Comparative Financial Performance Analysis of BIST-500 Listed Insurance Companies Using TOPSIS, VIKOR and MOORA Methods

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BİST-500'de İşlem Gören Sigorta Şirketlerinin TOPSIS, VIKOR ve MOORA Yöntemleri ile Karşılaştırmalı Finansal Performans Analizi

Abstract

The study analysed the financial data of 8 insurance companies traded in the BIST-500 insurance index for 2013-2022 using TOPSIS, VIKOR, and MOORA methods with 18 criteria. The study aims to guide decision-makers and investors by revealing the financial status of insurance sector companies. As a result of the analysis, the financial performance rankings of the companies showed differences according to the three methods. According to the financial performance ranking made by TOPSIS, VIKOR, and MOORA methods, the results show differences when the leverage ratio is evaluated at maximum. The results are similar when the leverage ratio is assessed as a minimum. No company achieved the best and worst performance rankings in the periods evaluated.

Keywords : BIST-500, TOPSIS, VIKOR, MOORA, Insurance Companies.

JEL Classification Codes : G22, G32, M21.

Öz

Çalışmada, BİST-500 sigorta endeksinde işlem gören 8 sigorta şirketinin 2013-2022 dönemlerine ait finansal verileri TOPSIS, VIKOR ve MOORA yöntemleri ile 18 kriterle analiz edilmiştir. Çalışma ile sigorta sektörü şirketlerinin finansal durumunu ortaya koyarak karar vericiler ve yatırımcılar için yol gösterici olması amaçlanmıştır. Analiz sonucunda, şirketlerin finansal performans sıralamaları üç yönteme göre farklılıklar göstermiştir. TOPSIS, VIKOR ve MOORA yöntemleri ile yapılan finansal performans sıralamasına göre kaldıraç oranı maksimum olarak değerlendirildiğinde sonuçların farklılıklar gösterdiği görülmektedir. Kaldıraç oranı minimum olarak değerlendirildiğinde ise sonuçların benzerlik gösterdiği görülmektedir. Değerlendirme yapılan dönemlerde en iyi ve en kötü performans sıralamasını sağlayan tek bir şirket bulunmamaktadır.

Anahtar Sözcükler : BİST-500, TOPSIS, VIKOR, MOORA, Sigorta Şirketleri.

1. Introduction

The primary purpose of businesses operating in the insurance sector is to determine market risks and prevent the concentration of risk in specific individuals or groups by distributing risk (Knutsen, 1999). While the insurance sector creates resources for the finance sector through premium incomes, it also prevents losses in the national economy due to damages (Acar, 2019).

The insurance sector ranked second after the banking sector, with a share of 4.8% and TL 780.5 billion in the financial sector as of 2022 (TSB, 2022).

In terms of determining the sectoral status of financial companies, seeing whether they have achieved their goals, analysing whether they have used their resources correctly in these processes, and determining whether they can perform their services efficiently and effectively, performance evaluation is extremely important for both managers and investors to comprehend the current situation and to create forward-looking strategies (Akhisar & Tezergil, 2014). This analysis effectively reveals the extent to which companies transform their inputs into outputs and to what extent they are efficient (Altan, 2010).
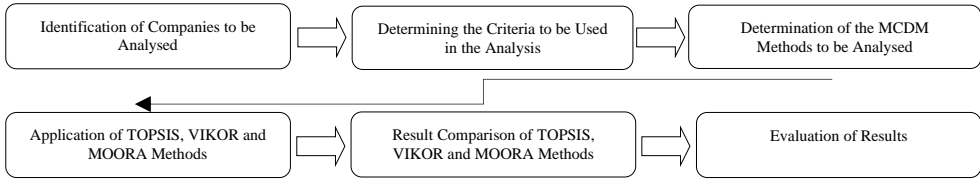
When the studies in the literature on the insurance sector are examined, it is understood that many different multi-criteria decision-making (MCDM) methods and criteria for the insurance sector have been examined. This study is trying to contribute to the academic literature as an innovative approach by using TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), VIKOR (Vlse Kriterijumska Optimizacija I Kompromisno Resenje) and MOORA (Multi-Objective Optimization by Ratio Analysis) methods, which are among the most widely used criteria and the most commonly used MCDM methods in the literature.

The questions to be investigated in the study are as follows;

1- Do the companies give the same results in the analysed MCDM methods?
2- When the weights of the criteria used in the financial analysis of the companies are given equal weights, how do they give results in the MCDM methods?

In the first part of this study, information about the insurance sector, one of the finance market's guarantor and locomotive sectors, is given. In the second part, studies on the insurance sector are examined in the literature. The third section provides information about the financial performance criteria for financial performance analysis and TOPSIS, VIKOR and MOORA methods from multi-criteria decision-making methods. In the fourth section, the financial performance analysis of the companies traded in the insurance index of BIST-500 is performed using the three methods, and the results are compared. The fifth and last sections compare insurance companies' financial performance analysis results. The flowchart showing the steps of the study is shown in Figure 1.

Figure: 1
Flowchart of the Study

2. Literature

While examining the insurance sector literature, it has been observed that financial performance analyses have been conducted many times. In the studies conducted in the literature, a single method and, at most, two methods were used together.

Chakraborty (2011) In this study, the MOORA method is applied to six decision-making problems involving the selection of (a) an industrial robot, (b) a flexible manufacturing system, (c) a computerised numerical control machine, (d) a non-traditional machining process suitable for a given work material and shape feature combination, (e) a rapid prototyping process, and (f) an automated inspection system.

Opricovic (2011) presents a comparative analysis of planning for developing a reservoir system to store surface runoff of the Mlava River and its tributaries for regional water supply using fuzzy VIKOR and several different approaches.

Brauers (2008) Using the MOORA method, the largest housing maintenance contractors in Vilnius, the capital of Lithuania, were contacted to rank the best performance from the customers' point of view and the contractors' point of view in terms of the quality of service and work after the completion of the works, as well as the satisfaction of the customers, the reduction of external costs and inconveniences, and as low as possible the management cost per employee.

Krohling & Pacheco (2015): To solve the problem of ranking and comparing algorithms, an approach based on TOPSIS was developed, and algorithm ranking, called the A-TOPSIS method, was performed.

Uotila, Maula, Keil, and Zahra (2008) discuss exploration and exploitation and the optimal balance between them, which depends on environmental conditions. Using a new methodology to measure relative exploration and exploitation orientation, an inverted U-shaped relationship is found between the relative share of exploration orientation and financial performance. This relationship is positively shaped by the R&D intensity of the firm's industry.

Perçin & Sönmez (2018) comparatively analysed the efficiency of five insurance companies traded on BIST using Entropy Weight and TOPSIS methods. The profitability,

operating, leverage, and liquidity analysis ratios showed that Ak Sigorta had the best financial performance and AVIVASA had the worst.

Ertuğrul, Öztaş, Özçil & Öztaş (2016) analysed the efficiency of insurance companies traded on BIST for the period 2008-2016. In evaluating profitability, leverage, and financial stability, it is observed that the most effective factors in efficiency are profitability and stability criteria.

Akhisar & Tezergil (2014) used equity, total assets, premiums received, net profit (loss) and technical profit variables of 23 insurance companies operating in non-life branches in the Turkish Insurance Sector for 2006-2010 and ranked their efficiency. The results showed that the top five companies with the highest efficiency were Ak Sigorta, Türkiye Genel, Başak Groupama, Ankara and Şeker Sigorta, respectively.

Özcan & Ömürbek (2016) evaluated the financial performance of insurance companies operating in BIST by using the MOORA Ratio Method with ten financial ratios obtained from financial statements. Thus, they showed that the MULTI-MOORA method can also be used for other sectors.

Çakır (2016) measured the performance of six BIST-listed firms in the Turkish insurance sector using the VIKOR method with five criteria: personnel expenses, written premiums, total assets, claims paid with shareholders' equity, and total technical provisions in 2014.

Akpınar & Yıldız (2018) used the TOPSIS method to determine the most successful and unsuccessful years of non-life insurance companies between 2007 and 2016, using the criteria of Shareholders' Equity, Premium Production, Total Assets, Financial Assets and Financial Investments at Insurers' Risk, Insurance Technical Provisions, Short-Term Liabilities, Cash and Net Profit.

