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ORIGINAL ARTICLE

AN INTEGRATED MULTI-CRITERIA DECISION MAKING MODEL (MCDM) FOR FINANCIAL PERFORMANCE MONITORING IN THE EUROPEAN INSURANCE SECTOR

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Abstract

The insurance sector ranks as one of the largest institutional investors in financial markets and significantly influences these markets. In Europe, particularly in industrialized countries, the insurance industry accounts for a sizable portion of the financial system. The purpose of this study is to assess and evaluate the performance of the insurance industry in the European Union. In today's world, the use of multi-criteria decision-making models (MCDM) is a common method for analyzing the performance of insurance companies. In this article, PSI, LOPCOW, and AROMAN methodologies are used to evaluate the performance of European insurance businesses. This study is based on data from the European insurance sector. Also the study utilizes a temporal framework covering the years from 2004 to 2020. The statistics were compiled from papers available on the European Insurance Association's website. The study demonstrates that, while the insurance sector is critical to financial markets, it is also influenced by changes in the economy and financial markets.

Keywords

Financial markets, Insurance sector, MCDM, PSI, LOPCOW, AROMAN.

JEL Classification

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1. INTRODUCTION

Finance-growth nexus hypothesis states that technical innovation, saving rate, efficiency in directing savings toward investments, and marginal productivity of capital are the ways which financial development drives economic growth (Levine, 1997). Financial intermediation functions of insurance companies affect economic growth through various channels. Insurance companies are also important financial sustainability. For the stability of the financial system insurers are crucial for three primary reasons. First, insurers are important investors in financial markets. Insurers have a strong relationship with banks and other financial organizations, so any issues companies face can also affect the banking industry. Insurers contribute to the stability of household and firm balance sheets by insuring risks (ECB FSR, December 2009: 161).

Insurance companies, in addition to mutual and pension funds, are among the largest institutional investors in financial markets. Insurance companies directly contribute to the growth and development of capital markets and national economies by transferring risks to more than one party while carrying out insurance and reinsurance activities, thereby increasing the efficiency and financial stability of the financial system and providing resources to the financial system. (Akotey et al., 2013: 286; Akyüz and Kaya, 2013: 355; Caporale et al., 2017: 108; ECB FSR, December 2009:161). In addition, companies in the insurance sector assume the risks that individuals, firms and countries may face in return for the premiums collected. In addition, insurance companies provide important services in financing long-term investments in the economy, minimizing transaction costs and maximizing the level of liquidity in the economy (Alenjagh, 2013: 3479; Akotey vd., 2013: 286-287). In addition to commodity and accident insurance, health and life insurance also have a significant share in the European insurance sector (Statista, 2024). Especially in industrialized European countries such as Germany, the UK and France, the insurance sector has a significant impact on the financial system. Europe's largest institutional investor is the insurance sector with more than half of GDP (Insurance Europe, 2024). In this context, it is important to monitor, measure and objectively evaluate the performance of the insurance sector in order to ensure the continuity of the activities of the financial sector in Europe and the development of the regional economy. Performance and efficiency analyses for the insurance sector increase the quality of activities in the sector. In addition, the insurance sector can provide important information to decision-making mechanisms to identify problems in a timely manner and develop strategies to solve these problems (Alenjagh, 2013: 3478; Ünal, 2019: 556). This study aims to measure and evaluate the performance of the insurance sector operating in the European Union Insurance sector. The application of multi-criteria decision-making models (MCDM) has become a prevalent approach in evaluating the performance of insurance organisations in the present era. In this article, PSI, LOPCOW and AROMAN techniques are used to analyze the performance of insurance companies in Europe.

After the introduction, the first part of the study includes a literature review. The second section presents the research methodology, and the third section presents the case study. The book chapter is completed with the fourth and conclusion section.

2. THE REVIEW OF LITERATURE

A substantial corpus of literature exists which analyses the performance of companies from all sectors, including the insurance sector, based on various multi-criteria decision-making methods (Güçlü, 2024; Gürler et al, 2024; Joshi, 2024; Kaya et al., 2024; Khabbazi and Fashkache (2024); Işık et al., 2024; Taşçı, 2024; Lukic, 2023; Wang et al., 2021; Akhisar and Tunay, 2016). The past studies that assess performance and efficiency by applying MCDM methods in the insurance industry are overviewed in this section. In the literature, there are a large number of studies that examine the performance of companies operating in the insurance sector with various MCDM techniques. A similar situation has recently emerged with regard to literature in the insurance sector in European countries (Puska et al., 2023; Mourmouris and Poufinas, 2023; Ardielli, 2020). The below summarizes key studies in the insurance sector in European countries.

