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# Measuring the Financial Performance of Reinsurance Companies in Türkiye with LODECI, CRADIS and AROMAN MCDM Methods

*LODECI, CRADIS ve AROMAN ÇKKV Yöntemleri ile Türkiye’de Reasürans Şirketlerinin Finansal Performansının Ölçülmesi*

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## ABSTRACT

### Keywords:

Insurance,

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### Jel Codes:

C61, E60, G22

This study aims to measure and evaluate the financial performance of four reinsurance companies operating in Türkiye between 2022 and 2023 using the LODECI, CRADIS, and AROMAN decision models. In the study, the LODECI procedure was used to calculate the objective weight coefficients of ten performance evaluation indicators considered. Subsequently, the financial performance of the reinsurance companies over the years was assessed using the CRADIS and AROMAN procedures. The results obtained from the weighting procedures indicate that the conservation ratio is the most influential criterion on financial performance, whereas the active profitability ratio has been found to have the least effect. The CRADIS and AROMAN ranking procedures show that the performance rankings for 2022 and 2023 are as follows; Türk Reasürans, Türk Katılım Reasürans, Milli Reasürans, and VHV Reasürans. Moreover, the sensitivity analysis, carried out using 100 different scenarios to test the consistency of the findings from the proposed model, confirms that the current models produce robust and consistent results.

## ÖZET

### Anahtar Kelimeler:

Sigorta,

Reasürans,

Finansal Performans,

ÇKKV

### Jel Kodları:

C61, E60, G22

Bu çalışmanın amacı, Türkiye’de faaliyet gösteren dört reasürans şirketinin 2022-2023 yılları arasındaki finansal performansının LODECI, CRADIS ve AROMAN karar modeli kullanılarak ölçülmesi ve değerlendirilmesidir. Çalışmada dikkate alınan on adet performans değerlendirme göstergelerinin objektif ağırlık katsayılarının hesaplanmasında LODECI prosedürü kullanılmıştır. Daha sonra, reasürans şirketlerinin yıllara ilişkin finansal performansları CRADIS ve AROMAN prosedürü vasıtasıyla değerlendirilmiştir. Ağırlıklandırma prosedürlerinin uygulanmasından elde edilen sonuçlar göstermektedir ki konservasyon oranı finansal performans üzerinde etkili olan en önemli kriterdir. Bununla beraber aktif kârlılık oranı ise performans üzerinde en az etkiye sahip kriter olduğu tespit edilmiştir. CRADIS ve AROMAN sıralama prosedürleri, 2022 ve 2023 yıllarında performans sıralamalarının Türk Reasürans, Türk Katılım Reasürans, Milli Reasürans ve VHV Reasürans şeklinde olduğunu göstermektedir. Ayrıca, önerilen modelden elde edilen bulguların tutarlılığını test etmek amacıyla 100 farklı senaryo kullanılarak gerçekleştirilen duyarlılık analizi sonuçları mevcut modellerin sağlam ve tutarlı sonuçlar ürettiğini teyit etmektedir.

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## 1. INTRODUCTION

The main function of insurance in an economy is to manage risks arising from nature or related to human life. To support this, the insurance system fulfils the functions of collecting resources and transferring these resources in various ways (Kartasheva, 2014: 1). Insurance companies, which undertake the carriage of various risks of individuals and institutions in return for a certain premium, face the risk that the risks they guarantee may occur simultaneously and widely. However, it is not possible for insurance companies to guarantee all kinds of risks in terms of their technical and financial obligations. The reinsurance function is one of the most important elements that make it possible to manage these fundamental risks, which are vital for the financial system and economic life. With this reinsurance support, insurance companies can provide coverage to policies far exceeding their risk acceptance capacity and realize rapid claim payments (Ayan, 2020: 1004; Özcan & Yıldırım, 2021: 2).

Reinsurance aims to transfer the risks carried by insurance companies to national or international reinsurance companies, thus increasing the total risk capacity they can undertake, protecting the financial balance of the company and increasing its financial strength (Özdemir, 2022: 264). In other words, it is the partial or complete transfer of the insurance amount remaining from the retention shares determined by the insurance companies according to the technical structure of the risk and their financial possibilities from the risks they have taken on by insuring them to one or more other insurers or to reinsurance companies established exclusively for this business (Özer, 2014: 304; Özkan, 2015: 210). As stated, the primary purpose of reinsurance is to spread the risk of loss. In this way, the risks of losses that may lead the insurance company to bankruptcy are spread to the reinsurance company. Secondly, the reinsurance system enables the insurance company to accept risks that may be beyond its capacity and to transfer part of the risk to the reinsurance company. Reinsurance frees up capital reserves by allowing them to be treated as an asset in the financial statements of the insurance company, which in turn reduces the statutory reserve requirement. Thus, the insurance company has more capital and can use this capital in investments or insure more and different types of risks. This system encourages small insurance companies to compete with larger insurers. As a result, reinsurance creates more underwriting opportunities for insurance companies, enabling them to accept a wider range of risks and to offer higher policy limits on the risks they accept (Thomas, 1992: 1549).

As of the end of 2023, a total of 72 companies were operating in the insurance and private pension sector in Türkiye, of which 50 were non-life insurance companies, 3 were exclusively life insurance companies, 15 were pension companies and 4 were reinsurance companies. The total assets of the insurance and private pension sector, which has a 5.3% share in the financial sector, increased by 88% to TL 1,471 billion as of the end of 2023 compared to the end of the previous year. The sector also stands out in premium production. In 2023, the premium production of the sector increased by 106% compared to the previous year and reached TL 483 billion. The share of premium production in GDP was 1.8%. TL 57 billion of the production was realized in the life branch and TL 426 billion in non-life branches. As of year-end 2023, reinsurance companies' premium production increased by 124% year-on-year to TL 22 billion (SEDDK, 2023: 5-16).

**Table 1.** Financial Indicators (TL Billion)

	2019	2020	2021	2022	2023	2022-2023 Change (%)
<b>Panel 1: Asset Size</b>						
HD insurance companies	77	96	125	248	507	104
H/E insurance companies	154	205	294	514	920	79
Insurance companies total	232	301	419	762	1,472	87
Reinsurance companies	5	7	10	19	44	132
Insurance sector total	237	308	429	781	1,471	88
Financial sector	5,028	6,795	10,271	16,540	27,752	68
Insurance sector share (%)	4.71	4.53	4.18	4.72	5.30	12
<b>Panel 2: Financial Indicators Specific to Reinsurance Companies</b>						
Asset size/Financial sector (% share)	0.099	0.103	0.097	0.114	0.158	38
Shareholders' Equity	2.4	3.2	4.1	8	14	75
Technical profit	0.1	0.2	0.5	1	1.6	60
Balance sheet profit	0.3	0.5	0.8	1.6	5	212.5

**Source:** (SEDDK, 2023: 13-16). **Note:** HD stands for non-life insurance companies; H/E stands for life insurance and pension companies. Some data in the table are based on the authors' calculations from the relevant source.

