	5.557	5.511	5.403	6.498	5.267
	2023	5.728	5.495	5.663	6.449	5.060
RYSAS	2019	5.399	5.608	4.788	5.219	3.280
	2020	5.369	5.617	4.667	4.620	5.427
	2021	5.343	5.594	4.598	4.561	5.401
	2022	5.442	5.564	5.073	5.720	6.005
	2023	5.458	5.594	5.410	5.526	6.687
TLMAN	2019	5.861	6.663	8.065	7.242	7.892
	2020	5.727	6.151	7.552	6.636	7.427
	2021	5.716	6.057	7.642	6.709	7.523
	2022	5.651	6.449	7.002	6.204	6.835
	2023	5.622	6.015	6.111	5.641	5.488
THYAO	2019	5.485	5.115	5.021	5.263	4.818
	2020	4.827	4.430	4.485	4.159	4.477
	2021	5.491	5.367	4.954	5.173	4.828
	2022	5.561	5.384	5.473	5.920	5.262
	2023	5.761	5.479	6.119	6.336	5.257

4.2. ENTROPI Method

Due to the large amount of data used, values for 2023 are shown in the study.

The decision matrix in Table 3 was used as the decision matrix in the first stage of the method.

The second stage of the method, normalization, is shown in Table 4 by applying Equation (4) to the decision matrix in Table 3.

Table 4: Normalization of the Decision Matrix

Companies	N1	F1	A1	O1	E1
BEYAZ	0.147	0.135	0.135	0.134	0.141
CLEBI	0.149	0.139	0.152	0.157	0.160
GSDDE	0.092	0.145	0.093	0.101	0.096
PGSUS	0.155	0.141	0.151	0.164	0.135
RYSAS	0.148	0.144	0.144	0.140	0.179
TLMAN	0.152	0.155	0.162	0.143	0.147
THYAO	0.156	0.141	0.163	0.161	0.141

In the third stage of the method, after the Ej values of the criteria were determined, the Ej values of the criteria were calculated using equation (5). The determined Ej values are shown in Table 5 and the calculated Ej values are shown in Table 6.

Table 5: Determined Ej Values of Criteria

Companies	N1	F1	A1	O1	E1
BEYAZ	-0.282	-0.271	-0.271	-0.269	-0.276
CLEBI	-0.284	-0.274	-0.286	-0.291	-0.294
GSDDE	-0.219	-0.280	-0.221	-0.232	-0.225
PGSUS	-0.289	-0.277	-0.285	-0.296	-0.271
RYSAS	-0.283	-0.279	-0.279	-0.276	-0.308
TLMAN	-0.287	-0.289	-0.295	-0.278	-0.282
THYAO	-0.290	-0.276	-0.295	-0.294	-0.276

Table 6: Calculated Ej Values of Criteria

ln(m)	0.5139				
	N1	F1	A1	O1	E1
ej	0.9937	0.9996	0.9933	0.9947	0.9927

In the fourth stage of the method, the Dj values of the criteria were calculated using equation (6) with table 6, which shows the Ej values of the criteria, and shown in table 7.

Table 7: Calculated Dj Values of the Criteria

	N1	F1	A1	O1	E1
dj	0.0063	0.0004	0.0067	0.0053	0.0073

In the fifth and final stage, the Dj values of the criteria are shown in table 7 and the Wj values of the criteria are calculated using equation (7) and shown in table 8.