Puska et al. (2023) used Fuzzy LMAW Fuzzy CRADIS techniques in their study. The researchers concluded that Fuzzy methods can be used in the selection of insurance companies. Mourmouris and Poufinas (2023), in their study, compared the Promethee methods with the CRM methods. The researchers concluded that CRM techniques facilitate, support and help to improve the risk selection process. Ardielli (2020) used TOPSIS, WSA and MAPPAC techniques in his study. The researcher concluded that in the evaluation of e-health diffusion in the European Union member countries, Scandinavian countries are among the countries with the highest score in terms of ranking, while Eastern Europe has the lowest score.

As can be seen in the literature summary presented above, there are few studies analyzing the evaluation of insurance companies in European countries using multi-criteria decision-making (MCDM) methods. Since the literature review reveals that few studies have been conducted, this study aims to contribute to filling the gap in the field. For this purpose, the performance of the European insurance sector was evaluated and measured with new evaluation models consisting of MCDM PSI-LOPCOW-AROMAN methods were used.

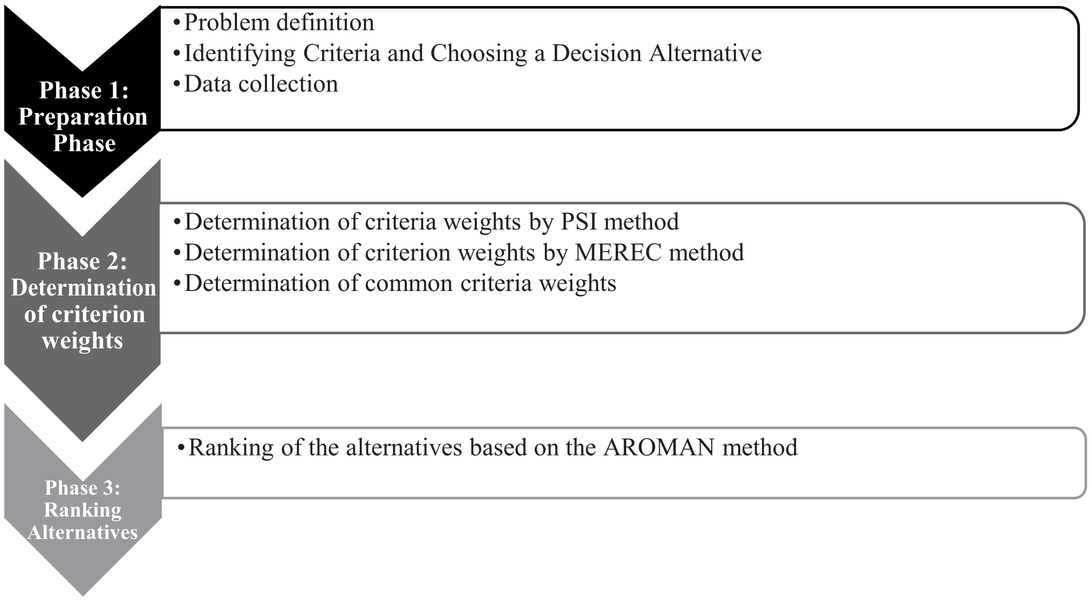
3. RESEARCH METHODOLOGY

This section elucidates the rationale behind the PSI-LOPCOW-AROMAN hybrid MCDM decision model, which has been proposed for evaluation of the performance of the European insurance ındustry. The study posits that the PSI and LOPCOW objective weighting methods can be employed to circumvent the potential for subjective evaluations when determining the importance weights of the evaluation criteria. Furthermore, in contrast to numerous other MCDM methods, the PSI method has been selected due to its computational simplicity and the clarity of its mathematical infrastructure (Maniya and Bahat, 2010: 1786). The rationale for employing the LOPCOW approach in this investigation is threefold. Firstly, it represents a contemporary methodology, free from the limitations imposed by negative data. Secondly, it bridges the gap resulting from the disparate sizes of the data sets by expressing them As a percentual value relative to the standard deviations of the mean square values of the series. Thirdly, it is not susceptible to the issues associated with the use of traditional statistical techniques in the presence of outliers (Bektaş, 2022: 254). The AROMAN method, which combines the normalized data obtained as a result of the two-step normalization process and creates an average matrix from the normalized data, represents a current approach to multi-criteria decision-making method (Kahreman, 2024: 77; Macit, 2023: 37).