To summarize the information specific to the reinsurance system in the light of the information presented in Table 1, reinsurance companies, which have a small share in the Türkiye financial system, received a share of approximately 0.1% in 2019 in terms of asset size, while this ratio increased to 0.15% in 2023. It is seen that the sector increased its asset size by approximately 50% between 2019 and 2023. Although the share of the reinsurance system in the financial system is very low in Türkiye, the joint risk management practices established with insurance companies are of vital importance for a country's economy. Considering the progress made by the sector in terms of asset size, shareholders' equity, technical profit and balance sheet profit in the 2019-2023 period, it is thought that the state-owned companies Türk Reasürans and Türk Katılım Reasürans, which have entered the sector in recent years, have played an important role in this development. At the point where reinsurance companies have reached in terms of both company and financial indicators, the financial performance of these companies is of vital importance for the sustainability of the insurance sector and the overall economic system. The strong financial structure of these companies can support the resilience of the insurance sector to shocks, such as large-scale natural disasters or economic crises. In addition, strong financial performance increases the capacity of reinsurance companies to fulfil their obligations and may instill confidence in the market. Thus, the effectiveness of risk management in the country can be increased by contributing to the stability of both insurance companies and the economy in general.

In this framework, the aim of this study is to analyze the financial performance of four reinsurance companies operating in Türkiye with annual data for the period 2022-2023 using LODECI-based CRADIS and AROMAN hybrid MCDM (Multi Criteria Decision Making) methods.

The decision-making process used in the application of this research is a mentally complex process, but it is a problem-solving program that aims to reach a desired result by considering different aspects. This process may be rational or irrational, and on the other hand, it may contain implicit or explicit assumptions influenced by various factors such as physiological, biological, cultural and social. All these aspects can influence the levels of authority and risk and the level of complexity of the decision-making process. Nowadays, complex decision-making problems can be solved using mathematical equations, multiple statistics, mathematics, economic theories and computer devices that help to automatically calculate and predict the solutions to these problems (Taherdoost & Madanchian, 2023: 77). In this framework, in recent years, MCDM methods have enabled the measurement of financial performance in a sound manner. These methods make financial decision processes more objective and transparent by balancing between different alternatives and criteria. In this way, it is possible to analyze the financial position of companies more accurately and to make strategic decisions.

The following comments can be made about the originality of this research and the motivation for writing it. Firstly, with the entry of state-owned reinsurance companies into the reinsurance market in Türkiye in recent years, competition has moved to a different dimension and the number of companies has increased from two (Milli Reasürans and VHV Reasürans) to four (Türk Reasürans and Türk Katılım Reasürans). A review of the relevant literature reveals that there is no financial performance study based on four reinsurance companies and this study is written with this main motivation. Although there is a very limited number of studies on the financial performance of reinsurance companies in Türkiye (Yılmaz, 2021a; Yılmaz, 2021b; Taşcı, 2024a), there is a similar situation in the international literature (Bawa & Verma, 2017; Mukherjee et al., 2020). Secondly, it is the application of MCDM methods in this study, which contain the methods that are closest to producing objective and healthy results in revealing the financial performance of companies. Although financial performance has been analyzed with MCDM methods as in Yılmaz (2021a), Yılmaz (2021b) and Taşcı (2024b), in this study, the methods developed in recent years and up-to-date methods were used. LODECI (Logarithmic DEcomposition of Criteria Importance) developed by Pala (2024a) was used to determine the importance level of the criteria; CRADIS (Compromise Ranking of Alternatives from Distance to Ideal Solution) developed by Puška et al. (2022a) and AROMAN (Alternative Ranking Order Method Accounting for Two-Step Normalization) developed by Bošković et al. (2023a) were used to rank the performance of alternatives. The LODECI-based CRADIS and AROMAN hybrid MCDM model has been applied for the first time in financial performance measurement. The LODECI method offers flexibility, efficiency and accuracy in solving nonlinear systems. This method is a powerful tool for numerical analysis, especially for complex problems that are difficult to solve analytically. CRADIS method offers advantages such as simplicity, flexibility, consistency and fast results in multi-criteria decision-making processes. This method has become popular especially because it produces balanced and reliable solutions in complex problems. The AROMAN method offers a systematic, flexible, transparent and objective approach to MCDM problems. These characteristics make the method an effective and reliable tool in complex decision problems. Finally, the criteria used to measure financial performance in the study are the most frequently used criteria by the practitioners in the sector, although they are sufficient and standardized criteria that can reveal

the financial health of a reinsurance company. All these reasons make this research different and unique from the previous ones and it is thought that it will enrich literature.

The other stages of the research are designed as follows. After the introduction, the relevant literature review, the methods used in the research and the application process are detailed. The research is completed with the conclusion and evaluation phase.

## 2. LITERATURE REVIEW

In the literature, there is a very limited number of studies addressing the financial performance of reinsurance companies with various methods. Ndirangu (2014), one of the examples of research on Kenya from African countries, analyzed the impact of exchange rate risk management practices on the financial performance of reinsurance companies. The research was conducted with primary data obtained through a questionnaire and secondary data obtained from the financial reports of the companies for the years 2008-2012. The data were analyzed by multiple regression methods. The research findings revealed that the ratio of foreign currency profits to total profits and the use of operational hedging are critical variables to improve financial performance for managers aiming at shareholder value maximization. Muchiri & Njoka (2021) examined how the financial performance of 7 reinsurance companies operating in Kenya is affected by the corporate governance practices of the companies using the regression analysis method with data for the period 2013-2017. The concept of corporate governance is measured in terms of board size, board composition, board independence and duality of the CEO. The research findings reveal that board size and composition have a positive and significant relationship with the financial performance of companies. In addition, the study also revealed that there is a positive and significant relationship between board independence and financial performance measures such as return on assets. Olarewaju & Msomi (2022) examined the profitability of 42 reinsurance companies operating in Sub-Saharan African countries using the generalized method of moments with data for the period 1991-2020. In the study, it is argued that reinsurance companies should expand their services and achieve premium growth to sustain their profitability, and it is determined that factors such as GDP, competition, premium growth, investment performance, underwriting risk and operational efficiency affect the profitability of companies.

Bawa & Verma (2017), one of the examples of research on the financial performance of General Insurance Corporation of India Reinsurance (GIC RE), which has a very prominent position in the Indian insurance market and dominates the Indian reinsurance market, conducted a financial performance analysis with the ratios obtained from the annual reports of the company with data for the period 2006-2015. CAMELS (capital adequacy, asset quality, reinsurance and actuarial issues, management soundness, income/profitability, liquidity and sensitivity to market risk) model was used in the research. According to the findings of the research, the company has performed well over the years; however, improvements in the combined ratio and liquidity would be beneficial. In another study on GIC RE, Mukherjee et al. (2020) examined the financial performance of this company in four different ways with data for the period 2002-2018. Firstly, the financial performance is analyzed by using some financial ratios; secondly, the consistency of different financial performance indicators of the company; thirdly, the internal growth capacity of the company; and finally, the probability of financial distress of the company. The net loss ratio, the ratio of company expenses and underwriting commission to net premium earned, the return on assets ratio, the ratio of net premium to gross premium expressed as risk retention ratio, the ratio of incurred losses and expenses to earned premium expressed as combined ratio were used to measure financial performance. Kendall's Coefficient of Consistency was used to assess the consistency of the company's different financial performance indicators, and the growth rate was used to assess the internal growth capacity. Finally, the probability of financial distress is analyzed with the modified Altman Z-score model, which is a multivariate discriminant analysis method, and Ohlson's O-score model, which is a logit analysis technique. According to the results of the research, it has been determined that the financial performance by years is partially satisfactory and there is no significant consistency between different financial performance indicators. Moreover, while the results confirm that the company does not have the capacity to grow internally, there is a significant likelihood of financial distress soon.