Table 8: Calculated Wj Values of Criteria

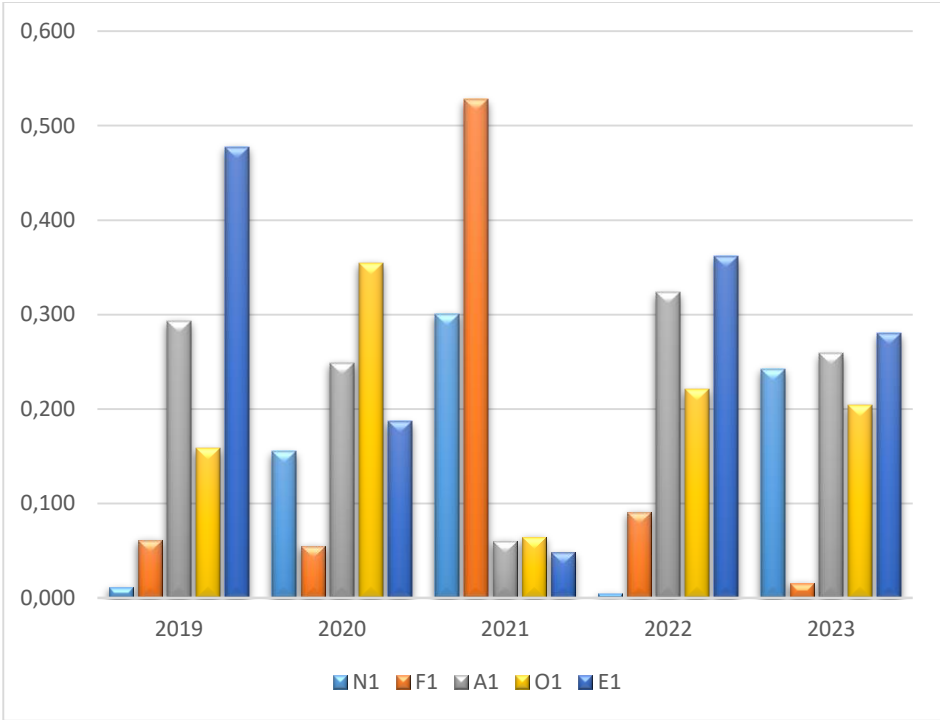
	N1	F1	A1	O1	E1
wj	0.2424	0.0154	0.2585	0.2039	0.2797

The weights of the criteria for each year analyzed are calculated separately and shown in Table 9 and Graph 1.

Table 9: Weights of Criteria by Years

Years	N1	F1	A1	O1	E1
2019	0.011	0.061	0.293	0.158	0.477
2020	0.155	0.055	0.249	0.355	0.187
2021	0.300	0.527	0.060	0.065	0.048
2022	0.004	0.091	0.323	0.220	0.361
2023	0.242	0.015	0.259	0.204	0.280

Graph 1: Weights of Criteria by Years



According to the results of the analysis made with the ENTROPI method, the criterion with the highest degree of importance is E1 criterion with 0.477 value in 2019, O1 criterion with 0.355 value in 2020, F1 criterion with 0.527 value in 2021, E1 criterion with 0.361 value in 2022, and E1 criterion with 0.280 value in 2023.

4.3. ELECTRE Method

Due to the large amount of data used, values for 2023 are shown in the study.

The decision matrix in Table 3 was used as the decision matrix in the first stage of the method.

The second stage of the method, normalization, is shown in Table 10 by applying Equation (9) to the decision matrix in Table 3.

Table 10: Normalized Decision Matrix

Companies	N1	F1	A1	O1	E1
BEYAZ	0.385	0.358	0.354	0.351	0.368
CLEBI	0.391	0.367	0.397	0.411	0.419
GSDDE	0.240	0.383	0.244	0.265	0.251
PGSUS	0.406	0.374	0.394	0.429	0.354
RYSAS	0.387	0.380	0.376	0.368	0.468
TLMAN	0.399	0.409	0.425	0.375	0.384
THYAO	0.409	0.373	0.425	0.422	0.368

In the third stage of the method, the normalized decision matrix shown in Table 10 is shown in Table 11 after weighting using Equation (10).

Table 11: Weighted Normalized Decision Matrix

Companies	N1	F1	A1	O1	E1
BEYAZ	0.385	0.358	0.354	0.351	0.368
CLEBI	0.391	0.367	0.397	0.411	0.419
GSDDE	0.240	0.383	0.244	0.265	0.251
PGSUS	0.406	0.374	0.394	0.429	0.354
RYSAS	0.387	0.380	0.376	0.368	0.468
TLMAN	0.399	0.409	0.425	0.375	0.384
THYAO	0.409	0.373	0.425	0.422	0.368

In the fourth stage of the method, the compatibility set of the alternatives is calculated by Equation (11) and Equation (12) and shown in Table 12.