3.1. Studies Using PSI, LOPCOW and AROMAN Methods

The study used the AROMAN method to rank the alternatives. Figure 1 shows the model proposed in the study.

Figure 1
Scheme of Progress of The Study



3.1.1 PSI Procedure

The PSI method, which is employed to ascertain the objective weights of the criteria and to rank the alternatives, was first introduced to the literature by Maniya and Bhaat (2010). The steps for applying the PSI method are as follows (Maniya and Bhaat, 2010: 1786; Işık, 2022: 367):

Step 1: In the first step, the initial decision matrix containing m alternatives and n criteria is created.

$$X=\begin{bmatrix} X_{11} & \dots & X_{1j} & \cdots & X_{1n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ X_{m1} & \dots & X_{mj} & \dots & X_{mn} \end{bmatrix} \tag{1}$$

Step 2: Obtaining the normalized decision matrix. The normalization process of the values in the initial decision matrix is done using Equality (2) (beneficial criterion) and Equality (3) (cost criterion).

$$n_{ij} = \frac{x_{ij}}{maksx_{ij}} \tag{2}$$

$$n_{ij} = \frac{minx_{ij}}{x_{ij}} \tag{3}$$

Step 3: In this step, the preference variance value (PV_j) is calculated for each criterion.

$$PV_j = \sum_{i=1}^{N} (n_{ij}^{x} - \overline{n_j^x})^2 \tag{4}$$

$\overline{n_j^x}$= Average of normalized value of jth criterion. $\overline{n_j^x} = \frac{1}{N}\sum_{i=1}^{N} n_{ij}^{x}$

Step 4: The deviation in the preference value for each criterion (Θ_j) is calculated using Equality (5). Then, the overall preference value, i.e. the criterion weights W_j is calculated using Equality (6).

$$\Theta_j = 1 - PV_j \tag{5}$$

$$Wj = \frac{\Theta_j}{\sum_{j=1}^{m} \Theta_j} \tag{6}$$

3.1.2. LOPCOW Procedure

The LOPCOW method represents a novel objective criterion weighting method that was first introduced to the literature by Ecer and Pamucar in 2022. Once the standard deviation and percentage values for each criterion have been calculated, the weights of the criteria can be determined in an objectively valid manner. The method is applied in the following stages (Ecer and Pamucar, 2022: 4-5):

Step 1: For a decision-making problem with m number of alternatives and n number of criteria, the initial decision matrix is created in the first stage.

$$X=\begin{bmatrix} X_{11} & \dots & X_{1j} & \cdots & X_{1n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ X_{m1} & \dots & X_{mj} & \dots & X_{mn} \end{bmatrix} \tag{7}$$

Step 2: At this stage of the method, the initial decision matrix elements are normalized with the help of Equality (8) (cost-oriented) and Equality (9) (benefit-oriented).

$$r_{ij}=\frac{X_{max}-X_{ij}}{X_{max}-X_{min}} \tag{8}$$

$$r_{ij}=\frac{X_{ij}-X_{min}}{X_{max}-X_{min}} \tag{9}$$

Step 3: At this stage of the method, percentage values (PV) of each criterion are calculated. In this step, The mean square value as a percent of the standard deviations of all criteria is calculated with the help of Equality (10) in order to eliminate the discrepancy caused by the size of the data set.

$$PV_{ij}=\left|\ln\left(\frac{\sqrt{\frac{\sum_{i}^{m}=r_{ij}^{2}}{m}}}{\sigma}\right).100\right| \tag{10}$$

Step 4: In the final stage of the process, the objective weightings for the criteria are determined through the application of Equation (11).

$$w_{ji}=\frac{PV_{ij}}{\sum_{i=1}^{n} PV_{ij}} \tag{11}$$

Combined Weighting

The criteria weights obtained from the PSI and LOPCOW methods are combined in equation (12) (Işık, 2022: 367; Zavadskas & Podvezko, 2016: 8).

$$W_{j,combined}=\frac{W_{j,PSI}W_{j,LOPCOW}}{\sum_{J=1}^{m} W_{j,PSI}W_{j,LOPCOW}} \tag{12}$$