Yılmaz (2021a), one of the rare studies on the financial performance of reinsurance companies in Türkiye, analyzed the financial performance of Milli Reasürans, Türk Reasürans and VHV Reasürans operating in Türkiye between 2018 and 2020 using the Weighted Product Method (WPM). In the study, equity/total assets representing capital adequacy, current assets/total assets and current ratio representing liquidity ratios, financial liabilities/equity and liabilities/equity representing financial structure ratios, return on assets and return on equity representing profitability, and the share of total assets in the insurance market as the sector share were used.

According to the performance results, Milli Reasürans was the most successful company between 2018 and 2020. This company was followed by Türk Reasürans and VHV Reasürans, respectively. The factors that are effective in Milli Re's high performance are high sector share, capital adequacy, profitability and low financial indebtedness. With the same company samples, Yılmaz (2021b) used AHP (Analytical Hierarchy Process) and ELECTRE MCDM methods to analyze financial performance with 2020 data in another study. In the study, equity/total assets, current ratio, return on assets and return on equity ratios were used to represent capital adequacy. According to the weighting findings obtained by the AHP method, the most important criterion affecting the performance of the companies is the return on equity, while the least effective criterion is the current ratio. In ELECTRE findings, Milli Reasürans was the highest performing company in 2020, while the performance of Türk Reasürans and VHV Reasürans was measured at the same level. Taşçı (2024b) analyzed the financial performance of Milli Reasürans, one of the leading companies in the reinsurance market in Türkiye, with the PSI-MEREC-ARAS decision model, which is one of the MCDM methods, using annual data for the period 2015-2022. Liquidity ratio, current ratio, return on equity, return on assets, loss ratio, expense ratio, combined ratio, technical profitability ratio, retention ratio and claim settlement ratio were used in the study. According to PSI and MEREC objective weighting methods, the conservation ratio is the most effective criterion on financial performance, while the technical profitability ratio is the criterion with the least effect on performance. In the ranking made by the ARAS method, the company showed the best performance in 2016 and the worst performance in 2015.

The fact that studies on the financial performance of reinsurance companies are rare shows that there is a lack of research in this field both in the world and in Türkiye. Therefore, it is necessary to analyze the reinsurance market, whose efficiency in the finance sector in Türkiye is increasing day by day, and to make it the subject of academic studies. In this framework, in this study, LODECI, CRADIS and AROMAN MCDM methods, which have been developed in recent years and have very limited use in the literature, have been used to evaluate the financial performance of four reinsurance companies (Milli Reasürans, VHV Reasürans, Türk Reasürans and Türk Katılım Reasürans) operating in 2022-2023.

As stated before, the methods used in this research are the most up-to-date methods used in the weighing of criteria and performance ranking of alternatives developed in recent years. Among these methods, LODECI was introduced by Pala (2024a). Pala (2024a), in the assessment of the social progress of the Member States of the European Union; Pala et al. (2024), in the evaluation of the financial performance of cement companies operating in Borsa Istanbul; Pala (2024b), in the evaluation of social discrimination in OECD countries; Yalçın et al. (2024), commercial insurance selection are some application areas where this method is used. CRADIS, developed by Puška et al. (2022a), has found application in the performance ranking of alternatives in recent years. Puška et al. (2022a), in the assessment and selection of waste incineration plants; Puška et al. (2022b), in the selection of green suppliers in the agricultural sector; Puška et al. (2023), in the selection of electric cars; Starčević et al. (2022), in assessing the impact of foreign direct investments on the sustainability of the economic system; Dordevic et al. (2022), in production optimization; Krishankumar & Ecer (2023), in the selection of IoT service provider for sustainable transportation; Ulutaş et al. (2023), in environmental impact and energy use in production; Keleş (2023), in the assessment of livable power center cities of the G7 countries and Türkiye; Xu et al. (2023), in the assessment of sustainable mountain tourism; Wang et al. (2023), in risk assessment in the energy sector; Altıntaş (2023), in the assessment of the welfare performance of the G7 countries; Taşçı (2024a) used the CRADIS method in the evaluation of the performance of the Doğal Afet Sigortaları Kurumu in Türkiye; Kanmaz & Ertuğrul (2024) used it in the selection of electric vehicles; Asker (2024) used it in the evaluation of the impact of the COVID-19 outbreak on the participation banking sector. Another method used in this study for measuring the performance of alternatives is the AROMAN method developed by Bošković et al. (2023a). It is observed that the AROMAN method is used in the selection of electric vehicles by Bošković et al. (2023a); in the cargo bicycle delivery problem by Bošković et al. (2023b); in the driver selection by Čubranić-Dobrodolac et al. (2023); in the determination of sustainable competitiveness levels by Kara et al. (2024); in the forest fire risk assessment by Pishahang et al. (2023); Şahin Macit (2023) in the evaluation of macroeconomic performances of selected European and Central Asian countries; Bakır & İnce (2024) in the evaluation of passenger satisfaction in airline companies; Özekenci (2024) in the evaluation of the financial and environmental performance of a logistics company; Dündar (2024) in the evaluation of the performances of provinces and some regions in Türkiye in terms of benefiting from entrepreneurship supports.

### 3. METHODOLOGY

In this section, LOCEDI, CRADIS and AROMAN methods used to evaluate the financial success of four reinsurance companies operating in Türkiye according to ten evaluation criteria with the data for the period 2022-2023 are introduced.

#### 3.1. LODECI Method

LODECI as an objective criterion weighting method was proposed by Pala (2024a) to resolve the contradiction between Entropy and MEREC. While Entropy emphasizes a criterion where a few alternatives are significantly superior to others, MEREC focuses on a criterion where a few alternatives are significantly inferior to others. In order to fulfil these two aspects simultaneously, a maximum decomposition approach is applied and evaluated for each alternative according to each criterion. In addition, the use of the logarithmic function in LODECI balances the range of weights on an appropriate scale to avoid the problem of overvaluation of some criteria encountered when using Entropy and MEREC (Pala, 2024a: 3).