Table 12: Harmony Cluster

Line Indices		N1	F1	A1	O1	E1	Degree of Compliance
1	2	0	0	0	0	0	**0.000**
1	3	1	0	1	1	1	**0.985**
1	4	0	0	0	0	1	**0.280**
1	5	0	0	0	0	0	**0.000**
1	6	0	0	0	0	0	**0.000**
1	7	0	0	0	0	1	**0.280**
2	1	1	1	1	1	1	**1.000**
2	3	1	0	1	1	1	**0.985**
2	4	0	0	1	0	1	**0.538**
2	5	1	0	1	1	0	**0.705**
2	6	0	0	0	1	1	**0.484**
2	7	0	0	0	0	1	**0.280**
3	1	0	1	0	0	0	**0.015**
3	2	0	1	0	0	0	**0.015**
3	4	0	1	0	0	0	**0.015**
3	5	0	1	0	0	0	**0.015**

3	6	0	0	0	0	0	**0.000**
3	7	0	1	0	0	0	**0.015**
4	1	1	1	1	1	0	**0.720**
4	2	1	1	0	1	0	**0.462**
4	3	1	0	1	1	1	**0.985**
4	5	1	0	1	1	0	**0.705**
4	6	1	0	0	1	0	**0.446**
4	7	0	1	0	1	0	**0.219**
5	1	1	1	1	1	1	**1.000**
5	2	0	1	0	0	1	**0.295**
5	3	1	0	1	1	1	**0.985**
5	4	0	1	0	0	1	**0.295**
5	6	0	0	0	0	1	**0.280**
5	7	0	1	0	0	1	**0.295**
6	1	1	1	1	1	1	**1.000**
6	2	1	1	1	0	0	**0.516**
6	3	1	1	1	1	1	**1.000**
6	4	0	1	1	0	1	**0.554**
6	5	1	1	1	1	0	**0.720**
6	7	0	1	0	0	1	**0.295**
7	1	1	1	1	1	0	**0.720**
7	2	1	1	1	1	0	**0.720**
7	3	1	0	1	1	1	**0.985**
7	4	1	0	1	0	1	**0.781**
7	5	1	0	1	1	0	**0.705**
7	6	1	0	1	1	0	**0.705**
Column Indices		1	2	3	4	5	

In the fifth stage of the method, the matrix of degrees of agreement calculated using Equation (13) is shown in Table 13.

Table 13: Degree of Fit Matrix c (x. y)

Companies		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
BEYAZ	1		0.000	0.985	0.280	0.000	0.000	0.280	**1.544**
CLEBI	2	1.000		0.985	0.538	0.705	0.484	0.280	**3.991**
GSDDE	3	0.015	0.015		0.015	0.015	0.000	0.015	**0.077**
PGSUS	4	0.720	0.462	0.985		0.705	0.446	0.219	**3.537**
RYSAS	5	1.000	0.295	0.985	0.295		0.280	0.295	**3.150**
TLMAN	6	1.000	0.516	1.000	0.554	0.720		0.295	**4.086**
THYAO	7	0.720	0.720	0.985	0.781	0.705	0.705		**4.615**
TOTAL		**4.456**	**2.009**	**5.923**	**2.463**	**2.850**	**1.914**	**1.385**	
Harmonization Separation Level				**0.50**					

In the fifth stage of the method, the mismatch degree matrix calculated using Equation (14) is shown in Table 14.

Table 14: Matrix of Degrees of Incompatibility d (x. y)

Companies		1	2	3	4	5	6	7	Total
BEYAZ	1		1.00	0.01	1.00	1.00	1.00	1.00	**5.01**
CLEBI	2	0.00		0.01	0.20	1.00	0.73	0.51	**2.45**
GSDDE	3	1.00	1.00		1.00	1.00	1.00	1.00	**6.00**
PGSUS	4	0.25	1.00	0.00		1.00	0.76	1.00	**4.02**
RYSAS	5	0.00	0.65	0.00	0.39		0.54	0.46	**2.03**
TLMAN	6	0.00	1.00	0.00	1.00	1.00		1.00	**4.00**
THYAO	7	0.01	1.00	0.00	0.19	1.00	0.48		**2.68**
TOTAL		**1.26**	**5.65**	**0.02**	**3.78**	**6.00**	**4.50**	**4.96**	
Mismatch Separation Level				**0.62**					

In the sixth and final stage of the method, the top-rank/superiority relationships calculated using equation (15) are shown in table 15, table 16 and table 17.