3.1.3. AROMAN Procedure

The AROMAN method, which was introduced to the MCDM literature in 2023 by Bošković et al. are as follows (Bošković et al., 2023: 39500; Kahreman; 2024: 77) :

Step 1: Creating the Initial Decision Matrix

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & & x_{2m} \\ \vdots & & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \quad (13)$$

Step 2: Creating the Normalized Decision Matrix

$$Y_{ij} = \frac{x_{ij} - minx_{ij}}{maksx_{ij} - minx_{ij}}, \quad \text{For linear normalization} \quad (14)$$

$$Y_{ij}^{*} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^{2}}}, \quad \text{For vector normalization} \quad (15)$$

$$Y_{ij}^{norm} = \frac{\beta Y_{ij} + (1-\beta) Y_{ij}^{*}}{2}, \quad \text{For batch normalization} \quad (16)$$

Step 3: Creation of Weighted Aggregate Normalized Decision Matrix

$$\widehat{Y_{ij}} = w_j * Y_{ij}^{norm} \quad (17)$$

Step 4: Calculation of Ranking Score (Z_i)

$$K_i = \sum_{j=1}^{n} \widehat{Y_{ij}}^{(cost)}, \quad \text{For cost-oriented criteria} \quad (18)$$

$$N_i = \sum_{j=1}^{n} \widehat{Y_{ij}}^{(benefit)}, \quad \text{For benefit-oriented criteria} \quad (19)$$

$$Z_i = K_i^{\lambda} + N_i^{(1-\lambda)} \quad (20)$$

The λ parameter represents the criterion diversity coefficient and can be used at different rates between 0 and 1. However, in the MCDM problem where only benefit and cost criteria are included, the λ value is accepted as 0.5 in order not to obtain undefined results. In this study, the λ parameter is also taken as 0.5. In addition, the λ value varies according to the cost and benefit status of the criteria considered. For example, if 1 cost criteria consist of 5 benefit criteria, the λ value can be taken as 1/6. The β parameter represents the weight parameter that takes different values between 0 and 1. In this study, the β parameter is taken as 0.5.

4. CASE STUDY

The study suggests a new model for evaluating the European insurance sector, using PSI, LOPCOW, and AROMAN methods. While the PSI and LOPCOW methods are employed to ascertain the relative importance of the criteria in accordance with the proposed hybrid model, the AROMAN method is utilised for assessing the European insurance sector's performance over time. This section presents the results of an analysis conducted to evaluate the performance of the European insurance sector. It begins by introducing the data set and alternatives used in the analysis, and then proceeds to present the results.

4.1. Data

The study is based on data from the European insurance sector for the period between 2004 and

2020. The study employs a temporal framework encompassing the annual periods between 2004 and 2020. The data employed in the study are collated from the reports published on the website of the European Insurance Association. The criteria employed to assess the performance of the European insurance sector, along with the associated criterion codes and the desired qualities of these criteria, are presented in Table 1 below.

Table 1
Performance evaluation criteria

Criteria	Code	Qualification
Number of companies on total market	C1	Maximum
Number of direct employees	C2	Maximum
Premiums written on total market	C3	Maximum
Gross claims expenditure	C4	Minimum
Density (total premiums per inhabitant)	C5	Maximum
Penetration (total premiums to GDP)	C6	Maximum

4.2. Results from the PSI procedure

The initial decision matrix, comprising data from the European insurance sector for the period 2004-2020, was constructed and presented in Table 2.

Table 2
Initial Decision Matrix

Year	C1	C2	C3	C4	C5	C6
2004	10.193	1.134.178	899.914	575.763	3.759	0,06
2005	10.490	1.103.338	1.029.588	627.295	5.407	0,06
2006	10.675	1.098.405	1.094.754	784.431	7.629	0,06
2007	11.093	1.097.221	1.186.379	812.151	7.799	0,07
2008	12.183	1.093.501	1.062.777	785.046	7.057	0,06
2009	12.451	1.105.305	1.125.869	769.938	9.754	0,07
2010	13.607	1.021.995	1.180.037	814.118	10.309	0,07
2011	12.529	1.018.783	1.142.186	874.909	3.265	0,06
2012	12.627	1.015.287	1.125.208	896.171	3.248	0,06
2013	12.085	1.013.154	1.179.338	654.660	2.655	0,06
2014	7.284	999.051	1.259.110	856.216	2.855	0,06
2015	8.999	951.073	1.284.611	967.917	3.254	0,07
2016	10.083	952.204	1.300.057	1.013.060	5.707	0,08
2017	9.992	942.512	1.317.315	1.085.803	7.314	0,09
2018	10.130	835.344	1.385.825	1.088.026	7.604	0,09
2019	9.913	947.665	1.361.829	1.045.472	8.024	0,10
2020	9.101	924.060	1.264.236	1.010.379	3.679	0,07