The maximum normalization approach proposed for the decision matrix  $= \|x_{ij}\|_{(n \times m)}$  in the MCDM problem can also be used for LODECI as in Equations 1 and 2 (Pala, 2024a):

$$a_{ij} = \frac{x_{ij}}{x_j^{max}} \text{ benefit criteria} \quad (1)$$

$$a_{ij} = 1 - \frac{x_{ij}}{x_j^{max}} \text{ cost criteria} \quad (2)$$

The Discrimination Value (AD) is calculated using  $a_{ij}$  as in Equation 3.

$$AD_{ij} = maks\{|a_{ij} - a_{rj}|\} \quad r \neq i, r = 1, 2, \dots, n \quad (3)$$

Logarithmic AD (LAD) for each criterion is calculated as in Equation 4.

$$LAD_j = \ln \left( 1 + \frac{\sum_{i=1}^n AD_{ij}}{n} \right) \quad (4)$$

The importance levels of the criteria,  $w_j$ , are obtained according to Equation 5.

$$w_j = \frac{LAD_j}{\sum_{j=1}^m LAD_j} \quad (5)$$

#### 3.2. CRADIS Method

The CRADIS (Compromise Ranking of Alternatives from Distance to Ideal Solution) method developed by Puška et al. (2022a) solves the decision problem based on ideal and non-ideal solutions (Starcevic et al., 2022). The process steps of the CRADIS method, which is expressed as a combination of TOPSIS, ARAS and MARCOS methods, are given below (Puška et al., 2022a).

The evaluation criteria in the decision matrix are normalized by Equation (6) and Equation (7) according to their benefit or cost orientation.

$$x_{ij} = \frac{c_{ij}}{c_j^{max}} \text{ for utility-oriented criteria} \quad (6)$$

$$x_{ij} = \frac{c_j^{min}}{c_{ij}} \text{ for cost-oriented criteria} \quad (7)$$

The normalized decision matrix is multiplied by the criteria weight values obtained because of the CRADIS method as shown in Equation (8) to obtain the weighted normalized decision matrix.

$$v_{ij}=x_{ij} \cdot w_j \quad (8)$$

In order to find the ideal solution, the largest value in the weighted decision matrix is determined by Equation (9), while in order to find the non-ideal solution, the smallest value in the weighted decision matrix is determined by Equation (10).

$$t_i=\max(v_{ij}) \quad (9)$$

$$t_{ai}=\min(v_{ij}) \quad (10)$$

The deviations of the decision alternatives from the ideal and non-ideal solution are calculated using Equation (11) and Equation (12), respectively.

$$d^+=t_i-v_{ij} \quad (11)$$

$$d^-=v_{ij}-t_{ai} \quad (12)$$

Then, the ideal and non-ideal deviation degrees of each decision alternative are calculated by means of Equation (13) and Equation (14).

$$s_i^+=\sum_{j=1}^m d^+ \quad (13)$$

$$s_i^-=\sum_{j=1}^m d^- \quad (14)$$

According to the amount of deviation in the optimum alternatives, the utility function for each alternative is calculated by Equation (15) and Equation (16).

$$K_i^+=\frac{s_0^+}{s_i^+} \quad (15)$$

$$K_i^-=\frac{s_i^-}{s_0^-} \quad (16)$$

In the last step of the method, the average deviation of the degree of utility of the decision alternatives ( $Q_i$ ) is calculated by means of Equation (17).

$$Q_i=\frac{K_i^++K_i^-}{2} \quad (17)$$

The decision alternative with the highest value ( $Q_i$ ) among the decision alternatives is considered as the best alternative.

### 3.3. AROMAN Method

AROMAN is a new method developed by Bošković et al. (2023a) in order to solve MCDM problems. The main objective of the method is to provide a more accurate computational approach to decision-making problems by combining linear and vector normalization techniques (Čubranić-Dobrodolac et al., 2023: 11). In practice, the AROMAN method combines the values obtained as a result of two-step normalization with the help of a  $\beta$  parameter (Nikolić et al., 2023: 12). This method offers a practical and powerful alternative ranking opportunity by avoiding complex calculations (Kara et al., 2024: 2).

After the initial decision matrix is constructed, normalization is performed in order to standardize the matrix elements between 0 and 1. In this direction, linear normalization with the help of Equations (18) and (19) is applied for both benefit and cost criteria respectively (Bošković et al., 2023a).



$$t_{ij} = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}} (\text{benefit}) \quad (18)$$

$$t_{ij} = \frac{\max x_{ij} - x_{ij}}{\max x_{ij} - \min x_{ij}} (\text{cost}) \quad (19)$$

With the help of Equations (20) and (21), vector normalization is applied for both benefit and cost criteria respectively.

$$t_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} (\text{benefit}) \quad (20)$$

$$t_{ij} = 1 - \frac{x_{ij}}{\sqrt{\sum_{i=1}^m x_{ij}^2}} (\text{cost}) \quad (21)$$

In this step where the arithmetic mean is used, the matrices obtained as a result of linear and vector normalization are combined with the help of Equation (22).

$$t_{ij}^{norm} = \frac{\beta t_{ij} + (1-\beta) t_{ij}^*}{2}, \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n. \quad (22)$$

Where  $t_{ij}^{norm}$  refers to the combined and averaged normalized matrix and the parameter  $\beta$  represents a weighting factor ranging between 0 and 1. Bošković et al. (2023a) suggested a threshold of 0.5 for the  $\beta$  parameter.

The combined normalized matrix elements are multiplied by the weight coefficient of the relevant criterion using Equation (23).

$$\hat{t}_{ij} = w_{ij} \cdot t_{ij}^{norm}, \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n. \quad (23)$$

The weighted normalized values for the cost type criteria are summed using equation (24) and the weighted normalized values for the benefit type criteria are summed using equation (25).

$$L_i = \sum_{j=1}^n \hat{t}_{ij}^{(min)}, \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n. \quad (24)$$

$$A_i = \sum_{j=1}^n \hat{t}_{ij}^{(mak)}, \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n. \quad (25)$$

In this step, the  $\lambda$  value represents the coefficient degree of the criterion type. In other words, the value of  $\lambda$  can vary according to the benefit-cost criterion ratio in the research. For example, if there are 2 cost and 1 benefit criteria in the decision problem, the value of  $\lambda$  can be used as 2/3 (Bošković et al., 2023b). The related operations are performed using Equations (26) and (27) respectively.

$$L_i^\lambda = L_i^\lambda = \left( \sum_{j=1}^n \hat{t}_{ij}^{(min)} \right)^\lambda, \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n. \quad (26)$$

$$A_i^\lambda = A_i^{1-\lambda} = \left( \sum_{j=1}^n \hat{t}_{ij}^{(mak)} \right)^{1-\lambda}, \quad i = 1, 2, \dots, m; j = 1, 2, \dots, n. \quad (27)$$

Equation (28) is applied to obtain the final ranking ( $R_i$ ) of the alternatives.

$$R_i = L_i^\lambda + A_i^{1-\lambda}, \quad i = 1, 2, \dots, m. \quad (28)$$

The  $R_i$  value reflects the final utility score of the alternatives, with the largest  $R_i$  value indicating the most optimal alternative.

#### 4. RESULTS

In the study, the financial performance analysis of four reinsurance companies listed in Table 2, which operate in the insurance sector in the period 2022-2023 and whose financial indicators can be accessed in this period range, has been carried out.

**Table 2.** Reinsurance Companies Operating in Türkiye

Symbol	Companies
MR	Milli Reasürans Türk A.Ş.
TKR	Türk Katılım Reasürans A.Ş.
TR	Türk Reasürans A.Ş.
VHV	VHV Reasürans A.Ş.