Table 15: Superiority Fit Matrix (SC)

Companies		1	2	3	4	5	6	7
BEYAZ	1		0	1	0	0	0	0
CLEBI	2	1		1	1	1	0	0
GSDDE	3	0	0		0	0	0	0
PGSUS	4	1	0	1		1	0	0
RYSAS	5	1	0	1	0		0	0
TLMAN	6	1	1	1	1	1		0
THYAO	7	1	1	1	1	1	1	

Table 16: Superiority Mismatch Matrix (SD)

Companies		1	2	3	4	5	6	7
BEYAZ	1		0	1	0	0	0	0
CLEBI	2	1		1	1	0	0	1
GSDDE	3	0	0		0	0	0	0
PGSUS	4	1	0	1		0	0	0
RYSAS	5	1	0	1	1		1	1
TLMAN	6	1	0	1	0	0		0
THYAO	7	1	0	1	1	0	1	

Table 17: Holistic Superiority Matrix (S)

Companies		1	2	3	4	5	6	7	Total
BEYAZ	1	0	0	1	0	0	0	0	**1**
CLEBI	2	1	0	1	1	0	0	0	**3**
GSDDE	3	0	0	0	0	0	0	0	**0**
PGSUS	4	1	0	1	0	0	0	0	**2**
RYSAS	5	1	0	1	0	0	0	0	**2**
TLMAN	6	1	0	1	0	0	0	0	**2**
THYAO	7	1	0	1	1	0	1	0	**4**
Total		**5**	**0**	**6**	**2**	**0**	**1**	**0**	

In the last stage of the methodology, the summary superiority relations of the higher-ranking/superiority relations shown in Table 15, table 16 and Table 17 are shown in Table 18.

Table 18: Table of Superiority Relationships

Companies		1	2	3	4	5	6	7
BEYAZ	1			1 > 3				
CLEBI	2	2 > 1		2 > 3	2 > 4			
GSDDE	3							
PGSUS	4	4 > 1		4 > 3				
RYSAS	5	5> 1		5 > 3				
TLMAN	6	6 > 1		6 > 3				
THYAO	7	7 > 1		7 > 3	7 > 4		7 > 6	

The net agreement and net disagreement values calculated in the last stage of the method are shown in Table 19 and Table 20.

Table 19: Net Compliance (NC)

Companies	Value		Ranking	
BEYAZ	-2.91	1	THYAO	3.23
CLEBI	1.98	2	TLMAN	2.17
GSDDE	-5.85	3	CLEBI	1.98
PGSUS	1.07	4	PGSUS	1.07
RYSAS	0.30	5	RYSAS	0.30
TLMAN	2.17	6	BEYAZ	-2.91
THYAO	3.23	7	GSDDE	-5.85

Table 20: Net Mismatch (ND)

Companies	Value		Ranking	
BEYAZ	3.75	1	RYSAS	-3.97
CLEBI	-3.20	2	CLEBI	-3.20
GSDDE	5.98	3	THYAO	-2.29
PGSUS	0.24	4	TLMAN	-0.50
RYSAS	-3.97	5	PGSUS	0.24
TLMAN	-0.50	6	BEYAZ	3.75
THYAO	-2.29	7	GSDDE	5.98

The results of the analysis of BIST Transportation and Warehousing Index companies between 2019 and 2023 using the ELECTRE method are shown in Table 21.

Table 21: ELECTRE Method Analysis Results

Companies	2019			2020			2021			2022			2023		
	NC	ND	Row	NC	ND	Row	NC	ND	Row	NC	ND	Row	NC	ND	Row
BEYAZ	-0.24	0.15	4	3.05	-3.30	2	-1.60	3.17	6	-5.56	5.98	7	-2.91	3.75	6
CLEBI	3.61	-3.90	2	-3.96	3.59	6	0.57	-1.01	3	3.26	-3.68	2	1.98	-3.20	2
GSDDE	-4.56	3.73	6	0.02	-2.04	4	4.38	-3.83	2	-3.71	3.82	6	-5.85	5.98	7
PGSUS	1.90	-1.98	3	-3.30	5.14	6	-6.00	6.00	7	1.33	-0.72	3	1.07	0.24	5
RYSAS	-4.47	5.76	6	1.27	-0.40	3	-0.64	-0.40	4	-0.20	-0.95	4	0.30	-3.97	3
TLMAN	6.00	-6.00	1	5.27	-5.60	1	5.40	-5.99	1	5.12	-5.87	1	2.17	-0.50	4
THYAO	-2.24	2.24	5	-2.34	2.60	5	-2.10	2.07	5	-0.24	1.43	5	3.23	-2.29	1

According to the results of the analysis made with the ELECTRE method, TLMAN achieved the best performance in 2019, 2020, 2021, and 2022, THYAO in 2023, GSDDE and RYSAS in 2019, CLEBI and PGSUS in 2020, PGSUS in 2021, BEYAZ in 2022, and GSDDE in 2023.