Özaktaş (2017) examined whether there is a connection between the criteria of Total Assets, Paid-in Capital, Technical Expenses, Technical Provisions, Personnel and Administrative Expenses, Premiums Received, Technical Income and the trading status in the stock exchange and the efficiency status between 2002 and 2015 with the Data Envelopment Method.

Bülbül & Köse (2016) analysed the financial performance of insurance companies with the Promethee method between 2010 and 2013 with the criteria of Equity/Technical Reserves, Liquid Assets/Total Assets, Loss Premium Ratio, Retention Ratio, Premium Production/Share, Technical Profit.

Bayramoğlu & Başarır (2016) used the TOPSIS method to rank the success of insurance companies based on the criteria of Total Premium Production, Paid Claims, Premiums Received/Equity, Equity/Technical Reserves, Retention Ratio, Loss Premium Ratio and Financial Structure Ratios between 2011-2014.

Altan (2010) used the data envelope analysis method to determine the efficient companies in terms of balance sheets and income statement items, financial investments at risk of insurance, and insurance technical provisions between 2005 and 2007, as well as their efficiency scores.

Çağlar & Öztaş (2016) Data envelopment analysis and analytical hierarchy process were used to determine the most efficient ranking of 8 non-life insurance companies in terms of financial ratios in 2014.

Akhisar and Tunay (2016) analysed the performance of 24 pension and life insurance companies between 2009 and 2013 using AHP (Analytic Hierarchy Process) and TOPSIS methods.

Akyüz and Kaya (2013) used the TOPSIS method to determine the most financially successful years for non-life and life pension companies between 2007 and 2011.

Altan & Yıldırım (2019) determined the weighting of 10 financial ratios to determine the financial performance of the insurance sector between 2012 and 2016 using the Entropy method. By analysing the financial ratios whose weights were determined with the TOPSIS method, the success ranking of the non-life and life/pension branches of the sector was made.

Aydın (2019) determined the financial and technical performances of life/pension companies in the insurance sector in Türkiye between 2015 and 2017 by weighting ten financial and eight technical ratios with the CRITIC method. He analysed the financial and technical ratios whose weights were determined by the TOPSIS method and ranked the companies' financial and technical performance.

Akbulut & Gümüşkaya (2022) determined the weights of 11 financial ratios that will determine the financial performance of the Turkish non-life insurance sector between 2010 and 2021 using AHP, SV, and common weighting methods. The success ranking of the Turkish non-life insurance sector was made by analysing the financial ratios whose weights were determined with the MAIRCA method.

3. Data and Methodology

In this study, contrary to the studies conducted in the literature, not one or two methods together, but the most commonly used MCDM methods are used together in the financial performance analysis of insurance companies in the literature (Aydın, 2019; Altan & Yıldırım, 2019; Akyüz & Kaya, 2013; Akhisar & Tunay, 2016; Bayramoğlu & Başarır, 2016; Akpınar & Yıldız, 2018; Çakır, 2016; Özcan & Ömürbek, 2016; Perçin & Sönmez, 2018). TOPSIS, VIKOR and MOORA are the most commonly used methods. They will be used together to analyse the comparative financial performance of the companies operating in the insurance sector in the BIST-500 for 2013-2022.

The boundaries of the study are insurance sector companies in BIST-500 as the sector and the last ten years (2013-2022) as the period that best summarises the financial status of the companies.

3.1. Companies Traded on the Insurance Index in BIST-500

Although six companies are traded in BIST-500, in the financial performance analysis, the financial data of Güneş Sigorta A.Ş., Halk Sigorta A.Ş. and Ziraat Sigorta A.Ş. were analysed separately instead of Türkiye Sigorta A.Ş. in 2013-2019. Upon the merger of Güneş Sigorta A.Ş., Halk Sigorta A.Ş. and Ziraat Sigorta A.Ş. under the name of Türkiye Sigorta A.Ş. in 2020, Türkiye Sigorta A.Ş. was included in the financial performance analysis in 2020-2022.

3.1.1. Agesa Hayat Emeklilik A.Ş.

The company was first established on 06/12/1941 and was renamed Avivasa Emeklilik ve Hayat A.Ş. in 2007 with the merger of Ak Emeklilik A.Ş. and Aviva Hayat ve Emeklilik A.Ş. As of 08/07/2021, the company name was changed to Agesa Hayat Emeklilik A.Ş. The first public offering was made on 07/11/2014.

3.1.2. Aksigorta A.Ş.

The Company was first established on 18/04/1960 and started its insurance operations. Its first public offering was realised on 23/11/1994.

3.1.3. Anadolu Hayat Emeklilik A.Ş.

The company was established on 31/05/1990 and changed from Anadolu Hayat Sigorta A.Ş. to Anadolu Hayat Emeklilik A.Ş. on 21/03/2003. Its initial public offering was made on 11/02/2000.

3.1.4. Anadolu Anonim Türk Sigorta A.Ş.

The Company was first established on 17/04/2013 and started its insurance operations. The initial public offering was made on 11/10/1993.

3.1.5. Güneş Sigorta A.Ş.

The Company was first established on 17/09/1957 and continued its insurance operations under the name Türkiye Sigorta A.Ş. by merging with Halk Sigorta A.Ş. and Ziraat Sigorta A.Ş. on 24/06/2020.

3.1.6. Halk Sigorta A.Ş.

The Company was first established on 29/12/1958 and continued its insurance operations under the name Türkiye Sigorta A.Ş. after merging with Güneş Sigorta A.Ş. and Ziraat Sigorta A.Ş. on 24/06/2020.

3.1.7. Ray Sigorta A.Ş.

The Company was first established on 15/08/1958 and started its insurance operations. Its first public offering was made on 17/07/1997.

3.1.8. Türkiye Sigorta A.Ş.

The company was first established on 27/08/2020 with the merger of Güneş Sigorta A.Ş., Halk Sigorta A.Ş., and Ziraat Sigorta A.Ş., and it started its insurance activities. The first public offering was made on 14/11/1994 under the name Güneş Sigorta A.Ş.

3.1.9. Ziraat Sigorata A.Ş.

The Company was first established on 11/05/2009 and continued its insurance operations under the name Türkiye Sigorta A.Ş. by merging with Halk Sigorta A.Ş. and Güneş Sigorta A.Ş. on 24/06/2020.

The companies' data to be analysed were obtained from the balance sheets and income statements published by the companies.

3.2. Financial Performance Ratios

The financial performance criteria for the study consist of financial ratios related to liquidity, leverage, profitability and efficiency ratios (cost, revenue and profit). In the selection of financial performance ratios to be used in the analysis in Table 1, studies conducted for the insurance sector were utilised (McDonald & Morris, 1984; Çiftçi, 2004; Kayalı, 2007; Ajlouni & Tobaishat, 2010; Altan, 2010; Dalkılıç, 2012; Akın & Ece, 2013; Aktaş & Ünal, 2015; Bülbül & Köse, 2016; Akel, Torun & Aksoy, 2017).

The 18 financial ratios to be used as financial performance criteria in the study are shown in Table 1.

Table: 1
Ratios Used as Financial Performance Analysis Criteria

			Impact on Financial Data
Current Ratio	C1	Current Assets / Short-Term Liabilities	Maximum
Leverage Ratio	K1	Long-Term Liabilities / Shareholders' Equity	Max/Min
	K2	Short Term Liabilities / Total Debt	Max/Min
	K3	Total Debt / Total Assets	Max/Min
	K4	Total Debt / Equity	Max/Min
	K5	Total Assets / Equity	Max/Min
Profitability Ratio	P1	Net Profit for the Period / Total Assets	Maximum
	P2	Net Profit for the Period / Shareholders' Equity	Maximum
	P3	Technical Profit / Total Assets	Maximum
	P4	Technical Profit / Total Technical Income	Maximum
Cost Ratio	M1	Technical Reserves / Total Assets Short-Term	Minimum
	M2	Technical Reserves / Total Assets Long Term	Minimum
	M3	Technical Reserves / Total Assets Total Technical Reserves	Minimum
	M4	Technical Expenses / Earned Premiums	Minimum
	M5	Financial Expenses / Earned Premiums	Minimum
Income Ratio	G1	Earned Premiums / Total Assets	Maximum
	G2	Earned Premiums / Technical Reserves	Maximum
	G3	Interest Income / Total Assets	Maximum

4. Empirical Results

Since the tables of the data to be analysed for performance analysis are very long, only the table for 2022 is shown as an example at each stage of the study.