Financial ratios generally used in the insurance sector have been considered in analyzing the financial position of the companies. Financial ratios used in the study were determined in Table 3 because of researching the studies on the reinsurance sector in the literature. The liquidity ratios used assess a company's ability to pay its short-term debts and test whether its working capital is sufficient. The current ratio and acid-test ratio are important liquidity ratios (Akgüç, 2010: 23). The current ratio provides a broad perspective on liquidity and is calculated by dividing current assets by short-term liabilities. The acid-test ratio, on the other hand, examines liquidity in a more stringent manner by excluding certain current assets that take longer to convert to cash and is calculated by dividing liquid assets by short-term liabilities (Okay, 2019: 138). The best indicator of the effective use of equity invested in the company by shareholders is the return on equity ratio, which is also referred to as financial profitability. This ratio is calculated by dividing net income for the period by shareholders' equity. The return on assets ratio examines the profitability resulting from a company's investment in its assets and assesses the effective use of those assets. This ratio is obtained by dividing net income for the period by total assets (Elmas & Ardıç, 2018: 149). The technical profitability ratio, which is found by relating technical profit to earned premiums, measures the profitability obtained from a company's core activities. A high value for this ratio indicates that the company has high technical profitability (Kalaycı & Yılmaz, 2011: 93). The combined ratio expresses the ratio of losses and expenses incurred to earned premiums. This ratio is considered a key indicator of the overall financial performance of a reinsurance company, and a lower ratio indicates better financial performance for the company (Mukherjee et al., 2020: 188). The claim premium ratio is calculated as the ratio of incurred losses to earned premiums for the current period (Sariaslan, 2007: 14). This ratio indicates how much loss has occurred for every 100 units of premium written. A lower claim premium ratio positively impacts the technical profitability of companies (Kalaycı & Yılmaz, 2011: 90). The conservation ratio, which is associated with the risk retention ratio, indicates the risk undertaken by the company, or its risk-bearing capacity. It is calculated as the ratio of Net Premium to Gross Premium. A higher ratio demonstrates that the company has a better risk retention capacity. This suggests that the company relies more on its own resources and is less dependent on external sources (Bawa & Verma, 2017: 49). The expense ratio is calculated by dividing the total expenses of the reinsurance company, including the net commissions paid, by the net premium. This ratio indicates what portion of the net premium is used by the reinsurance company to acquire, write, and service the business obtained from insurance companies. In other words, it is used to assess whether the expenses of the reinsurance company are reasonable (Bawa & Verma, 2017: 48). Finally, the claims payout ratio is a metric that shows the damages incurred and the extent to which the company has paid these claims (Kalaycı & Yılmaz, 2011: 89). The financial indicators presented in Table 3 and the selection of the benefit/cost aspects of these indicators are based on the research conducted by Taşçı (2024b).

**Table 3.** Evaluation Criteria for Reinsurance Companies

Financial Ratios	Symbol	Benefit/Cost
Return on assets ratio	ROA	Maximum
Combined ratio, net	CRNet	Minimum
Current ratio	CR	Maximum
Claim premium ratio, net	CPRNet	Minimum
Conservation ratio	CONR	Maximum
Liquidity ratio (acid-test ratio)	LR	Maximum
Expense ratio, net	ERNet	Minimum
Return on equity ratio	ROE	Maximum
Claims payment ratio	CPAR	Maximum
Technical profitability ratio (Technical department balance/Earned premiums)	TPR	Maximum

The financial ratios for Türk Reasürans, Türk Katılım Reasürans, and Milli Reasürans were obtained directly from the companies' activity reports, while the financial ratios for VHV Reasürans were calculated by the authors using

statistical data from the Türkiye Sigorta Birliği and the company's unconsolidated independent auditor's report. In the selection of the research period, it was important that the Türk Katılım Reasürans started its operations in 2021. The financial performances of the companies for the years 2022-2023, which are the most recent data of the companies during the study, have been evaluated and the results of the 2023 data are given in detail in the method stages. Table 4 shows the decision matrix consisting of financial ratios of reinsurance companies.

**Table 4.** 2022-2023 Decision Matrix

Company	Period	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
MR	2022	7.16	160	101	114	85	131	25	17.58	37	6
	2023	16	155	87	275	79	90	26	35.83	51	2
TKR	2022	0.3	109	393	75	97	194	34	1	57	1
	2023	2.2	108	243	72	90	70	37	15	78	4
TR	2022	15.62	96	384	64	95	211	32	43	66	29
	2023	7.38	100	309	66	90	143	34	45	71	24
VHV	2022	1.82	861.01	138.59	710.6	9.84	128.79	150.41	3.28	30	-266.53
	2023	-0.22	298.11	109.47	272.6	15.13	104.09	25.51	-0.91	26	-40.25

Since it is not appropriate to use the negative values in the decision matrix in the LODECI method, which includes the logarithm process, the Z-score method proposed by Zhang et al. (2014) was used.

$$x_{ij} = \frac{X_{ij} - \bar{X}_j}{S_j} \quad (29)$$

$$x'_{ij} = x_{ij} + A \quad A > |\min x_{ij}| \quad (30)$$

' $x_{ij}$ ' in Equation 29 The transformation of ' $x_{ij}$ ' is realized by subtracting the criterion means from the decision matrix ' $x_{ij}$ ' and dividing by the standard deviation of the criterion. In Equation 30, the process is completed by adding an  $A$  number that will make the values of ' $x'_{ij}$ ' positive. Since there were negative values in all years in the study, all operations were carried out with Z-score-adjusted data. The adjusted decision matrix is presented in Table 5.

**Table 5.** Edited Decision Matrix for 2022-2023

Company	Period	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
MR	2022	1.634	1.104	0.517	1.095	1.819	0.671	0.911	1.570	0.875	1.954
	2023	2.845	1.387	0.559	2.375	1.790	1.117	0.696	2.084	1.263	1.668
TKR	2022	0.643	0.966	2.389	0.970	2.107	2.153	1.061	0.711	2.064	1.918
	2023	0.922	0.875	2.024	0.659	2.096	0.469	2.605	1.077	2.421	1.742
TR	2022	2.857	0.931	2.332	0.935	2.059	2.553	1.028	2.886	2.599	2.119
	2023	1.644	0.788	2.643	0.608	2.096	2.836	2.084	2.528	2.120	2.482
VHV	2022	0.862	2.995	0.758	2.995	0.011	0.619	2.996	0.829	0.459	0.005
	2023	0.585	2.946	0.770	2.355	0.015	1.574	0.611	0.307	0.192	0.104

#### 4.1. LODECI Analysis Findings

The normalized decision matrix obtained for LODECI with the help of Equations 1 and 2 is calculated as shown in Table 6.

**Table 6.** 2023 LODECI Normalized Decision Matrix

Company	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
MR	1.000	0.529	0.211	0.000	0.854	0.394	0.733	0.825	0.522	0.672
TKR	0.324	0.703	0.766	0.723	1.000	0.165	0.000	0.426	1.000	0.702
TR	0.578	0.732	1.000	0.744	1.000	1.000	0.200	1.000	0.876	1.000
VHV	0.206	0.000	0.291	0.009	0.007	0.555	0.766	0.121	0.079	0.042

The DV matrix and LDV values calculated by Equations 3 and 4 are given in Table 7. Accordingly, CONR (Conservation Ratio) provided the highest decomposition. The lowest level of decomposition was obtained with ROA (Return on Assets Ratio).

