Approach for Multi-Criteria Ranking of Balkan Countries Based on the Index of Economic Freedom

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Abstract

Understanding the level of economic freedom is an important indicator for investors and policymakers. The index of economic freedom, which the Heritage Foundation releases annually, is the most significant of the methods used to measure this indicator in practice, as this index evaluates the degree of market openness over the degree of fiscal and regulatory restraint. The research presented in this paper was conducted in order to establish the level of economic freedom in the Balkan countries. For this purpose, a multi-criteria ranking of Balkan countries based on economic freedom criteria was used. The weight of the criteria was determined using the Entropy method, and the countries were ranked using the CRADIS (Compromise Ranking of Alternatives from Distance to ideal Solution) method. These methods employed a double normalisation approach, and according to the results of this application, Bulgaria has the best indicators of economic freedom, while Montenegro has the worst, with sensitivity analysis and validation of the results confirming these findings. The approach of using double normalisation contributes to decision-making stability since the results of different methods are uniform when compared to the use of the classical approach in the case of multi-criteria analysis methods.

Keywords: index of economic freedom, Balkan countries, multi-criteria decision-making, double normalization, Entropy, Compromise Ranking of Alternatives from Distance to ideal Solution (CRADIS)

1. Introduction

Following changes in business practises at the end of the previous century and the beginning of this one, the countries were on the verge of adopting a market-based business system. However, this business model requires a certain set of economic freedoms in order to be implemented. The economic freedoms are an important factor in the country's economic development and prosperity (Brkić, et al., 2020) and they are

considered critical for increasing investment in certain countries (Assi, et al., 2020). High-level economic freedom countries have little government intervention and a stable market (Economou, 2019; Sudhana Rao, et al., 2022), but there are exceptions to the rule that economic freedom is the only condition for investing in a country (Koziuk and Ivashuk, 2022). According to research by Bashir et al. (2021), Chinese companies invest more in countries with less economic freedom and higher political risk. This is solely done for financial gain, as there is more profit to be made in countries with higher levels of corruption and other problems than in countries with strict legal systems and minimal corruption.

Based on this, it is critical to understand the state of countries' economic freedoms. The Heritage Foundation's annual index of economic freedom (IEF) is the most important of the methods used to measure this indicator in practise (Ecer and Hashemkhani Zolfani, 2022). The research presented in this paper was conducted in order to establish the level of economic freedom in the Balkan countries, with the goal of establishing the ranking of countries in terms of economic freedom according to the IEF for the year 2022.

Based on the research problem as defined above, it is evident that several countries should be ranked using the IEF's criteria, and when there are several alternatives that must be evaluated using specific criteria, multi-criteria decision-making (MCDM) methods are used (Ali, et al., 2020; Tešić et al., 2022). Since MCDM methods are frequently employed in practise (Đukić, et al., 2022), this research will also utilise them as well. To rank countries based on economic freedom, the Entropy method will be used to determine the weights of the criteria, followed by the CRADIS (Compromise Ranking of Alternatives from Distance to ideal Solution) method to determine the ranking of countries. Double normalisation will be used in conjunction with these methods to promote decision-making stability (Ivanović, et al., 2022).

The following illustrates the contribution of this research based on the objectives set and the strategies employed to achieve them:
- Ranking of Balkan countries in terms of economic freedom,
- Outlining strategies for improving economic freedom in Balkan countries,
- Improving stability when using MCDM methods for decision-making and ranking,
- Developing hybrid approaches to solve MCDM issues.

This paper is comprised of six distinct sections, including an introduction. The literature review section provides an overview of prior research that pertains to the ranking of countries based on economic freedom and the utilisation of double normalization. The methodology and methods section outlines the methodology that was employed in conducting the research and the specific methods utilized. The results section presents the key findings of the research, and the validation of the results and sensitivity analysis are performed to make the results as detailed as possible. The discussion section presents more detailed results and their relationship to similar studies. Finally, the conclusion section summarises the most crucial results obtained, highlights the limitations of conducted research, and provides suggestions for future research directions.

2. Literature review

This section will present papers in which MCDM methods were used to rank countries in terms of economic freedom, as well as papers in which double normalisation was used.

To rank OPEC countries, Ecer and Hashemkhani Zolfani (2022) used the MEREC (MEthod based on the REmoval effects of Criteria) and DNMA (Double Normalization-based Multi-Aggregation) methods. The results revealed that among these countries, the United Arab Emirates (UAE) has the best indicators. Dinç and Erilli (2022) used a hybrid method that includes spatial econometrics, fuzzy cluster analysis, and multi-criteria decision-making. When studying economic freedom statistics for 2019, 2020, and 2021. Özkaya (2022) ranked 40 countries based on economic freedom values using various MCDM methods such as Entropy, TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), ARAS (Additive Ratio Assessment), SAW (Simple Additive

Weighting), the Borda Count Method, Clustering, and Spearman correlation analysis. He obtained a result indicating that countries with the highest GDP also have the highest level of economic freedom, such as Hong Kong, Singapore, and Switzerland, while countries with low GDP are at the bottom of that ranking.