In section 4.4. Comparison of financial performance analyses made with TOPSIS, VIKOR and MOORA methods, the data of the insurance companies for the years 2013-2022 are given comparatively.

4.1. TOPSIS (Technique for Order Preference by Similarity to Ideal Solution)

This method, first developed by Hwang and Yoon, is built on the assumption that in solving multi-criteria decision-making problems, the choice should be closest to the positive ideal solution and farthest from the negative ideal solution (Jadidi et al., 2008).

It evaluates and compares business performance, considers the intensely competitive environment, and solves multi-criteria decision-making problems by considering multiple financial ratios (Akyüz et al., 2011).

The TOPSIS method consists of 6 steps.

Step 1 - Creating the Decision Matrix

The TOPSIS method started by creating a decision matrix. The insurance companies and years of performance analysis were placed in the rows, and the criteria to be evaluated were placed in the columns. The decision matrix created with the data to be analysed for performance analysis is given in Table 2.

Table: 2
Decision Matrix

Decision Matrix	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
Anadolu Sigorta	2022	1,162	0,147	0,814	1,057	6,184	6,184	0,044	0,275	0,049	0,090	1,794	0,341	0,499	1,348	0,673	0,366	1,100	0,101
Türkiye Sigorta	2022	1,129	0,067	0,777	1,140	4,787	4,787	0,022	0,106	0,018	0,052	1,153	0,261	0,346	1,329	0,520	0,250	0,974	0,042
Anadolu Hayat Emeklilik	2022	1,038	0,050	0,960	1,004	26,155	26,155	0,015	0,380	0,006	0,084	2,495	0,100	0,111	1,939	0,042	0,035	0,351	0,006
Aksigorta	2022	1,155	0,109	0,832	1,041	6,583	6,583	-0,009	-0,062	-0,006	-0,011	1,362	0,233	0,298	1,351	-0,516	0,383	1,669	0,086
Agesa Hayat Emeklilik	2022	6,339	48,742	0,020	7,850	50,762	50,762	0,010	0,507	0,002	0,020	0,099	2,437	0,107	1,852	0,066	0,040	0,408	0,007
Ray Sigorta	2022	1,138	0,200	0,804	1,094	6,109	6,109	0,033	0,202	0,047	0,153	0,527	0,107	0,116	0,959	0,354	0,273	2,637	0,035

Step 2 - Normalization of the Decision Matrix

With the data in Table 2, each value in the columns is normalised by dividing each value by the square root of the sum of the squares of the values in its column.

While normalising the decision matrix, each year was evaluated and normalised by dividing the sum of the squares of the values of each year by the square root of the sum of squares.

The normalised decision matrix is given in Table 3.

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^{m} a_{ij}^2}} \quad i = 1, \dots, m \; j = 1, \dots, n \tag{1}$$

Table: 3
Normalised Decision Matrix

Normalised Decision Matrix	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
Anadolu Sigorta	2022	0,097	0,003	0,194	0,080	0,061	0,061	0,388	0,195	0,418	0,231	0,241	0,098	0,338	0,154	0,591	0,272	0,154	0,363
Türkiye Sigorta	2022	0,094	0,001	0,185	0,086	0,048	0,048	0,193	0,075	0,157	0,134	0,155	0,075	0,234	0,151	0,457	0,186	0,136	0,152
Anadolu Hayat Emeklilik	2022	0,087	0,001	0,228	0,076	0,260	0,260	0,127	0,270	0,054	0,216	0,336	0,029	0,075	0,221	0,037	0,026	0,049	0,021
Aksigorta	2022	0,097	0,002	0,198	0,079	0,065	0,065	-0,082	-0,044	-0,048	-0,028	0,183	0,067	0,202	0,154	-0,453	0,284	0,234	0,310
Agesa Hayat Emeklilik	2022	0,530	0,988	0,005	0,595	0,505	0,505	0,087	0,360	0,013	0,053	0,013	0,700	0,073	0,211	0,058	0,029	0,057	0,026
Ray Sigorta	2022	0,095	0,004	0,191	0,083	0,061	0,061	0,288	0,143	0,407	0,395	0,071	0,031	0,078	0,109	0,311	0,203	0,369	0,127

Step 3 - Weighting the Normalised Decision Matrix

The effects of financial criteria on financial performance were weighted so that the sum of their impact on financial performance was 1, and weight coefficients (W) were determined (Eleren et al., 2009).

$$\sum_{i=1}^{n} W_i = 1 \tag{2}$$

Each data obtained in the normalised decision matrix is multiplied by the determined weight coefficients, and the Normalized decision matrix is weighted.

The Weighted Normalized Decision Matrix is given in Table 4.

Table: 4
Weighted Normalized Decision Matrix

Weighted Normalised Decision Matrix	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
Weight Matrice W=1		0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055	0,055
Anadolu Sigorta	2022	0,005	0,000	0,011	0,004	0,003	0,003	0,022	0,011	0,023	0,013	0,013	0,005	0,019	0,009	0,033	0,015	0,009	0,020
Türkiye Sigorta	2022	0,005	0,000	0,010	0,005	0,003	0,003	0,011	0,004	0,009	0,007	0,009	0,004	0,013	0,008	0,025	0,010	0,008	0,008
Anadolu Hayat Emeklilik	2022	0,005	0,000	0,013	0,004	0,014	0,014	0,007	0,015	0,003	0,012	0,019	0,002	0,004	0,012	0,002	0,001	0,003	0,001
Aksigorta	2022	0,005	0,000	0,011	0,004	0,004	0,004	-0,005	-0,002	-0,003	-0,002	0,010	0,004	0,011	0,009	-0,025	0,016	0,013	0,017
Agesa Hayat Emeklilik	2022	0,029	0,055	0,000	0,033	0,028	0,028	0,005	0,020	0,001	0,003	0,001	0,039	0,004	0,012	0,003	0,002	0,003	0,001
Ray Sigorta	2022	0,005	0,000	0,011	0,005	0,003	0,003	0,016	0,008	0,023	0,022	0,004	0,002	0,004	0,006	0,017	0,011	0,021	0,007

Step 4 - Creation of Positive (A^+) and Negative Ideal (A^-) Solutions

The Positive Ideal solution set comprises the highest data in the weighted decision matrix.

The Negative Ideal solution set comprises the lowest data in the weighted decision matrix.

The effect of leverage ratios, one of the financial performance analysis criteria, on the financial structure of insurance companies is calculated as both maximum and minimum.

If the leverage effect is evaluated as Maximum, the data constituting the Positive and Negative ideal solution set are given in Table 5.

Table: 5
Positive (A^+) and Negative (A^-) Ideal Solution Set

		C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
Aims for each variable	Years	Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	Min	Min	Min	Min	Min	Max	Max	Max
Ideal A^+	2022	0,029	0,055	0,013	0,033	0,028	0,028	0,022	0,020	0,023	0,022	0,001	0,002	0,004	0,006	-0,025	0,016	0,021	0,020
A^-	2022	0,005	0,000	0,000	0,004	0,003	0,003	-0,005	-0,002	-0,003	-0,002	0,019	0,039	0,019	0,012	0,033	0,001	0,003	0,001

If the leverage effect is considered Minimum, Table 6 gives the data constituting the Positive and Negative ideal solution sets.

Table: 6
Positive (A^+) and Negative (A^-) Ideal Solution Set

		C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
Aims for each variable	Years	Max	Min	Min	Min	Min	Min	Max	Max	Max	Max	Min	Min	Min	Min	Min	Max	Max	Max
Ideal A+	2022	0,029	0,000	0,000	0,004	0,003	0,003	0,022	0,020	0,023	0,022	0,001	0,002	0,004	0,006	-0,025	0,016	0,021	0,020
A-	2022	0,005	0,055	0,013	0,033	0,028	0,028	-0,005	-0,002	-0,003	-0,002	0,019	0,039	0,019	0,012	0,033	0,001	0,003	0,001

Step 5 - Establishing the Distance Values (S+ and S-) to the Positive and Negative Ideal Solution

Using the Euclidian Distance Approach, the deviations of each decision point to the ideal and negative ideal solution points are determined. Ideal Separation S_i^* and Negative Ideal Separation Measure S_i^- are determined for the decision point obtained here (Erdoğan & Yamaltdinova, 2018).