**Table 7.** 2023 LODECI, DV Matrix and LDV Values

Company	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
MR	0.794	0.529	0.789	0.744	0.847	0.606	0.733	0.703	0.478	0.630
TKR	0.676	0.703	0.554	0.723	0.993	0.835	0.766	0.574	0.921	0.660
TR	0.422	0.732	0.789	0.744	0.993	0.835	0.566	0.879	0.797	0.958
VHV	0.794	0.732	0.709	0.736	0.993	0.445	0.766	0.879	0.921	0.958
LDV	0.514	0.515	0.536	0.552	0.671	0.519	0.535	0.564	0.576	0.589

In Table 8, the criterion importance levels calculated using Equation 5 are given for the years 2022 and 2023.

**Table 8.** LODECI Criteria Importance Weights for 2022-2023

Period	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
2022	0.0922	0.0925	0.1010	0.0925	0.1206	0.0969	0.0927	0.0922	0.0989	0.1206
2023	0.0922	0.0925	0.0963	0.0991	0.1205	0.0931	0.0960	0.1013	0.1034	0.1056

In 2022 and 2023, the prominent criterion is CONR (Conservation Ratio), while the importance of ROA (Return on Assets Ratio) is at the lowest level. In general, the importance levels of criteria in 2022 and 2023 are close to each other.

#### 4.2. CRADIS Analysis Findings

In the study, firstly, the performance ranking of the companies was carried out based on the CRADIS method and using the data in Table 5, the CRADIS normalized decision matrix was obtained according to Equations 6 and 7 as shown in Table 9.

**Table 9.** 2023 CRADIS Normalized Decision Matrix

Company	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
MR	1.000	0.568	0.211	0.256	0.854	0.394	0.878	0.825	0.522	0.672
TKR	0.324	0.900	0.766	0.923	1.000	0.165	0.234	0.426	1.000	0.702
TR	0.578	1.000	1.000	1.000	1.000	1.000	0.293	1.000	0.876	1.000
VHV	0.206	0.268	0.291	0.258	0.007	0.555	1.000	0.121	0.079	0.042

The weighted decision matrix is given in Table 10.

**Table 10.** 2023 CRADIS Weighted Decision Matrix

Company	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
MR	0.092	0.053	0.020	0.025	0.103	0.037	0.084	0.084	0.054	0.071
TKR	0.030	0.083	0.074	0.091	0.120	0.015	0.023	0.043	0.103	0.074
TR	0.053	0.092	0.096	0.099	0.120	0.093	0.028	0.101	0.091	0.106
VHV	0.019	0.025	0.028	0.026	0.001	0.052	0.096	0.012	0.008	0.004

Deviations from ideal and anti-ideal solutions and utility values obtained by CRADIS are calculated as shown in Table 11. Türk Reasürans, which is in a relatively good position in terms of deviations from anti-ideal and ideal solutions, outperformed the other companies in terms of both  $K_i^-$  and  $K_i^+$  values. VHV Reasürans, on the other hand, lagged with the worst performance in terms of both parameters.

**Table 11.** CRADIS 2023 Deviations and Benefit Values from Ideal and Anti-Ideal Solutions

Company	$S_i^+$	$S_i^-$	$K_i^+$	$K_i^-$
MR	0.582	0.614	0.352	0.620
TKR	0.547	0.649	0.374	0.654
TR	0.324	0.872	0.631	0.879
VHV	0.934	0.262	0.219	0.265

The final CRADIS rankings and scores for all years are as shown in Table 12.

**Table 12.** CRADIS Scores of Reinsurance Companies for the Period 2022-2023

Company	2022		2023	
	Score	Rank	Score	Rank
MR	0.509	3	0.486	3
TKR	0.645	2	0.514	2
TR	0.957	1	0.755	1
VHV	0.210	4	0.242	4

According to Table 12, TR stands out as the reinsurance company with the best performance in all years, while TKR stands out as the reinsurance company with the second-best performance. In all years, MR performs in third place, while VHV ranks last. In 2023, it was determined that the CRADIS scores of TR, TKR and MR decreased, while the CRADIS score of VHV increased. The reason for this situation may be the decrease in the value of benefit-oriented criteria and the increase in the value of cost-oriented criteria in 2023 compared to 2022 for TR, TKR and MR. On the contrary, it can be suggested that the value of benefit-oriented criteria increased, and the value of cost-oriented criteria decreased in 2023 for VHV. In 2023, although TR ranked first, its CRADIS score decreased the most compared to 2022.

#### 4.3. AROMAN Analysis Findings

AROMAN method uses linear and vector normalization techniques together to provide a more powerful solution in decision problems. Secondly, the performance ranking of the companies was carried out based on the AROMAN method and using the data in Table 5, the decision matrix was obtained as shown in Table 13 according to Equations 18 and 19 with AROMAN linear normalization technique.

**Table 13.** 2023 Linear Normalized Decision Matrix

Company	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
MR	1.000	0.722	0.000	0.000	0.853	0.274	0.957	0.800	0.481	0.658
TKR	0.149	0.960	0.703	0.971	1.000	0.000	0.000	0.347	1.000	0.689
TR	0.469	1.000	1.000	1.000	1.000	1.000	0.261	1.000	0.865	1.000
VHV	0.000	0.000	0.101	0.011	0.000	0.467	1.000	0.000	0.000	0.000

The normalized decision matrix obtained because of vector normalization using Equations (21) and (22) is given in Table 14.

**Table 14.** 2023 Vector Normalized Decision Matrix

Company	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
MR	0.822	0.599	0.161	0.314	0.517	0.323	0.799	0.602	0.365	0.482
TKR	0.266	0.747	0.584	0.810	0.605	0.135	0.248	0.311	0.699	0.503
TR	0.475	0.772	0.763	0.824	0.605	0.819	0.398	0.730	0.612	0.717
VHV	0.169	0.149	0.222	0.320	0.004	0.455	0.824	0.089	0.055	0.030

After the normalization process, the AROMAN method combines the matrix elements obtained because of different normalization techniques using the arithmetic mean technique (Bošković et al., 2023a: 39501). In this step, the normalized matrix elements in Table 13 and Table 14 are combined using Equation (22). The combined and averaged normalized decision matrix is given in Table 15. The parameter  $\beta$  was taken as 0.5 during the merging.

**Table 15.** 2023 Combined Normalized Decision Matrix

Company	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
MR	0.455	0.330	0.040	0.079	0.343	0.149	0.439	0.351	0.211	0.285
TKR	0.104	0.427	0.322	0.445	0.401	0.034	0.062	0.164	0.425	0.298
TR	0.236	0.443	0.441	0.456	0.401	0.455	0.165	0.433	0.369	0.429
VHV	0.042	0.037	0.081	0.083	0.001	0.230	0.456	0.022	0.014	0.008

The criteria weights obtained by the CRADIS method are included in the AROMAN application using Equation (23). The weighted normalized decision matrix is given in Table 16.