The values in the initial decision matrix were normalized using Equality (2) and Equality (3). The matrix consisting of normalized values is presented in Table 3.

Table 3
Normalized Matrix

Year	C1	C2	C3	C4	C5	C6
2004	0,749	1,000	0,649	1,000	0,365	0,617
2005	0,771	0,973	0,743	0,918	0,524	0,665
2006	0,785	0,968	0,790	0,734	0,740	0,681
2007	0,815	0,967	0,856	0,709	0,757	0,688
2008	0,895	0,964	0,767	0,733	0,685	0,659
2009	0,915	0,975	0,812	0,748	0,946	0,749
2010	1,000	0,901	0,852	0,707	1,000	0,764
2011	0,921	0,898	0,824	0,658	0,317	0,659
2012	0,928	0,895	0,812	0,642	0,315	0,672
2013	0,888	0,893	0,851	0,879	0,257	0,618
2014	0,535	0,881	0,909	0,672	0,277	0,649
2015	0,661	0,839	0,927	0,595	0,316	0,683
2016	0,741	0,840	0,938	0,568	0,554	0,861
2017	0,734	0,831	0,951	0,530	0,709	0,967
2018	0,744	0,737	1,000	0,529	0,738	0,979
2019	0,729	0,836	0,983	0,551	0,778	1,000
2020	0,669	0,815	0,912	0,570	0,357	0,714

After obtaining the normalized decision matrix, the PV_j value of each criterion was calculated using Equality (4), the Θ_j value of each criterion was calculated using Equality (5) and finally the criterion weights W_j were calculated using Equality 6 and the relevant values are given in

Table 4
PV_j, Θ_j, W_j *Values*

	C1	C2	C3	C4	C5	C6
PV_j	0,793	0,895	0,857	0,691	0,567	0,743
Θ_j	0,227	0,085	0,136	0,304	0,961	0,263
$\boldsymbol{W_j}$	0,192	0,228	0,215	0,173	0,010	0,183

As illustrated in Table 4, the impact levels of the criteria employed in evaluating the performance of the European insurance sector are ordered as C2>C3>C1>C6>C4>C5.

4.3. Results from the LOPCOW procedure

The initial decision matrix elements presented in Table 2 are normalised using Equality (8) and (9), and the resulting normalised decision matrix is shown in Table 5.

Table 5
Normalized Matrix

Year	C1	C2	C3	C4	C5	C6
2004	0,460	1,000	0,000	1,000	0,144	0,000
2005	0,507	0,897	0,267	0,899	0,360	0,127
2006	0,536	0,880	0,401	0,593	0,650	0,168
2007	0,602	0,876	0,590	0,539	0,672	0,185
2008	0,775	0,864	0,335	0,591	0,575	0,111
2009	0,817	0,903	0,465	0,621	0,927	0,346
2010	1,000	0,625	0,576	0,535	1,000	0,384
2011	0,830	0,614	0,499	0,416	0,080	0,110
2012	0,845	0,602	0,464	0,375	0,078	0,144
2013	0,759	0,595	0,575	0,846	0,000	0,003
2014	0,000	0,548	0,739	0,453	0,026	0,085
2015	0,271	0,387	0,792	0,234	0,078	0,173
2016	0,443	0,391	0,823	0,146	0,399	0,638
2017	0,428	0,359	0,859	0,004	0,609	0,914
2018	0,450	0,000	1,000	0,000	0,647	0,946
2019	0,416	0,376	0,951	0,083	0,701	1,000
2020	0,287	0,297	0,750	0,152	0,134	0,253

Percentage values (PV) for each criterion were calculated using Equation (10). The importance weight W_j for each criterion was determined using Equation (11). The relevant values are shown in Table 6.