Establishing the Distance Value to Positive Ideal Solution is calculated according to formula (3),

$$S_i^* = \sqrt{\sum_{j-1}^n (V_{ij} - V_j^*)^2} \tag{3}$$

Establishing the Distance to the Negative Ideal Solution is calculated according to formula (4).

$$S_i^- = \sqrt{\sum_{j-1}^n (V_{ij} - V_j^-)^2} \tag{4}$$

Distance to Positive Ideal Solution Values are given in Table 7.

Table: 7
Distance to Positive Ideal Solution

Calculate Si (Di)+	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3	Si (Di)+
Anadolu Sigorta	2022	0,024	0,055	0,002	0,029	0,025	0,025	0,000	0,009	0,000	0,009	-0,013	-0,004	-0,015	-0,002	-0,058	0,001	0,012	0,000	0,0984
Türkiye Sigorta	2022	0,024	0,055	0,002	0,028	0,025	0,025	0,011	0,016	0,014	0,014	-0,008	-0,003	-0,009	-0,002	-0,051	0,005	0,013	0,012	0,0975
Anadolu Hayat Emeklilik	2022	0,025	0,055	0,000	0,029	0,014	0,014	0,014	0,005	0,020	0,010	-0,018	0,000	0,000	-0,006	-0,027	0,014	0,018	0,019	0,0868
Aksigorta	2022	0,024	0,055	0,002	0,029	0,024	0,024	0,026	0,022	0,026	0,023	-0,009	-0,002	-0,007	-0,002	0,000	0,000	0,008	0,003	0,0907
Agesa Hayat Emeklilik	2022	0,000	0,000	0,012	0,000	0,000	0,000	0,017	0,000	0,022	0,019	0,000	-0,037	0,000	-0,006	-0,028	0,014	0,017	0,019	0,0662
Ray Sigorta	2022	0,024	0,055	0,002	0,028	0,025	0,025	0,006	0,012	0,001	0,000	-0,003	0,000	0,000	0,000	-0,042	0,005	0,000	0,013	0,0882

Distance to Negative Ideal Solution Values are given in Table 8.

Table: 8
Distance to Negative Ideal Solution

Calculate Si (Di)-	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3	Si (Di)-
Anadolu Sigorta	2022	0,001	0,000	0,010	0,000	0,001	0,001	0,026	0,013	0,026	0,014	-0,005	-0,033	0,000	-0,004	0,000	0,014	0,006	0,019	0,0599
Türkiye Sigorta	2022	0,000	0,000	0,010	0,001	0,000	0,000	0,015	0,007	0,011	0,009	-0,010	-0,035	-0,006	-0,004	-0,007	0,009	0,005	0,007	0,0464
Anadolu Hayat Emeklilik	2022	0,000	0,000	0,012	0,000	0,012	0,012	0,012	0,017	0,006	0,014	0,000	-0,037	-0,015	0,000	-0,031	0,000	0,000	0,000	0,0603
Aksigorta	2022	0,001	0,000	0,011	0,000	0,001	0,001	0,000	0,000	0,000	0,000	-0,008	-0,035	-0,008	-0,004	-0,058	0,014	0,010	0,016	0,0737
Agesa Hayat Emeklilik	2022	0,025	0,055	0,000	0,029	0,025	0,025	0,009	0,022	0,003	0,004	-0,018	0,000	-0,015	-0,001	-0,030	0,000	0,000	0,000	0,0882
Ray Sigorta	2022	0,000	0,000	0,010	0,000	0,001	0,001	0,021	0,010	0,025	0,023	-0,015	-0,037	-0,014	-0,006	-0,016	0,010	0,018	0,006	0,0661

Step 6 - Calculating the Relative Closeness to the Ideal Solution

In this step, which is the last step of the TOPSIS method, the proximity of each of the performance criteria to the ideal solutions is calculated with the formula (5) by utilizing the positive and negative ideal solution data.

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*} \tag{5}$$

C_i^* takes a value between 0 and 1, if the result for C_i^* is 0, this indicates the absolute closeness to the negative ideal solution; if the result for C_i^* is 1, this indicates absolute closeness to the ideal solution (Karim & Karmaker, 2016). The calculation of the relative closeness to the ideal solution in this step is given in Table 9.

Table: 9
Proximity to the Ideal Solution

Companies	Years	The Situation where the Leverage Effect is Maximum			A situation where the Leverage Effect is Minimum		
		Ci	S+	S-	Ci	S+	S-
Anadolu Sigorta	2022	0,3785	0,0984	0,0599	0,5722	0,0690	0,0923
Türkiye Sigorta	2022	0,3225	0,0975	0,0464	0,5574	0,0672	0,0846
Anadolu Hayat Emeklilik	2022	0,4099	0,0868	0,0603	0,5840	0,0614	0,0861
Aksigorta	2022	0,4483	0,0907	0,0737	0,6382	0,0576	0,1016
Agesa Hayat Emeklilik	2022	0,5713	0,0662	0,0882	0,3536	0,0967	0,0529
Ray Sigorta	2022	0,4283	0,0882	0,0661	0,6426	0,0536	0,0963

Using the TOPSIS method, the performance of the insurance index companies in BIST-500 was evaluated with their financial data, and the success ranking according to the evaluation is given in Table 10.

Table: 10
Ranking of Proximity Values to the Ideal Solution

Companies	Years	Ranking with Maximum Leverage Ratios				Ranking with Minimum Leverage Ratios			
		Ci	S+	S-	Best	Ci	S+	S-	Best
Agesa Hayat Emeklilik	2022	0,5713	0,0662	0,0882	8	0,3536	0,0967	0,0529	63
Aksigorta	2022	0,4483	0,0907	0,0737	13	0,6382	0,0576	0,1016	29
Ray Sigorta	2022	0,4283	0,0882	0,0661	16	0,6426	0,0536	0,0963	27
Anadolu Hayat Emeklilik	2022	0,4099	0,0868	0,0603	20	0,5840	0,0614	0,0861	47
Anadolu Sigorta	2022	0,3785	0,0984	0,0599	25	0,5722	0,0690	0,0923	50
Türkiye Sigorta	2022	0,3225	0,0975	0,0464	37	0,5574	0,0672	0,0846	53

According to the ranking of the best financial performance of the BIST-500 insurance index companies between 2013 and 2022 using the TOPSIS method in the two cases where the leverage effect is maximum and minimum, Ziraat Sigorta A.Ş. showed the most successful financial performance with its 2015 financial data.

According to the ranking of the best financial performance of the BIST-500 insurance index companies between 2013 and 2022 in the two cases where the leverage effect is maximum and minimum with the TOPSIS method, Güneş Sigorta A.Ş. showed the worst financial performance with its 2015 financial data.

4.2. VIKOR (Multiple Criteria Optimization and Compromise Solution)

The VIKOR method, which allows decision-makers to reach a consensus solution for the final decision, was developed by Opricovic in 1998. The concept of consensus refers to the common acceptance of decision-makers on any alternative. This consensus or compromise solution ensures maximum group benefit and minimum individual regret (Opricovic & Tzeng, 2004). For VIKOR management, steps similar to the steps in Opricovic & Tzeng (2007), Karthik et al. (2011), Yıldırım & Önder (2014), Aktaş & Kabak (2020) were followed and shown below:

Phase 1. Creating the Decision Matrix

The decision matrix includes evaluating the alternatives based on criteria. Table 11 shows the decision matrix created with the data to be analysed for performance analysis.

Table: 11
Decision Matrix

Decision Matrix	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
Anadolu Sigorta	2022	1,162	0,147	0,814	1,057	6,184	6,184	0,044	0,275	0,049	0,090	1,794	0,341	0,499	1,348	0,673	0,366	1,100	0,101
Türkiye Sigorta	2022	1,129	0,067	0,777	1,140	4,787	4,787	0,022	0,106	0,018	0,052	1,153	0,261	0,346	1,329	0,520	0,250	0,974	0,042
Anadolu Hayat Emeklilik	2022	1,038	0,050	0,960	1,004	26,155	26,155	0,015	0,380	0,006	0,084	2,495	0,100	0,111	1,939	0,042	0,035	0,351	0,006
Aksigorta	2022	1,155	0,109	0,832	1,041	6,583	6,583	-0,009	-0,062	-0,006	-0,011	1,362	0,233	0,298	1,351	-0,516	0,383	1,669	0,086
Agesa Hayat Emeklilik	2022	6,339	48,742	0,020	7,850	50,762	50,762	0,010	0,507	0,002	0,020	0,099	2,437	0,107	1,852	0,066	0,040	0,408	0,007
Ray Sigorta	2022	1,138	0,200	0,804	1,094	6,109	6,109	0,033	0,202	0,047	0,153	0,527	0,107	0,116	0,959	0,354	0,273	2,637	0,035

Phase 2. Creation of the Normalized Decision Matrix

For each evaluation criterion, the best (f_i^+) and the worst (f_i^-) values are determined. The effect of leverage ratios, one of the financial performance analysis criteria, on the financial structure of insurance companies is calculated as both maximum and minimum.