**Table 16.** 2023 Weighted Normalized Decision Matrix

Company	ROA	CRNet	CR	CPRNet	CONR	LR	ERNet	ROE	CPAR	TPR
MR	0.042	0.031	0.004	0.008	0.041	0.014	0.042	0.036	0.022	0.030
TKR	0.010	0.039	0.031	0.044	0.048	0.003	0.006	0.017	0.044	0.031
TR	0.022	0.041	0.042	0.045	0.048	0.042	0.016	0.044	0.038	0.045
VHV	0.004	0.003	0.008	0.008	0.000	0.021	0.044	0.002	0.001	0.001

$L_i$ ,  $A_i$ , and  $R_i$  values were calculated by utilising Table 16 and Equations (26)-(28) and the ranking of the alternatives was obtained. Information on these variables is given in Table 17. Here, while calculating the  $R_i$  value, the coefficient  $\lambda$  is taken as 3/10 since there are minimum type 3 criteria and maximum type 7 criteria.

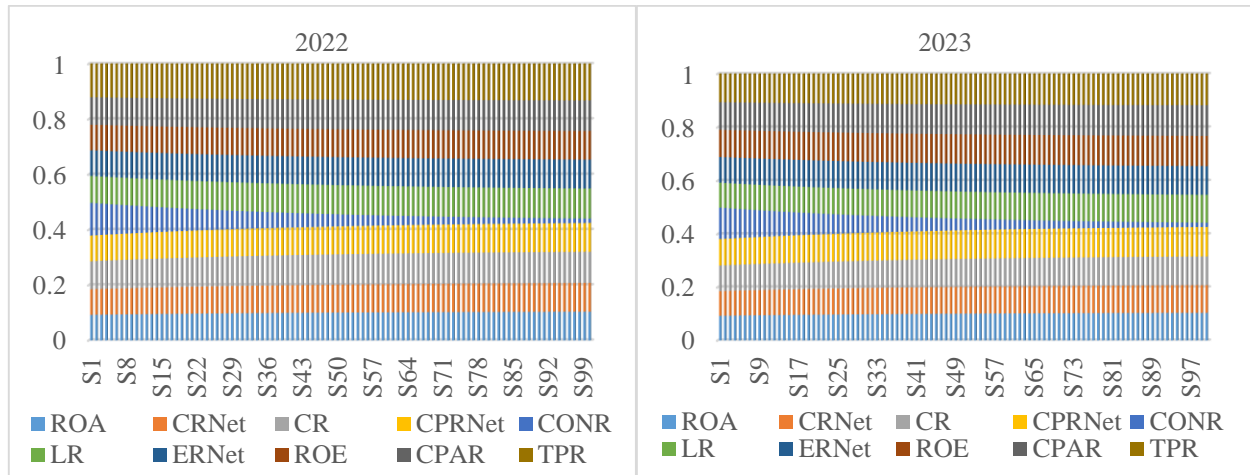
**Table 17.** 2022-2023 Period Reinsurance Companies AROMAN Scores

Company	2022				2023			
	$L_i$	$A_i$	$R_i$	Rank	$L_i$	$A_i$	$R_i$	Rank
MR	0.114	0.148	0.784	3	0.081	0.188	0.781	3
TKR	0.116	0.212	0.862	2	0.090	0.184	0.791	2
TR	0.118	0.307	0.965	1	0.102	0.282	0.917	1
VHV	0.009	0.031	0.335	4	0.055	0.038	0.521	4

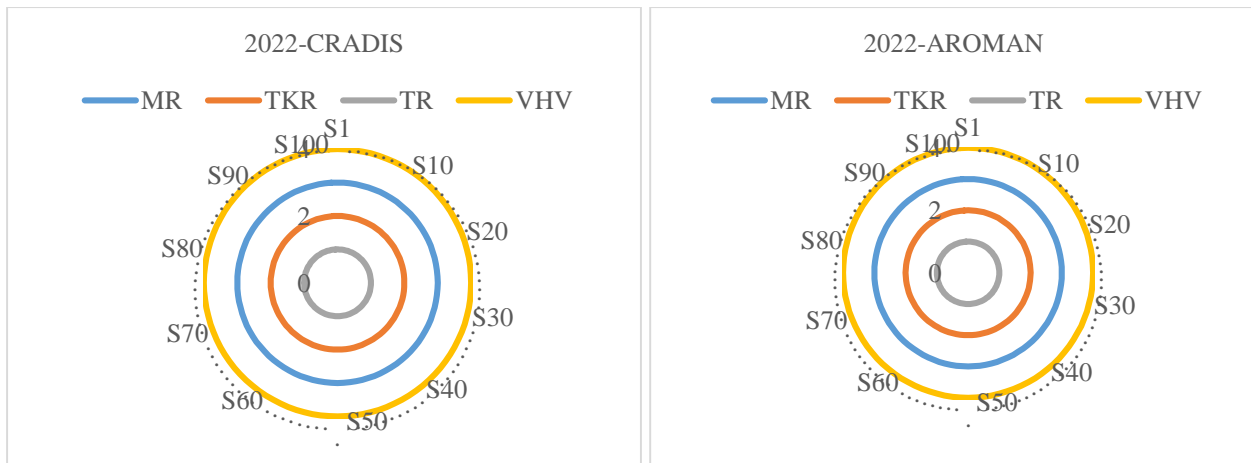
Table 17 shows the financial performance rankings of reinsurance companies for the period 2022-2023 according to the AROMAN method. Accordingly, Türk Reasürans is the most successful reinsurance company in terms of financial performance in 2022 and 2023. Türk Katılım Reasürans and Milli Reasürans ranked second and third, respectively, while VHV Reasürans ranked last.

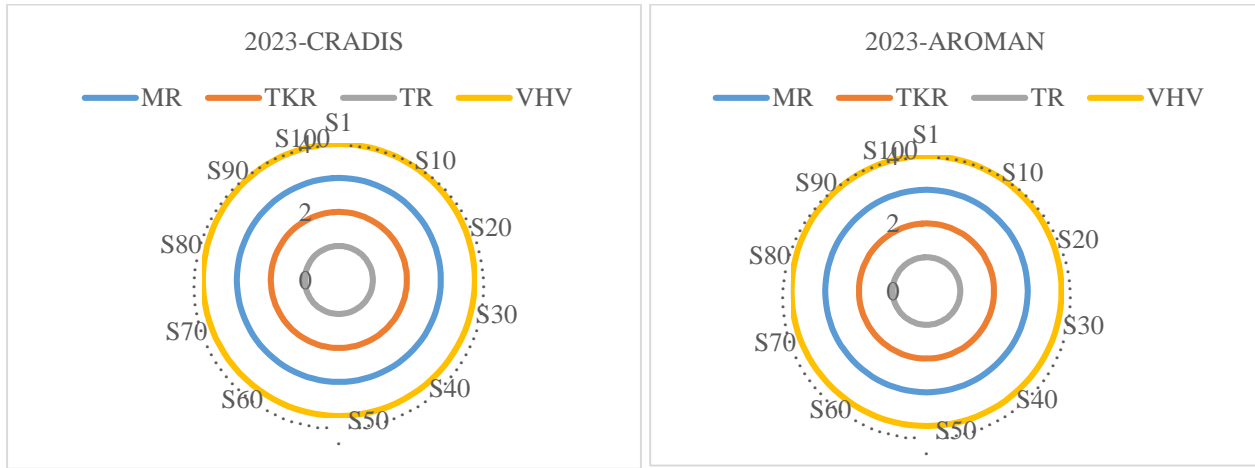
#### 4.4. Sensitivity Analysis Findings

In order to observe the effect of the change in the importance weights of the criteria on the ranking of the decision alternatives, 100 different scenarios were created. The method developed by Božanić et al. (2021) and Pamucar et al. (2022) was preferred for the testing of MCDM methods. According to this sensitivity analysis, the weight of the criterion with the highest importance level was reduced by 2% each time and the weights of the other criteria were increased proportionally. In this method, the sum of the importance levels of all criteria considered in the same way was calculated to be equal to 1. The criteria weights obtained for 100 scenarios are visualized in Figure 1.