Table 6

Percentile Values (PV) and Criteria Weights (W_j)

Year	C1	C2	C3	C4	C5	C6
2004	0,460	1,000	0,000	1,000	0,144	0,000
2005	0,507	0,897	0,267	0,899	0,360	0,127
2006	0,536	0,880	0,401	0,593	0,650	0,168
2007	0,602	0,876	0,590	0,539	0,672	0,185
2008	0,775	0,864	0,335	0,591	0,575	0,111
2009	0,817	0,903	0,465	0,621	0,927	0,346
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2011	0,830	0,614	0,499	0,416	0,080	0,110
2012	0,845	0,602	0,464	0,375	0,078	0,144
2013	0,759	0,595	0,575	0,846	0,000	0,003
2014	0,000	0,548	0,739	0,453	0,026	0,085
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2016	0,443	0,391	0,823	0,146	0,399	0,638
2017	0,428	0,359	0,859	0,004	0,609	0,914
2018	0,450	0,000	1,000	0,000	0,647	0,946
2019	0,416	0,376	0,951	0,083	0,701	1,000
2020	0,287	0,297	0,750	0,152	0,134	0,253
Sum	6,277	7,354	7,090	4,812	4,692	3,629
M	17,000	17,000	17,000	17,000	17,000	17,000
sum/m	0,369	0,433	0,417	0,283	0,276	0,213
Sq	0,608	0,658	0,646	0,532	0,525	0,462
Std	0,256	0,276	0,263	0,308	0,330	0,335
Pv	86,402	86,891	89,826	54,762	46,459	32,196
W_j	0,218	0,219	0,227	0,138	0,117	0,081

Upon examination of the LOPCOW procedure results presented in Table 6, it becomes evident that the impact level of the criteria in determining the performance of the European insurance sector is C3>C2>C1>C4>C5>C6.

4.4. Results from the Hybrid Weighting Procedure

To get more consistent and better objective weights for the criteria, we combined the weights from the PSI and LOPCOW procedures with an operator based on a weighted average (Equation 12). Thus, the combination of the two methods yielded more optimal results by capitalising on the advantages inherent to both. Table 7 shows the final weight values for the criteria.

Table 7

Common Criteria Weights

	C1	C2	C3	C4	C5	C6
W_j	0,232	0,277	0,270	0,132	0,006	0,082

Table 7 presents the final importance weights of the criteria used in the assessment of the performance of the European insurance sector. Upon examination of the results, it becomes evident that the criterion with the highest level of impact on the performance of the European insurance sector is C2 (Number of direct employees), while the criterion with the lowest level of impact is C5 (Density).

4.5. Results from the AROMAN Procedure

In the second stage of the study, the application procedures of the AROMAN method were used to calculate and rank the performance of the insurance sector. Using the initial decision matrix given in

Table 2, the linear normalisation matrix, the vector normalisation matrix and the batch normalisation matrix were calculated using equations 14-16 and are presented in Tables 8, 9 and 10 respectively.

Table 8

Linear Normalization Matrix

Year	C1	C2	C3	C4	C5	C6
2004	0,460	1,000	0,000	0,000	0,144	0,000
2005	0,507	0,897	0,267	0,101	0,360	0,127
2006	0,536	0,880	0,401	0,407	0,650	0,168
2007	0,602	0,876	0,590	0,461	0,672	0,185
2008	0,775	0,864	0,335	0,409	0,575	0,111
2009	0,817	0,903	0,465	0,379	0,927	0,346
2010	1,000	0,625	0,576	0,465	1,000	0,384
2011	0,830	0,614	0,499	0,584	0,080	0,110
2012	0,845	0,602	0,464	0,625	0,078	0,144
2013	0,759	0,595	0,575	0,154	0,000	0,003
2014	0,000	0,548	0,739	0,547	0,026	0,085
2015	0,271	0,387	0,792	0,766	0,078	0,173
2016	0,443	0,391	0,823	0,854	0,399	0,638
2017	0,428	0,359	0,859	0,996	0,609	0,914
2018	0,450	0,000	1,000	1,000	0,647	0,946
2019	0,416	0,376	0,951	0,917	0,701	1,000
2020	0,287	0,297	0,750	0,848	0,134	0,253