4.4. GRA method

Due to the large amount of data used, values for 2023 are shown in the study.

The decision matrix in Table 3 was used as the decision matrix in the first stage of the method.

The second stage of the method, the reference series decision matrix, is shown in Table 22 by applying equation (17) to the decision matrix in Table 3.

Table 22: Reference Series Decision Matrix

Criteria	N1	F1	A1	O1	E1
Companies	**maks**	**maks**	**maks**	**maks**	**maks**
Reference Series	5.761	6.015	6.119	6.449	6.687
BEYAZ	5.434	5.257	5.091	5.277	5.266
CLEBI	5.514	5.400	5.714	6.176	5.990
GSDDE	3.383	5.629	3.512	3.983	3.596
PGSUS	5.728	5.495	5.663	6.449	5.060
RYSAS	5.458	5.594	5.410	5.526	6.687
TLMAN	5.622	6.015	6.111	5.641	5.488
THYAO	5.761	5.479	6.119	6.336	5.257

After the normalization process, which is the third stage of the method, is calculated using equations (18) and (19) according to the status of the criteria, a normalized decision matrix is created using equation (20) and shown in table 23.

Table 23: Normalized Decision Matrix

Criteria	N1	F1	A1	O1	E1
Companies	**maks**	**maks**	**maks**	**maks**	**maks**
Reference Series	1.000	1.000	1.000	1.000	1.000
BEYAZ	0.863	0.000	0.606	0.525	0.540
CLEBI	0.896	0.188	0.844	0.889	0.774
GSDDE	0.000	0.491	0.000	0.000	0.000
PGSUS	0.986	0.314	0.825	1.000	0.473
RYSAS	0.873	0.445	0.728	0.626	1.000
TLMAN	0.942	1.000	0.997	0.672	0.612
THYAO	1.000	0.293	1.000	0.954	0.537

After the value of the absolute difference, which is the fourth stage of the method, is calculated using Equation (21), an absolute value matrix is created using Equation (22) and shown in Table 24.

Table 24: Absolute Value Matrix

Criteria	N1	F1	A1	O1	E1
BEYAZ	0.137	1.000	0.394	0.475	0.460
CLEBI	0.104	0.812	0.156	0.111	0.226
GSDDE	1.000	0.509	1.000	1.000	1.000
PGSUS	0.014	0.686	0.175	0.000	0.527
RYSAS	0.127	0.555	0.272	0.374	0.000
TLMAN	0.058	0.000	0.003	0.328	0.388
THYAO	0.000	0.707	0.000	0.046	0.463

The fifth stage of the method, the GRA coefficient, is calculated using equations (23), (24) and (25) and shown in Table 25.

Table 25: GRA Coefficient

Coefficient	Value
max	1.000
min	0.000
ç	0.5

The sixth and final stage of the methodology, GRA ratings, is calculated using equation (26) and shown in table 26.

Table 26: GRA Coefficient Matrix

	N1	F1	A1	O1	E1	Average	Ranking
BEYAZ	0.785	0.333	0.559	0.513	0.521	0.590	6
CLEBI	0.828	0.381	0.763	0.818	0.689	0.763	5
GSDDE	0.333	0.496	0.333	0.333	0.333	0.336	7
PGSUS	0.973	0.422	0.741	1.000	0.487	0.774	2
RYSAS	0.797	0.474	0.648	0.572	1.000	0.764	4
TLMAN	0.896	1.000	0.994	0.604	0.563	0.770	3
THYAO	1.000	0.414	1.000	0.916	0.519	0.839	1

Table 27 shows the results of the GRA conducted on BIST Transportation and Warehousing Index companies between 2019 and 2023.

Table 27: GRA Method Results

Years	2019	2020	2021	2022	2023
Alternative	Row	Row	Row	Row	Row
BEYAZ	4	2	5	7	6
CLEBI	2	7	3	2	5
GSDDE	6	3	2	6	7
PGSUS	3	6	7	3	2
RYSAS	7	4	4	4	4
TLMAN	1	1	1	1	3
THYAO	5	5	6	5	1

According to the results of the analysis conducted with the GRA method, TLMAN in 2019, 2020, 2021 and 2022, THYAO in 2023, RYSAS in 2019, CLEBI in 2020, PGSUS in 2021, BEYAZ in 2022 and GSDDE in 2023 achieved the best performance.