**Figure 1.** Scenario Based Criteria Weights (2022-2023)

The sensitivity analysis ranking results of the repeated CRADIS and AROMAN application using the criteria weights in Figure 1 are given in Figure 2.





**Figure 2.** Ranking Results of Reinsurance Companies According to 100 Different Scenarios

According to Figure 2, the ranking suggested by the LODECI-CRADIS and LODECI-AROMAN model was not affected by the change in the criteria weights and a very strong implementation was obtained. When the results are analyzed, it is found that the ranking of the best alternative, Türk Reasürans, is not significantly affected by different criteria weight scenarios for 100 scenarios. According to the reported results, it is seen that there are no changes in the performance rankings of other decision alternatives in different scenarios. As a result, the ranking results obtained from the applied sensitivity analysis confirm that the MCDM performance evaluation models proposed in this study are consistent, robust and applicable.

## 5. CONCLUSION

The increase in the assets of the insurance sector, which is included in the finance sector, is extremely important for the entire national economy due to its function of transferring resources to the economy. The financial performance of reinsurance companies, which have the function of contributing to the financing of insurance companies, taking over their risks and transferring some of these risks to other reinsurance companies abroad, affects other insurance companies. The reinsurance function is of vital importance for the insurance sector to operate effectively and create economic benefits. With the contribution of reinsurance activities, the risks of insurance companies are spread over a larger geography. In this way, large risks are homogenized in a more diversified and balanced portfolio structure. Thus, large risks can be managed more easily, increasing the capacities and flexibility of insurance companies.

The aim of this study is to evaluate the financial performance of four Reinsurance Companies operating in the Türkiye reinsurance sector for the period 2022- 2023 with a MCDM approach including LODECI, CRADIS and AROMAN methods. For this purpose, the performance of four reinsurance companies was evaluated using 10 performance indicators. With the application of the LODECI method, it was determined that the most effective criterion on the performance of these reinsurance companies during the analysis period was the conservation rate criterion, while the variable with the least effect on the performance of these companies was the return on assets ratio. According to the results of CRADIS and AROMAN ranking methods, in both 2022 and 2023, Türk Reasürans ranked first, Türk Katılım Reasürans ranked second, Milli Reasürans ranked third and VHV Reasürans ranked last.

In the literature, studies analysing the financial performance of reinsurance companies are limited and are generally specific to certain countries or regions. For example, Ndirangu (2014) analysed the financial performance of reinsurance companies in Kenya in the context of exchange rate risk management, while Muchiri & Njoka (2021) examined the impact of corporate governance practices on financial performance. Olarewaju & Msomi (2022) analysed the determinants of profitability of reinsurance companies in Sub-Saharan African countries. The common point of these studies is that they reveal the determinants of financial performance by using regression analyses and time series methods. On the other hand, the studies focusing on reinsurance companies in India and Türkiye were mostly conducted with financial ratio analyses and multi-criteria decision-making (MCDM) methods. While Bawa & Verma (2017) and Mukherjee et al. (2020) evaluate the financial performance of GIC RE in India using ratio analyses and statistical methods, studies in Türkiye focus on MCDM

methods. For example, Yılmaz (2021a, 2021b) and Taşçı (2024b) analysed reinsurance companies operating in Türkiye with different MCDM methods and created performance rankings. Unlike these studies, this study evaluates the financial performance of four reinsurance companies operating in Türkiye in 2022-2023 with LODECI, CRADIS and AROMAN decision models. While similar analyses in the literature generally use methods such as AHP, ELECTRE and PSI-MEREC-ARAS, in this study, the LODECI procedure is preferred for objective weight calculations and CRADIS and AROMAN procedures are applied for ranking purposes. The findings of Yılmaz (2021a; 2021b), which is the closest study to this study in terms of sample and period, differ from the results of this study. It can be thought that the reason for this situation may be due to the fact that the financial performance of reinsurance companies may vary periodically, and different analysis methods and evaluation criteria are used.

This study evaluates the financial performance of four reinsurance companies operating in Türkiye between 2022 and 2023 using LODECI, CRADIS, and AROMAN decision models, offering significant insights for the sector. The results indicate that the conservation ratio is the most decisive factor affecting financial performance, whereas the return on assets has a relatively lower impact. Based on these findings, it is recommended that reinsurance companies strengthen their capital structures and improve risk management strategies to achieve higher conservation ratios. Notably, the financial leadership of Türk Reasürans highlights the necessity of increasing local capacity and exploring opportunities for integration into international markets. The growth of participation-based reinsurance also underscores the need for alternative financing models. Additionally, the sensitivity analysis results confirming the robustness of the model encourage the use of advanced analytical techniques in the industry. Regulatory bodies should implement stricter policies regarding capital adequacy and liquidity management to ensure financial stability. Investments in digitalization and data analytics can enhance operational efficiency and strengthen risk assessment processes. The study's findings are expected to serve as a guide for insurance and reinsurance sector stakeholders, company executives, and policymakers. Company managers can plan future strategies and take preventive measures based on the results, while insurance companies may consider these findings when selecting reinsurance partners. The performance evaluation decision model used in this study can also be applied at the firm or sector level for performance assessment across various financial and non-financial industries. In this context, industry stakeholders are expected to make more informed decisions regarding risk management, investment strategies, and regulatory policies based on the study's findings.

The inclusion of all reinsurance companies in the study, the use of ten evaluation criteria and the fact that the data set covers the 2022-2023 period can be considered as limitations of the study. In future studies, the time interval of reinsurance companies to be included in the analysis can be increased if the data is accessible. In addition, the scope of the study can be expanded by conducting analyses based on grey numbers, fuzzy numbers or intuitionistic fuzzy numbers. In addition, it is thought that it would be useful to compare the results obtained from this analysis of the reinsurance sector operating in Türkiye with other multi-criteria decision-making techniques and other analyses using different criteria to be conducted in the same sector in the future.

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This paper complies with Research and Publication Ethics, has no conflict of interest to declare, and has received no financial support.

#### **AUTHORS' CONTRIBUTIONS:**

Conceptualization, writing-original draft, editing – AÇ and OŞ, data collection, methodology, formal analysis – AÇ and OŞ, Final Approval and Accountability – AÇ and OŞ.

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