Table 9

Vector Normalization Matrix

Year	C1	C2	C3	C4	C5	C6
2004	0,227	0,270	0,183	0,159	0,144	0,199
2005	0,233	0,263	0,209	0,174	0,207	0,214
2006	0,237	0,262	0,222	0,217	0,292	0,219
2007	0,247	0,261	0,241	0,225	0,299	0,221
2008	0,271	0,261	0,216	0,217	0,270	0,212
2009	0,277	0,263	0,229	0,213	0,373	0,241
2010	0,303	0,243	0,240	0,225	0,395	0,246
2011	0,279	0,243	0,232	0,242	0,125	0,212
2012	0,281	0,242	0,228	0,248	0,124	0,216
2013	0,269	0,241	0,239	0,181	0,102	0,199
2014	0,162	0,238	0,256	0,237	0,109	0,209
2015	0,200	0,227	0,261	0,268	0,125	0,220
2016	0,224	0,227	0,264	0,281	0,218	0,277
2017	0,222	0,225	0,267	0,301	0,280	0,311
2018	0,225	0,199	0,281	0,301	0,291	0,315
2019	0,220	0,226	0,276	0,289	0,307	0,322
2020	0,202	0,220	0,257	0,280	0,141	0,230

Table 10

Batch Normalization Matrix

Year	C1	C2	C3	C4	C5	C6
2004	0,172	0,318	0,046	0,040	0,072	0,050
2005	0,185	0,290	0,119	0,069	0,142	0,085
2006	0,193	0,285	0,156	0,156	0,235	0,097
2007	0,212	0,284	0,208	0,172	0,243	0,102
2008	0,261	0,281	0,138	0,156	0,211	0,081
2009	0,274	0,292	0,173	0,148	0,325	0,147
2010	0,326	0,217	0,204	0,173	0,349	0,157
2011	0,277	0,214	0,183	0,207	0,051	0,081
2012	0,281	0,211	0,173	0,218	0,050	0,090
2013	0,257	0,209	0,204	0,084	0,025	0,050
2014	0,041	0,196	0,249	0,196	0,034	0,073
2015	0,118	0,153	0,263	0,258	0,051	0,098
2016	0,167	0,154	0,272	0,284	0,154	0,229
2017	0,163	0,146	0,282	0,324	0,222	0,306
2018	0,169	0,050	0,320	0,325	0,234	0,315
2019	0,159	0,150	0,307	0,302	0,252	0,331
2020	0,122	0,129	0,252	0,282	0,069	0,121

The batch normalization matrix was weighted with the help of Equation 17 and the findings are presented in Table 11.

Table 11
Weighted Normalization Matrix

Year	C1	C2	C3	C4	C5	C6
2004	0,037	0,070	0,010	0,006	0,008	0,004
2005	0,040	0,064	0,027	0,009	0,017	0,007
2006	0,042	0,063	0,035	0,022	0,028	0,008
2007	0,046	0,062	0,047	0,024	0,028	0,008
2008	0,057	0,062	0,031	0,022	0,025	0,007
2009	0,060	0,064	0,039	0,020	0,038	0,012
2010	0,071	0,048	0,046	0,024	0,041	0,013
2011	0,060	0,047	0,041	0,029	0,006	0,007
2012	0,061	0,046	0,039	0,030	0,006	0,007
2013	0,056	0,046	0,046	0,012	0,003	0,004
2014	0,009	0,043	0,056	0,027	0,004	0,006
2015	0,026	0,034	0,060	0,036	0,006	0,008
2016	0,036	0,034	0,062	0,039	0,018	0,019
2017	0,035	0,032	0,064	0,045	0,026	0,025
2018	0,037	0,011	0,073	0,045	0,027	0,026
2019	0,035	0,033	0,069	0,042	0,030	0,027
2020	0,027	0,028	0,057	0,039	0,008	0,010

For cost-oriented criteria (C4), Equation 18, for benefit-oriented criteria (C1, C2, C3, C5 and C6), Equation 19 was used, and the ranking score was calculated with the help of Equation 20. The findings are presented in Table 12.