The comparative results of the analysis made with the MCDM methods are shown in Table 28.

Table 28: Results of Comparative Analysis of MCDM Methods

Years	2019		2020		2021		2022		2023	
	ELECTRE	GRA	ELECTRE	GRA	ELECTRE	GRA	ELECTRE	GRA	ELECTRE	GRA
Alternative	Row		Row		Row		Row		Row	
BEYAZ	4	4	2	2	6	5	7	7	6	6
CLEBI	2	2	6	7	3	3	2	2	2	5
GSDDE	6	6	4	3	2	2	6	6	7	7
PGSUS	3	3	6	6	7	7	3	3	5	2
RYSAS	6	7	3	4	4	4	4	4	3	4
TLMAN	1	1	1	1	1	1	1	1	4	3
THYAO	5	5	5	5	5	6	5	5	1	1

As a result of the comparison of the analyzes made with the MCDM methods, the best performance according to both methods is TLMAN in 2019, 2020, 2021 and 2022, THYAO in 2023, and the worst performance are GSDDE and RYSAS in 2019 according to the ELECTRE method, RYSAS according to the GRA method, PGSUS and CLEBI according to the ELECTRE method, CLEBI according to the GRA method in 2020, PGSUS according to both methods in 2021, BEYAZ according to both methods in 2022, and GSDDE according to both methods in 2023.

4.5 Sensitivity analysis

After the weights of the criteria used in evaluating the financial performance of the transportation sector companies were determined by the ENTROPI method, the sensitivities of the financial performance analysis results made by the ELECTRE and GRA methods and the financial performance analysis results made by the ELECTRE and GRA methods were tested after the weights of the criteria used in financial performance evaluation were determined equally.

Since it is known that there are 5 criteria in the decision matrix, the weight of each criterion was found to be (1/5=0,200). As a result of the sensitivity analysis, the financial performance rankings of the companies made by the ELECTRE method are shown in Table 29, and the financial performance rankings made by the GRA method are shown in Table 30.

Table 29: Sensitivity Analysis ELECTRE Method Analysis Results

Years	2019		2020		2021		2022		2023	
Weight	ENTROPI	EQUAL	ENTROPI	EQUAL	ENTROPI	EQUAL	ENTROPI	EQUAL	ENTROPI	EQUAL
Alternative	Row		Row		Row		Row		Row	
BEYAZ	4	4	2	2	6	3	7	6	6	3
CLEBI	2	2	6	4	3	2	2	2	2	2
GSDDE	6	6	4	3	2	2	6	5	7	4
PGSUS	3	3	6	4	7	5	3	3	5	2
RYSAS	6	6	3	3	4	4	4	4	3	2
TLMAN	1	1	1	1	1	1	1	1	4	2
THYAO	5	5	5	4	5	4	5	4	1	1

According to the results of the sensitivity analysis, it was determined that TLMAN had the best performance ranking in all years analyzed, despite different weightings in the analysis

conducted with the ELECTRE method. Although there are slight differences in the rankings of other companies in terms of years, it is determined that they have similar rankings in general.

Table 30: Sensitivity Analysis GRA Method Analysis Results

Years	2019		2020		2021		2022		2023	
Weight	ENTROPI	EQUAL	ENTROPI	EQUAL	ENTROPI	EQUAL	ENTROPI	EQUAL	ENTROPI	EQUAL
Alternative	Row		Row		Row		Row		Row	
BEYAZ	4	4	2	3	5	4	7	7	6	6
CLEBI	2	2	7	6	3	2	2	3	5	5
GSDDE	6	7	3	2	2	3	6	6	7	7
PGSUS	3	3	6	5	7	7	3	2	2	3
RYSAS	7	6	4	4	4	6	4	5	4	4
TLMAN	1	1	1	1	1	1	1	1	3	1
THYAO	5	5	5	7	6	5	5	4	1	2

According to the sensitivity analysis results, TLMAN had the best performance ranking in all other years analyzed except 2023, despite different weightings in the analysis made with the GRA method. Although there are slight differences in the rankings of other companies in terms of years, they have similar rankings in general.

When the sensitivity analysis results are analyzed, it is determined that the results of ELECTRE and GRA obtained with different weighting methods are generally similar and the rankings are close. The most important reason for the different results of the methods is the different normalization processes (Ersoy, 2018).