If the leverage effect is considered as Maximum, Table 12 gives the best (f_i^+) and the worst (f_i^-) values.

Table: 12
Best and Worst Values of the Evaluation Criteria

	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
fi+	2022	6,339	48,742	0,960	7,850	50,762	50,762	0,044	0,507	0,049	0,153	0,099	0,100	0,107	0,959	-0,516	0,383	2,637	0,101
fi-	2022	1,038	0,050	0,020	1,004	4,787	4,787	-0,009	-0,062	-0,006	-0,011	2,495	2,437	0,499	1,939	0,673	0,035	0,351	0,006

If the leverage effect is considered as Minimum, Table 13 gives the best (f_i^+) and the worst (f_i^-) values.

Table: 13
Best and Worst Values of the Evaluation Criteria

	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
fi+	2022	6,339	48,742	0,960	7,850	50,762	50,762	0,044	0,507	0,049	0,153	0,099	0,100	0,107	0,959	-0,516	0,383	2,637	0,101
fi-	2022	1,038	0,050	0,020	1,004	4,787	4,787	-0,009	-0,062	-0,006	-0,011	2,495	2,437	0,499	1,939	0,673	0,035	0,351	0,006

Where i is the comparison criteria (i=1, 2, 3, ..., n) and j is the alternatives (j=1, 2, 3, ..., m).

$$R_{ij} = \frac{f_i^+ - f_{ij}}{f_i^+ - f_i^-} \tag{6}$$

Normalized values for cost-based criteria $f_i^+ = \max(f_{ij})$ and $f_i^- = \min(f_{ij})$ is calculated by accepting). The normalised decision matrix is given in Table 14.

Table: 14
Normalised Decision Matrix

Normalised Decision Matrix	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
Anadolu Sigorta	2022	0,977	0,998	0,155	0,992	0,970	0,970	0,000	0,407	0,000	0,386	0,708	0,103	1,000	0,397	1,000	0,048	0,673	0,000
Türkiye Sigorta	2022	0,983	1,000	0,195	0,980	1,000	1,000	0,414	0,704	0,560	0,616	0,440	0,069	0,609	0,377	0,871	0,381	0,728	0,616
Anadolu Hayat Emeklilik	2022	1,000	1,000	0,000	1,000	0,535	0,535	0,555	0,222	0,782	0,422	1,000	0,000	0,010	1,000	0,469	1,000	1,000	1,000
Aksigorta	2022	0,978	0,999	0,137	0,995	0,961	0,961	1,000	1,000	1,000	1,000	0,527	0,057	0,486	0,400	0,000	0,000	0,424	0,157
Agesa Hayat Emeklilik	2022	0,000	0,000	1,000	0,000	0,000	0,000	0,640	0,000	0,868	0,809	0,000	1,000	0,000	0,911	0,489	0,987	0,975	0,985
Ray Sigorta	2022	0,981	0,997	0,166	0,987	0,971	0,971	0,213	0,536	0,023	0,000	0,179	0,003	0,021	0,000	0,732	0,315	0,000	0,689

Phase 3. Obtaining the Weighted Normalized Decision Matrix

A weighted normalised decision matrix reflects the criteria's influence level on the decision. The values of the weighted normalised decision matrix elements are calculated by multiplying the normalised decision matrix elements by the weight value of the relevant criterion. The weighted normalised decision matrix elements are calculated using Equation (7).

$$V_{ij} = R_{ij} * w_j \tag{7}$$

The weighted normalised decision matrix is given in Table 15.

Table: 15
Weighted Normalized Decision Matrix

Weighted Normalized Decision Matrix	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
Anadolu Sigorta	2022	0,054	0,055	0,009	0,055	0,054	0,054	0,000	0,023	0,000	0,021	0,039	0,006	0,056	0,022	0,056	0,003	0,037	0,000
Türkiye Sigorta	2022	0,055	0,056	0,011	0,054	0,056	0,056	0,023	0,039	0,031	0,034	0,024	0,004	0,034	0,021	0,048	0,021	0,040	0,034
Anadolu Hayat Emeklilik	2022	0,056	0,056	0,000	0,056	0,030	0,030	0,031	0,012	0,043	0,023	0,056	0,000	0,001	0,056	0,026	0,056	0,056	0,056
Aksigorta	2022	0,054	0,055	0,008	0,055	0,053	0,053	0,056	0,056	0,056	0,056	0,029	0,003	0,027	0,022	0,000	0,000	0,024	0,009
Agesa Hayat Emeklilik	2022	0,000	0,000	0,056	0,000	0,000	0,000	0,036	0,000	0,048	0,045	0,000	0,056	0,000	0,051	0,027	0,055	0,054	0,055
Ray Sigorta	2022	0,055	0,055	0,009	0,055	0,054	0,054	0,012	0,030	0,001	0,000	0,010	0,000	0,001	0,000	0,041	0,018	0,000	0,038

Phase 4. Calculation of Group Utility and Individual Regret Measures

Group utility is the total weighted normalized value that would be obtained if the alternative is chosen, while individual regret is the maximum loss that would occur on the basis of a criterion if the alternative is not chosen. Equations (8) and (9) calculate the measures of group utility and individual regret.

$$S_i = \sum_{j=1}^n W_j \frac{f_j^+ - f_{ij}}{f_j^+ - f_j^-} = \sum_{j=1}^n V_{ij} \tag{8}$$

$$R_i = max_j \left(w_j \frac{f_j^+ - f_{ij}}{f_j^+ - f_j^-} \right) = max_j \, v_{ij} \tag{9}$$

The effect of leverage ratios on group utility and individual regret measures is calculated as both maximum and minimum and presented in Table 16.

Table: 16
Measures of Group Benefit and Individual Regret

Companies	Years	After Maximum Leverage Ratios are Maximized		After Minimum Leverage Ratios are Assessed	
		Si	Ri	Si	Ri
Ray Sigorta	2022	0,432	0,055	0,432	0,055
Agesa Hayat Emeklilik	2022	0,481	0,056	0,481	0,056
Anadolu Sigorta	2022	0,543	0,056	0,543	0,056
Aksigorta	2022	0,616	0,056	0,616	0,056
Anadolu Hayat Emeklilik	2022	0,641	0,056	0,641	0,056
Türkiye Sigorta	2022	0,641	0,056	0,641	0,056

Phase 5. Calculation of the Consensus Measure

The compromise criterion is calculated to combine the measures of group utility and individual regret to decide between alternatives. Ranking of other options S_i and R_i may differ in terms of their criteria, so combining them into a single value makes it easier for the decision maker to make a final decision. The consensus criterion is calculated by Equation (10).

$$Q_i = v \frac{S_i - S^+}{S^- - S^+} + (1 - v) \frac{R_i - R^+}{R^- - R^+}$$ (10)

The effect of leverage ratios is calculated as both maximum and minimum in the calculation of the consensus criterion and given in Table 17.

Table: 17
Consensus Criteria

Companies	DQ=0,059	After Maximum Leverage Ratios are Maximized		After Minimum Leverage Ratios are Assessed	
	Years	Qi	Q=0,50	Qi	Q=0,50
Ray Sigorta	2022	0,000	1	0,000	1
Agesa Hayat Emeklilik	2022	0,617	2	0,617	2
Anadolu Sigorta	2022	0,766	3	0,766	3
Aksigorta	2022	0,938	4	0,938	4
Anadolu Hayat Emeklilik	2022	0,998	5	0,998	5
Türkiye Sigorta	2022	1,000	6	1,000	6

Phase 6. Validation of Results

The last step of the VIKOR method is verifying the obtained alternative ranking. For validation, it is examined whether the results meet the following two conditions (Aktaş & Kabak, 2020).