Table 12
AROMAN Procedure Ranking Results

Year	*K*	*N*	*Z*	Rank
2004	0,006	0,130	0,434	17
2005	0,009	0,154	0,490	16
2006	0,022	0,175	0,566	11
2007	0,024	0,192	0,592	7
2008	0,022	0,181	0,573	9
2009	0,020	0,213	0,604	6
2010	0,024	0,218	0,622	4
2011	0,029	0,161	0,570	10
2012	0,030	0,160	0,574	8
2013	0,012	0,155	0,501	15
2014	0,027	0,118	0,508	14
2015	0,036	0,133	0,553	13
2016	0,039	0,168	0,608	5
2017	0,045	0,182	0,638	2
2018	0,045	0,173	0,628	3
2019	0,042	0,193	0,644	1
2020	0,039	0,130	0,558	12

Table 12 presents the ranking results of the European insurance sector's performance in the period 2004-2020 according to the AROMAN procedure. When the results are examined, it is determined that the European insurance sector showed the best performance in 2019 and the worst performance in 2004.

5. CONCLUSION

The insurance sector is among the largest institutional investors in financial markets and plays an important role in financial markets. In Europe, especially in industrialized countries, the insurance sector has a large share in the financial system (Insurance Europe, 2024). The goal of this study is to evaluate the performance of the European insurance sector using sectoral indicators. To this end, we propose a new integrated MCDM model comprising PSI, LOPCOW, and AROMAN methods for assessing the performance of the European insurance ındustry.

The determination of the objective importance weights of the assessment criteria employed in the evaluation of the performance of the European insurance sector was conducted through the utilisation of the PSI and LOPCOW methodologies, as proposed within the model. Subsequently, the results of the aforementioned two methods were integrated to derive the final importance weights of the criteria. Upon examination of the results produced by the common weighting method, it is seen that the two most effective criteria on the performance of the European insurance sector are C2 (Number of direct employees) and C3 (Premiums written on total market), respectively, while the two least effective criteria are C5 (Density) and C6 (Penetration) respectively. These results can be interpreted as indicating that the European insurance sector has the potential to enhance its performance by developing a robust personnel infrastructure and increasing premium production. The annual premium production is an essential indicator that is utilised as a measure of success for both individual companies and the insurance sector as a whole. This evidence lends support to the assertion that the premiums written on a total market basis represent a significant and influential criterion. Furthermore, the identification of personnel and premium production as the two most significant criteria suggests that an increase in the former may lead to an increase in the latter, thus strengthening the sector's personnel capabilities and boosting sales and premium production.

When the results of the AROMAN ranking procedure are examined, it is seen that the performance of the European insurance sector has fluctuated between 2004-2020. The best performance of the European insurance sector was determined as 2019, and the worst performance was determined as 2004. While the European insurance sector showed its best performance in 2019, it is seen that there was an eleven-place drop in the performance ranking in 2020. It can be thought that this situation was caused by the Covid-19 pandemic, which started in 2019 and spread throughout the world and started to show its negative effects in Europe in 2020. Increasing health claims, uncertainty in life insurance, and operational difficulties may be contributing factors. Upon examination of the AROMAN method results, it becomes evident that there was a fluctuating decline in the performance of the European insurance sector after 2010 until 2016. This situation can be interpreted as the negative impact of the European debt crisis, which first manifested in Greece in 2009 and subsequently spread to a considerable extent by affecting neighbouring countries, on the European insurance sector. It can be stated that the decline in insurance companies' investment income following the 2008 crisis and tighter regulations also had a negative impact on performance.

The study shows that while the insurance sector is important for financial markets, the insurance sector itself is also affected by changes in the economy and financial markets. In order to ensure the stability of the financial performance of the insurance sector, future research should focus on methods (e.g. balance sheet management) that may minimize the extent to which the insurance sector is affected by macroeconomic indicators. The study's findings suggest that insurance companies should enhance their financial resilience by strengthening their personnel infrastructure and increasing premium production through digital sales channels. Furthermore, policymakers should consider implementing macroprudential measures to protect the sector's liquidity during times of crisis.

The findings of this study may inform the decision-making processes of those involved in the insurance industry, including policymakers, regulatory and supervisory institutions, insurance company managers, investors, and customers. Additionally, the insights gained may contribute to the development of future strategies. Moreover, the decision model proposed in the study can be applied to a range of research areas, including the assessment of firm-level performance, the comparison of performance across countries, and the analysis of sector-specific performance.

Objective weighting methods such as PSI and LOPCOW were used to determine the criteria weights in the study. While this minimizes errors that may arise from the subjective judgments of decision-makers, the lack of use of Fuzzy Logic based approaches that reflect the views of industry experts can be seen as a limitation. In future studies, the latest weighting methods such as SITDE, CRISUS, and LOGSTA can be used to validate and enrich the results of the model proposed in this article.

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