5. Conclusion

The transportation sector has an essential place in countries' economic structures in terms of its economic impact as it is the first and most important part of investment decisions and the production process (Gerçek, 2001). Evaluating the financial performance of a sector that is so important for countries is also important for developing countries. For this reason, the study evaluates the financial performance of companies in the BIST Transportation and Warehousing Index XULAS between 2019 and 2023. The ENTROPI method calculated the criteria's weightings within the evaluation's scope. With ENTROPI, which is an objective weighting method, the importance levels of the criteria are determined with the decision matrix data without resorting to the subjective opinions of the decision makers. This method avoids subjective judgments and misjudgments and provides a sound evaluation. The financial performance evaluation of the alternatives was made with ELECTRE and GRA methods. The ELECTRE method was chosen because it helps solve many problems in terms of numerical analysis. In contrast, the GRA method was chosen because it consists of clear calculation steps and can be calculated with a small number of available data. In addition, sensitivity analysis was performed by changing the criteria weights. Sensitivity analysis was used to test the sensitivity of the results.

A comparative analysis of the results of the analysis made with the MCDM methods reveals that the top three companies with the best performance in 2019 are TLMAN, CLEBI and PGSUS, TLMAN, BEYAZ and GSDDE = RYSAS in 2020, TLMAN, GSDDE and CLEBI in 2021, TLMAN, CLEBI and PGSUS in 2022, THYAO, PGSUS = CLEBI and TLMAN = RYSAS in 2023. When the results of the analyses made with the MCDM methods are evaluated comparatively, it is determined that the last three companies with the worst performance in 2019 are RYSAS,

GSDDE and THYAO, CLEBI, PGSUS and THYAO in 2020, PGSUS, WHITE = THYAO in 2021, WHITE, GSDDE and THYAO in 2022, and GSDEE, WHITE and PGSUS = CLEBI in 2023.

Among the studies conducted in the literature, Sakarya & Saçkes, 2022 found that TLMAN showed the best performance in all years 2018, 2019 and 2020, while THYAO showed the worst performance in the analysis conducted with the GRA method. In Kınalı, 2020 study, in the analysis conducted with the TOPSIS method, it was determined that CLEBI showed the most successful performance in 2016-2020, while BEYAZ company showed the worst performance. When the analysis results are compared with these studies in the literature, it is observed that the best-performing company in Sakarya & Saçkes, (2022) is the same as the best-performing company in this study, while the worst-performing company in Kınalı, (2022) is the same as the worst performing company in this study. Although the MCDM methods differed in the studies, it was determined that the results were similar to each other in the analyzes made with the data of the companies.

Considering the analyzed periods of 2019-2023, it was determined that TLMAN was the company with the best financial performance among the BIST Transportation and Warehousing Index companies by showing the best performance for 4 consecutive periods, while GSDDE and BEYAZ companies were the companies with the worst financial performance among the BIST Transportation and Warehousing Index companies by exhibiting the worst performance during the analysis period.

Researchers are advised to compare the financial performance rankings of BIST Transportation and Warehousing Index companies with the ranking to be obtained as a result of the study to be conducted with the shared values of BIST Transportation and Warehousing Index companies with reference to this study.

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Extended Summary

Measuring the Financial Performance of Transportation and Warehousing Companies Traded on the BIST

The transportation and warehousing sector plays a pivotal role in the global economy by facilitating the movement of goods and services. This industry significantly contributes to economic development in Turkey, supported by its strategic geographical position.

The transportation sector, a fundamental component of investment decisions and the production process holds a vital role in the economic structures of nations due to its significant economic impact. This study examines the financial performance of companies listed in the BIST Transportation and Warehousing Index (XULAS) over the 2019-2023. Key performance indicators such as Net Profit Margin, Operating Profit Margin, Return on Assets, Return on Equity, and Economic Efficiency were utilized to assess the financial performance of these companies. \n\nGiven the sector\u2019s critical importance to national economies, particularly in developing countries, the analysis focused on companies within the XULAS Index. As of October 2024, 5 of the 12 companies in the index began trading after 2021. Consequently, this study evaluates the financial performance of the 7 companies listed before 2021.