• Condition. Acceptable Advantage

Assume that the alternative with the lowest Qi has Q(a'), the second best alternative has the second lowest Qi (Q(a'')), and DQ is defined as equal to 1/ (m-1). If the condition Q(a")-Q(a') ≥DQ is satisfied, the acceptable advantage condition is met (Aktaş & Kabak, 2020).

- **Condition. Acceptable Stability in Decision Making**

The alternative with the best Qi value should also be the best alternative regarding group utility and/or individual regret (Aktaş & Kabak, 2020).

When both conditions are met, the alternative with the best Qi value is identified as the compromise solution. If only Condition 1 is satisfied, the two alternatives with the best consensus criterion values are recognised as the best solution. If Condition 1 is not satisfied, all alternatives up to the mth ranked alternative that satisfies the condition $Q(a(m))-Q(a')$ ≥DQ are determined as a compromise solution (Aktaş & Kabak, 2020).

The verification of the alternative ranking obtained with the VIKOR method is given in Table 18.

Table: 18
Validation of Alternative Ranking

Years	After Maximum Leverage Ratios are Maximized				After Minimum Leverage Ratios are Assessed			
	Condition 1		Condition 2		Condition 1		Condition 2	
2013	17,000	≥DQ	0,378	≥DQ	2,995	≥DQ	0,000	≤DQ
2014	4,175	≥DQ	0,254	≥DQ	11,174	≥DQ	0,000	≤DQ
2015	2,404	≥DQ	0,359	≥DQ	6,651	≥DQ	0,000	≤DQ
2016	3,586	≥DQ	0,289	≥DQ	6,685	≥DQ	0,000	≤DQ
2017	1,499	≥DQ	0,412	≥DQ	9,992	≥DQ	0,000	≤DQ
2018	1,705	≥DQ	0,400	≥DQ	8,580	≥DQ	0,000	≤DQ
2019	1,549	≥DQ	0,340	≥DQ	2,805	≥DQ	0,048	≤DQ
2020	0,491	≥DQ	0,257	≥DQ	1,575	≥DQ	0,000	≤DQ
2021	4,467	≥DQ	0,237	≥DQ	6,464	≥DQ	0,000	≤DQ
2022	10,491	≥DQ	0,000	≤DQ	10,491	≥DQ	0,000	≤DQ

According to the alternative ranking obtained by the VIKOR method, when the leverage ratio is evaluated as maximum, Ray Sigorta was the best alternative compromise solution in 2013 since both conditions were met. Aksigorta was determined as the best alternative compromise solution in 2014 since both conditions were met. Since both conditions were met, Ray Sigorta was the best alternative compromise solution in 2015. Since both conditions were met, Ray Sigorta was the best alternative compromise solution in 2016. In 2017, the best alternative, Ray Sigorta, was identified as the compromise solution since both conditions were met. In 2018, Ray Sigorta was identified as the compromise solution since both conditions were met. In 2019, Ray Sigorta was identified as the compromise solution since both conditions were met. In 2020, Aksigorta was identified as the compromise solution since both conditions were met. In 2021, Aksigorta was identified as the compromise solution since both conditions were met. In 2022, the two alternatives with the best consensus criterion values, Ray Sigorta and Agesa Hayat Emeklilik, are the best solution since only condition 1 was met.

According to the alternative ranking obtained by the VIKOR method when the leverage ratio is considered to be minimum, Ziraat Sigorta and Aksigorta, which are the two alternatives with the best consensus criterion value, were determined as the best compromise solution since only Condition 1 was met in 2013, Ziraat Sigorta and Aksigorta, which are

the two alternatives with the best consensus criterion value, were determined as the best compromise solution since only Condition 1 was met in 2014. In 2015, Ziraat Sigorta and Anadolu Sigorta, the two alternatives with the best consensus criterion value, were determined the best compromise solution since only Condition 1 was met; in 2016, Ziraat Sigorta and Ray Sigorta, the two alternatives with the best consensus criterion value, were determined as the best compromise solution since only Condition 1 was met; in 2017, Ziraat Sigorta and Aksigorta, the two alternatives with the best consensus criterion value, were determined as the best compromise solution since only Condition 1 was met; in 2018, Ziraat Sigorta and Ray Sigorta, the two alternatives with the best consensus criterion value, were determined as the best compromise solution since only Condition 1 was met; in 2019, Ziraat Sigorta and Aksigorta, the two alternatives with the best consensus criterion value, were determined as the best compromise solution since only Condition 1 was met; in 2020, Türkiye Sigorta and Aksigorta, the two alternatives with the best consensus criterion value, were determined as the best compromise solution since only Condition 1 was met, in 2021, Türkiye Sigorta and Aksigorta, the two alternatives with the best consensus criterion value, were determined as the best compromise solution, since only Condition 1 was met, in 2022, Ray Sigorta and Agesa Hayat Emeklilik, the two alternatives with the best consensus criterion value, were determined as the best compromise solution, since only Condition 1 was met.

4.3. MOORA (Multi-Objective Optimization based on Ratio Analysis)

The MOORA method, developed by Brauers and Zavadskas (2006), has gained significant traction recently. This method offers a holistic approach, considering all interactions between decision options and criteria, and performs weighted normalisation with objective weighted values. It is one of the most reliable Weighted Multiplication and TOPSIS methods, preferred over AHP and TOPSIS due to its uncomplicated application, minimal calculation time, and fewer mathematical operations. Unlike AHP, which is applied to qualitative data, MOORA is designed explicitly for quantitative data (Ankara Üniversitesi, 2024).

By differentiating the process steps of MOORA, an MCDM method based on proportional analysis,

- ✓ MOORA- Ratio
- ✓ MOORA- Reference Point
- ✓ MOORA- Importance Coefficient
- ✓ MOORA- Exact Product Form

methods have been developed under the headings.

MOORA-Ratio Approach Operations are carried out assuming the criteria have equal importance values.

The algorithmic steps of the MOORA-Ratio method are as follows.

Step 1. Decision Matrix (X) is Created

At the start of the MOORA method, decision-makers create a decision matrix. This matrix, with decision options in the rows and criteria in the columns, serves as the foundation for the subsequent steps of the method.

$$X_{ij} = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1m} \\ x_{21} & x_{22} & \dots & x_{2m} \\ \dots & \dots & \dots & \dots \\ x_{n1} & x_{n2} & \dots & x_{nm} \end{bmatrix} \tag{11}$$

The MOORA method started by creating a decision matrix. The insurance companies and years of performance analysis were placed in the rows, and the criteria to be evaluated were placed in the columns. The decision matrix created with the data to be analysed for performance analysis is given in Table 19.

Table: 19
Decision Matrix

Decision Matrix	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
Anadolu Sigorta	2022	1,162	0,147	0,814	1,057	6,184	6,184	0,044	0,275	0,049	0,090	1,794	0,341	0,499	1,348	0,673	0,366	1,100	0,101
Türkiye Sigorta	2022	1,129	0,067	0,777	1,140	4,787	4,787	0,022	0,106	0,018	0,052	1,153	0,261	0,346	1,329	0,520	0,250	0,974	0,042
Anadolu Hayat Emeklilik	2022	1,038	0,050	0,960	1,004	26,155	26,155	0,015	0,380	0,006	0,084	2,495	0,100	0,111	1,939	0,042	0,035	0,351	0,006
Aksigorta	2022	1,155	0,109	0,832	1,041	6,583	6,583	-0,009	-0,062	-0,006	-0,011	1,362	0,233	0,298	1,351	-0,516	0,383	1,669	0,086
Agesa Hayat Emeklilik	2022	6,339	48,742	0,020	7,850	50,762	50,762	0,010	0,507	0,002	0,020	0,099	2,437	0,107	1,852	0,066	0,040	0,408	0,007
Ray Sigorta	2022	1,138	0,200	0,804	1,094	6,109	6,109	0,033	0,202	0,047	0,153	0,527	0,107	0,116	0,959	0,354	0,273	2,637	0,035

Step 2. The Decision Matrix is Normalised

When creating the normalized decision matrix (N), regardless of the minimum or maximum objective in the criteria

$$x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^n x_{ij}^2}} \text{, i=1, 2, …, n, j=1, 2, …, m} \tag{12}$$

According to equation (12), the decision matrix X is normalised. The normalised decision matrix is given in Table 20.

Table: 20
Normalised Decision Matrix

Normalised Decision Matrix	Years	C1	K1	K2	K3	K4	K5	P1	P2	P3	P4	M1	M2	M3	M4	M5	G1	G2	G3
Anadolu Sigorta	2022	0,097	0,003	0,194	0,080	0,061	0,061	0,388	0,195	0,418	0,231	0,241	0,098	0,338	0,154	0,591	0,272	0,154	0,363
Türkiye Sigorta	2022	0,094	0,001	0,185	0,086	0,048	0,048	0,193	0,075	0,157	0,134	0,155	0,075	0,234	0,151	0,457	0,186	0,136	0,152
Anadolu Hayat Emeklilik	2022	0,087	0,001	0,228	0,076	0,260	0,260	0,127	0,270	0,054	0,216	0,336	0,029	0,075	0,221	0,037	0,026	0,049	0,021
Aksigorta	2022	0,097	0,002	0,198	0,079	0,065	0,065	-0,082	-0,044	-0,048	-0,028	0,183	0,067	0,202	0,154	-0,453	0,284	0,234	0,310
Agesa Hayat Emeklilik	2022	0,530	0,988	0,005	0,595	0,505	0,505	0,087	0,360	0,013	0,053	0,013	0,700	0,073	0,211	0,058	0,029	0,057	0,026
Ray Sigorta	2022	0,095	0,004	0,191	0,083	0,061	0,061	0,288	0,143	0,407	0,395	0,071	0,031	0,078	0,109	0,311	0,203	0,369	0,127

Step 3. Calculate the Performance of the Decision Options

By subtracting the sum of minimization-oriented performance values from the normalized sum of maximization-oriented performance values

$$y_i^* = \sum_{j=1}^{g} x_{ij}^* - \sum_{j=g+1}^{n} x_{ij}^*, \quad i=1, 2, \ldots, n \tag{13}$$

The performance of each decision option is determined according to the criteria defined in equation (13). Here, g and n-g denote the number of criteria to be maximised and minimised, respectively. y_i^*, i=1, 2, ..., *n* denotes the normalised values of decision option *i* for all criteria. The performances of the decision criteria are calculated after evaluating the leverage ratios as maximum and minimum and given in Table 21.

Table: 21
Decision Criteria Performance

Companies	Years	Maximising Leverage Ratios Y*i	Considering Leverage Ratios as a Minimum Y*i
Anadolu Sigorta	2022	1,096	0,297
Türkiye Sigorta	2022	0,424	-0,312
Anadolu Hayat Emeklilik	2022	0,977	-0,674
Aksigorta	2022	0,978	0,159
Agesa Hayat Emeklilik	2022	2,698	-2,498
Ray Sigorta	2022	1,827	1,028

Step 4. y_i^*, *i*=1, 2, ..., n, values are Sorted from Largest to Smallest

The first-ranked option is the most suitable in this ranking. The performance ranking obtained with the MOORA method is given in Table 22.

Table: 22
Financial Performance Ranking by Years

Companies	Years	Maximising Leverage Ratios Y*i	Best	Considering Leverage Ratios as a Minimum Y*i	Best
Agesa Hayat Emeklilik	2022	2,698	1	-2,498	6
Ray Sigorta	2022	1,827	2	1,028	1
Anadolu Sigorta	2022	1,096	3	0,297	2
Aksigorta	2022	0,978	4	0,159	3
Anadolu Hayat Emeklilik	2022	0,977	5	-0,674	5
Türkiye Sigorta	2022	0,424	6	-0,312	4

According to the MOORA performance ranking, when the leverage ratios are evaluated as maximum, Ziraat Sigorta in 2013, Agesa Hayat Emeklilik in 2014, Ziraat Sigorta in 2015, Agesa Hayat Emeklilik in 2016, Agesa Hayat Emeklilik in 2016, Agesa Hayat Emeklilik in 2017, Agesa Hayat Emeklilik in 2018, Agesa Hayat Emeklilik in 2019, Agesa Hayat Emeklilik in 2020, Agesa Hayat Emeklilik in 2021, Agesa Hayat Emeklilik in 2022 were determined to be the most suitable companies.

According to the MOORA performance ranking, when the leverage ratios are evaluated as minimum, Ziraat Sigorta in 2013, Ziraat Sigorta in 2014, Ziraat Sigorta in 2015, Ziraat Sigorta in 2016, Ziraat Sigorta in 2017, Ziraat Sigorta in 2018, Ziraat Sigorta in 2019, Türkiye Sigorta in 2020, Türkiye Sigorta in 2021, and Ray Sigorta in 2022 were determined to be the most suitable companies.

4.4. Comparison of Financial Performance Analysis with TOPSIS, VIKOR and MOORA Methods

The financial data of the companies traded in the insurance index of BIST-500 for 2013-2022 are analysed by TOPSIS, VIKOR, and MOORA methods, and the rankings obtained are given in Table 23.

Table: 23
Performance Ranking by TOPSIS, VIKOR and MOORA

Companies	Years	Ranking with Maximum Leverage Ratios			Ranking with Minimum Leverage Ratios		
		TOPSIS	VIKOR	MOORA	TOPSIS	VIKOR	MOORA
Agesa Hayat Emeklilik	2013	1	7	3	8	7	8
Anadolu Hayat Emeklilik	2013	2	6	2	7	8	7
Ziraat Sigorta	2013	3	2	1	1	1	1
Aksigorta	2013	4	5	4	3	2	2
Halk Sigorta	2013	5	3	5	2	3	3
Anadolu Sigorta	2013	6	4	6	4	4	4
Ray Sigorta	2013	7	1	7	5	5	5
Güneş Sigorta	2013	8	8	8	6	6	6
Agesa Hayat Emeklilik	2014	1	3	1	8	8	8
Ziraat Sigorta	2014	2	2	2	1	1	1
Aksigorta	2014	3	1	3	2	2	2
Halk Sigorta	2014	4	4	4	3	3	3
Anadolu Sigorta	2014	5	5	5	4	4	4
Anadolu Hayat Emeklilik	2014	6	6	6	7	7	7
Güneş Sigorta	2014	7	7	7	6	5	6
Ray Sigorta	2014	8	8	8	5	6	5
Ziraat Sigorta	2015	1	2	1	1	1	1
Anadolu Sigorta	2015	2	3	2	2	2	2
Anadolu Hayat Emeklilik	2015	3	6	3	3	6	3
Agesa Hayat Emeklilik	2015	4	4	4	4	8	4
Halk Sigorta	2015	5	5	5	5	4	5
Ray Sigorta	2015	6	1	6	6	3	6
Aksigorta	2015	7	7	7	7	5	7
Güneş Sigorta	2015	8	8	8	8	7	8
Agesa Hayat Emeklilik	2016	1	3	1	8	8	8
Ziraat Sigorta	2016	2	2	2	1	1	1
Ray Sigorta	2016	3	1	3	2	2	2
Anadolu Hayat Emeklilik	2016	4	7	5	5	6	6
Aksigorta	2016	5	5	4	3	4	3
Halk Sigorta	2016	6	6	7	6	5	5
Anadolu Sigorta	2016	7	4	6	4	3	4
Güneş Sigorta	2016	8	8	8	7	7	7
Agesa Hayat Emeklilik	2017	1	4	1	8	8	8
Ziraat Sigorta	2017	2	2	2	1	1	1
Aksigorta	2017	3	3	3	2	2	2
Anadolu Hayat Emeklilik	2017	4	5	4	6	7	7
Ray Sigorta	2017	5	1	5	3	3	3
Halk Sigorta	2017	6	6	8	7	5	6
Güneş Sigorta	2017	7	7	7	5	4	5
Anadolu Sigorta	2017	8	8	6	4	6	4
Agesa Hayat Emeklilik	2018	1	3	1	8	8	8
Ziraat Sigorta	2018	2	2	2	1	1	1
Aksigorta	2018	3	4	3	2	3	2
Anadolu Hayat Emeklilik	2018	4	5	4	7	6	7
Anadolu Sigorta	2018	5	6	6	3	7	4
Ray Sigorta	2018	6	1	5	5	2	3
Halk Sigorta	2018	7	7	7	6	5	6
Güneş Sigorta	2018	8	8	8	4	4	5