This study evaluates the financial performance of companies traded on the BIST Transportation and Warehousing Index XULAS using ENTROPI-based ELECTRE and GRA methods. After determining which is the most important criterion in evaluating the financial performance of these companies, an objective evaluation of their financial performance, especially for the COVID-19 period and the period after, was made. Unlike the studies in the literature on the performance evaluation of companies in the Transportation Index, this study objectively determines the weights of the criteria using the ENTROPI weighting method. Moreover, the ELECTRE and GRA methods used for ranking in the performance evaluation process are suitable for more accurately addressing the financial performance ranking between alternatives. The analysis is fundamental as it measures the financial performance of transport companies during and after the pandemic and provides insights into the sector's resilience.

In the literature, MCDM methods such as TOPSIS, ELECTRE and GRA have been widely applied to evaluate the financial performance of logistics companies. For example, Akgün & Temür (2016) evaluates the financial performance of companies registered in the BIST Transportation Index with the TOPSIS Method, Aksu & Bayramoğlu (2024) analyzes the financial performance of logistics companies with the ELECTRE Method, Başdeğirmen & Işıldak (2018) evaluates the performance of enterprises operating in the transportation sector with the GRA, Ersoy (2020) evaluates the financial performance of companies in the Borsa Istanbul Transportation Index with the GRA Method, While Kendirli & Kaya (2016) evaluated the Financial Performance of Firms in the BIST Transportation Index with TOPSIS Method, Mansyur & Saban (2023) analyzed the Financial Performance of the Transportation and Warehousing Sector with ENTROPI-TOPSIS Methods, While Ömürbek & Kınay (2013) evaluated the financial performance of airline transportation sector with TOPSIS method, Sakarya & Saçkes (2022) evaluated the financial performance of companies operating in the transportation and warehousing sector registered in BIST with Analytic Hierarchy Process (AHS) and GRA methods.

In the literature search, although there are studies conducted with different periods of companies in the transportation sector, no study analyzes and evaluates the financial performance of companies in the transportation sector between 2019 and 2023, the COVID-19 period and beyond. This study's contribution to the literature with ENTROPY-based ELECTRE and GRA methods is important to contribute to this gap in the literature.

This study analyzes the financial performance of companies traded on the BIST Transportation and Warehousing Index using data from 2019 to 2022. Financial data are collected from the Public Disclosure Platform (PDP) and independently audited financial statements published by the companies. It covers key financial indicators that assess companies' financial health and sustainability. The ENTROPI method was used to determine the weight of each criterion and the objective importance levels of the criteria were determined. To rank companies' financial performance, ELECTRE and GRA were applied, which are particularly suitable for comparing alternatives under multiple and often conflicting criteria. At the same time, ELECTRE and GRA were applied to the alternatives with equal weighting of the criteria in the sensitivity analysis for consistency and reliability of the results. The comparative evaluation of the results of ELECTRE and GRA methods, taking into account the sensitivity analysis, confirmed the consistency and reliability of the rankings.

In the study, when the financial performance of the companies in the BIST Transportation and Warehousing Index XULAS between 2019 and 2023 is evaluated comparatively, it is determined that the top three companies with the best performance in 2019 are TLMAN, CLEBI and PGSUS, TLMAN, BEYAZ and GSDDE = RYSAS in 2020, TLMAN, GSDDE and CLEBI in 2021, TLMAN, CLEBI and PGSUS in 2022, THYAO, PGSUS = CLEBI and TLMAN = RYSAS in 2023. When the results of the analyses conducted with MCDM methods are evaluated comparatively, it is determined that the last three companies with the worst performance in 2019 are RYSAS, GSDDE and THYAO, in 2020 CLEBI, PGSUS and THYAO, in 2021 PGSUS, WHITE = THYAO, in 2022 WHITE, GSDDE and THYAO, and in 2023 GSDEE, WHITE and PGSUS = CLEBI. Considering the analyzed periods 2019-2023, TLMAN has been the company with the best financial performance among the BIST Transportation and Warehousing Index companies by showing the best performance for 4 consecutive periods. As of the periods analyzed, GSDDE and BEYAZ companies exhibited the worst performance and became the companies with the worst financial performance among the BIST Transportation and Warehousing Index companies. Within the framework of the analysis results, the study contributes both to the academic literature and to the practical decision-making processes of companies regarding long-term financial sustainability.

Researchers are advised to compare the financial performance rankings of BIST Transportation and Warehousing Index companies with the ranking obtained as a result of the study to be conducted with the share values of BIST Transportation and Warehousing Index companies concerning this study.