Agesa Hayat Emeklilik	2019	1	4	1	8	8	8
Ziraat Sigorta	2019	2	3	2	1	1	1
Anadolu Hayat Emeklilik	2019	3	6	5	7	7	7
Aksigorta	2019	4	2	3	2	2	2
Ray Sigorta	2019	5	1	4	3	3	3
Halk Sigorta	2019	6	5	6	5	4	5
Güneş Sigorta	2019	7	7	7	4	5	4
Anadolu Sigorta	2019	8	8	8	6	6	6
Agesa Hayat Emeklilik	2020	1	4	1	6	6	6
Türkiye Sigorta	2020	2	3	3	1	1	1
Aksigorta	2020	3	1	2	2	2	2
Anadolu Hayat Emeklilik	2020	4	5	5	5	5	5
Ray Sigorta	2020	5	2	4	3	3	3
Anadolu Sigorta	2020	6	6	6	4	4	4
Agesa Hayat Emeklilik	2021	1	3	1	6	6	6
Türkiye Sigorta	2021	2	2	2	1	1	1
Anadolu Hayat Emeklilik	2021	3	6	5	5	5	5
Ray Sigorta	2021	4	4	3	2	3	2
Aksigorta	2021	5	1	4	3	2	3
Anadolu Sigorta	2021	6	5	6	4	4	4
Agesa Hayat Emeklilik	2022	1	2	1	6	2	6
Aksigorta	2022	2	4	4	2	4	3
Ray Sigorta	2022	3	1	2	1	1	1
Anadolu Hayat Emeklilik	2022	4	5	5	3	5	5
Anadolu Sigorta	2022	5	3	3	4	3	2
Türkiye Sigorta	2022	6	6	6	5	6	4

When the data in Table 23 are analysed, it is seen that when the leverage ratios are considered maximum, the ranking of the companies is more different among TOPSIS, VIKOR, and MOORA methods, while when the leverage ratios are considered minimum, the ranking of the companies is similar among TOPSIS, VIKOR, and MOORA methods.

5. Conclusion and Evaluation

People face decision problems in all areas of life, and managers face decision problems in all management functions. Solving these problems has become very difficult today. Decision-making is complicated by the many alternatives and often conflicting criteria used to evaluate these alternatives.

This is why a field of academic research and practice that provides decision-makers with methods to deal with these challenges has emerged and developed rapidly in recent years. Many techniques belonging to this field have been developed and made available to decision-makers or managers who face such problems. The methods created in this rapidly developing field are called Multi-Criteria Decision-Making.

This study used TOPSIS, VIKOR, and MOORA, which are multi-criteria decision-making methods, to analyse the financial performance of the companies traded in the insurance index in BIST-500 for 2013-2022 and obtain their performance rankings. The analyses calculated leverage ratios in two ways: maximum and minimum.

According to the results of the analysis made with TOPSIS, VIKOR and MOORA methods, when the leverage ratios are set as maximum, Agesa Hayat ve Emeklilik in 2013,

2014, 2016, 2017, 2018, 2019, 2020, 2021 and 2022 and Ziraat Sigorta in 2015 were the most successful companies in terms of financial performance according to TOPSIS method. According to the VIKOR method, Ray Sigorta in 2013, 2015, 2016, 2017, 2018, 2019 and 2022 and Aksigorta in 2014, 2020 and 2021 were the most successful companies in terms of financial performance. According to the MOORA method, Ziraat Sigorta in 2013 and 2015 and Agesa Hayat ve Emeklilik in 2014, 2016, 2017, 2018, 2019, 2020, 2021 and 2022 were the most successful companies in terms of financial performance.

According to the results of the analysis made with TOPSIS, VIKOR and MOORA methods, when the leverage ratios were determined as a minimum, Ziraat Sigorta in 2013, 2014, 2015, 2016, 2017, 2018 and 2019, Türkiye Sigorta in 2020 and 2021, and Ray Sigorta in 2022 were the most successful companies in terms of financial performance according to TOPSIS method. According to the VIKOR method, Ziraat Sigorta in 2013, 2014, 2015, 2016, 2017, 2018 and 2019, Türkiye Sigorta in 2020 and 2021, and Ray Sigorta in 2022 were the most successful companies in terms of financial performance. According to the MOORA method, Ziraat Sigorta in 2013, 2014, 2015, 2016, 2017, 2018 and 2019, Türkiye Sigorta in 2020 and 2021, and Ray Sigorta in 2022 were the most successful companies in terms of financial performance.

The study obtained 74 financial performance rankings by analysing 10-period data of 8 companies using three methods, according to 18 criteria and two different leverage values.

According to the ranking of TOPSIS, VIKOR, and MOORA methods, when the leverage ratios were evaluated as maximum, no period gave the same result for all three methods. When the leverage ratios are evaluated as minimum, Ziraat Sigorta, Anadolu Sigorta, Ray Sigorta and Güneş Sigorta in 2013, Ziraat Sigorta, Agesa Hayat ve Emeklilik, Aksigorta, Anadolu Sigorta, Halk Sigorta and Anadolu Hayat ve Emeklilik in 2014, Ziraat Sigorta and Anadolu Sigorta in 2015, Agesa Hayat ve Emeklilik, Ziraat Sigorta, Ray Sigorta and Güneş Sigorta in 2016, and Agesa Hayat ve Emeklilik in 2017, Ziraat Sigorta and Aksigorta; Agesa Hayat ve Emeklilik and Ziraat Sigorta in 2018; Agesa Hayat ve Emeklilik, Ziraat Sigorta, Anadolu Hayat ve Emeklilik, Aksigorta and Ray Sigorta in 2019; Agesa Hayat ve Emeklilik, Türkiye Sigorta, Aksigorta, Anadolu Hayat ve Emeklilik, Ray Sigorta and Anadolu Sigorta in 2020; Agesa Hayat ve Emeklilik, Türkiye Sigorta, Aksigorta, Anadolu Hayat ve Emeklilik, Ray Sigorta and Anadolu Sigorta in 2021; Türkiye Sigorta, Anadolu Hayat ve Emeklilik, Anadolu Hayat ve Emeklilik and Anadolu Sigorta in 2021; and Ray Sigorta in 2022 achieved the same result in all three methods.

According to the financial performance ranking based on TOPSIS, VIKOR, and MOORA methods, the results show differences when the leverage ratio is considered maximum. The results are similar when the leverage ratio is evaluated as a minimum. No company achieved the best and worst performance ranking in the periods assessed.

When the first research question of the study is evaluated, it is seen that the MCDM methods used in analysing insurance companies give different results.

When the second of the study's research questions is evaluated, it is seen that the criteria weights used in the financial performance analysis of insurance companies are given equally, which affects the MCDM methods used to provide different results.

Doğu (2021) analysed the financial performance of BIST-100 insurance sector companies in 2019 with TOPSIS and VIKOR methods. According to the analysis results, Aksigorta achieved the best financial performance using the TOPSIS method, and Anadolu Sigorta achieved the best financial performance using the VIKOR method. When we compared our study with the study of Doğu (2021), it was understood that the criteria weights were given equally in the two studies, but the results differed. The difference is related to the scarcity and diversity of requirements used in financial performance analysis.

Gülcemal, İzci & Taşcı (2023) analysed the financial performance of BIST-100 insurance sector companies for the years 2020-2021 by determining the weights of the criteria with the CRITIC method and analysing the financial performance with the COCOSO method. According to the analysis, it was understood that Türkiye Insurance achieved the best financial performance in 2020 and 2021. Comparing our study with the studies of Gülcemal, İzci & Taşcı (2023), it is understood that our study gives the same results as the analysis in which leverage ratios are evaluated as minimum. Gülcemal, İzci & Taşcı (2023) studies have shown different results with the analysis in our research where leverage ratios are evaluated as maximum.

Studies conducted using three methods, TOPSIS, VIKOR, and MOORA methods, 18 criteria, and two evaluations are scarce in the literature. Generally, studies are performed using two methods and fewer criteria. For this reason, this study differs from the other studies in the literature regarding the diversity of criteria and the use of MCDM methods, setting an example for those conducting academic studies and providing information about the company to decision-makers and investors from a single place.

Since analysing the financial performance of insurance sector companies according to the weighting of the criteria to be used in the analysis will change financial performance rankings, it is recommended that in future studies, the criteria to be used in the financial performance evaluation of insurance companies should be weighted first with MCDM methods and then evaluated using MCDM methods.

It is recommended that the relationship between financial performance and share values be investigated by determining the share values of the same companies for the same periods, with a new study for the 2013-2022 periods in which we analysed the financial performance of BIST-500 insurance sector companies.

This study, carried out using MCDM methods, will serve as a guideline for investors and managers regarding the analysed periods and will be an example for future studies.

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