De Lima Silva and De Almeida Filho (2020) used the TOPSIS method and its TOPSIS-Sort-B modification to rank 180 nations based on their economic freedom over the course of four years. Their findings demonstrated coherence with the IEF. De Lima Silva et al. (2023) ranked 180 nations over a four-year period based on their economic freedom using the TOPSIS method and its modification, the TOPSIS-Sort-C method. According to their findings, the proposed model uses the boundary profiles of the TOPSIS-Sort-B method to minimise the demand on cognitive effort. Cabello et al. (2021) ranked countries based on the IEF using the Multiple Reference Point method and they were able to improve the position of the observed countries that had the worst results through this research.

Further review of the literature demonstrated that various studies use double normalization. The technique that was most frequently used was DNMA (double-normalization-based multi-aggregation), which essentially makes use of double normalisation. With the help of the MCDM method with fuzzy information q-rung orthopair (q-ROFI), FUCOM (FUll COnsistency Method), and the DNMA method, Saha et al. (2022) chose the best medical waste management strategies. Liao et al. (2019) used the lung cancer-screening example to compare the effectiveness of the proposed models using the DNMA method and the fuzzy Delphi method. On the subject of the sustainable development of cloud service providers, Lai et al. (2020) applied the DNMA method based on Z-numbers and the Gini coefficient. The DNMA method was applied by Liao and Wu (2020) to the issue of ranking green companies as well as the selection of a tunnel excavation plan.

Using the Fermatean fuzzy approach and the DNMA method, Hezam et al. (2023) evaluated a digital sustainable transportation system for people with disabilities. Wang and Rani (2022) used the DNMA method in an intuitionistic fuzzy environment to assess risk in supply chain management. Lai and Liao (2021) used the CRITIC and DNMA methods with D numbers to address the challenges of evaluating blockchain platforms in the presence of information uncertainty. To choose among online financial products, Zhang et al. (2020) applied the Pythagorean fuzzy DNMA method.

In addition, the MARCOS (Measurement Alternatives and Ranking according to COmpromise Solution) method with double normalisation was used in the papers by Ivanović et al. (2022) and Saha et al. (2023). They made use of the benefits that applying double normalisation offered in terms of decision-making stability in their works. However, Ivanović et al. (2022) used the DNMARCOS method in conjunction with the MEREC method to select construction trucks for mixing concrete. On that occasion, double normalisation was used only with the DNMARCOS method, while single normalisation was used with the MEREC method. Saha et al. (2023) used a similar approach in their paper, using the CEBOM (Cross-Entropy-Based Optimization Model) method and a modification of the DNMARCOS method, specifically a score-based optimization approach.

3. Materials and methods

Economic freedoms are defined as the fundamental rights of every human being to control their own work and property (Ecer and Hashemkhani Zolfani, 2022). The degree of economic freedom determines how hard people work, produce, spend, and invest their capital. It is considered that individuals will be more willing to invest and start entrepreneurial ventures in a country with greater freedoms. That is why it is critical to examine which Balkan countries provide their citizens with the most economic freedom and which provide the least. The Heritage Foundation's IEF composite indicators were used in the development of this research. The IEF indicators for 2022 serve as the foundation for economic freedom research, and the following stages are used to accomplish this:

- Phase 1. Data collection for the analysis,

- •   Phase 2. Determining alternatives and criteria,
- •   Phase 3. Determining weights for the criteria,
- •   Phase 4. Ranking of the Balkan countries,
- •   Phase 5. Validating the results,
- •   Phase 6. Conducting sensitivity analysis.

Conducting Phase 1 of the research is done by accessing the Heritage Foundation website and searching for the latest IEF report. The last available report, including the database with all the indicators, is for the year 2022, and it is taken as a reference report for the analysis.

This is followed by Phase 2 of the research, which is determining alternatives and criteria. When determining the alternatives, the Southeast European countries or the Balkan countries are used. Seven countries of the Balkan Peninsula — Albania, Bosnia and Herzegovina (BH), Bulgaria, Greece, North Macedonia, Montenegro, and Serbia — represent the research's alternatives. Following that, the criteria of this research are determined, which are in fact 12 economic freedoms that are divided into four groups, namely: Rule of Law, which includes the indicators Property Rights, Judicial Effectiveness, Government Integrity; Government size, which includes the indicators Tax Burden, Government Spending and Fiscal Health; Regulatory Efficiency, which includes indicators of Business Freedom, Labour Freedom and Monetary Freedom; Open Markets, which includes indicators of Trade Freedom, Investment Freedom and Financial Freedom. These indicators (Table 1) represent the criteria used in this research.

<div align="center">Table 1. Criteria used in the research</div>

ID	Indicator	Definition
C1	Property Rights	The legal framework that allows individuals to acquire, hold and use private property
C2	Judicial Effectiveness	The legal framework that serves to protect the rights of citizens against illegal actions
C3	Government Integrity	Preventing negative practises such as corruption, bribery, and extortion, among others
C4	Tax Burden	Reflects on the personal and corporate marginal tax rates.
C5	Government Spending	Includes government spending and all transfer payments
C6	Fiscal Health	The degree of financial health that is related to the country's macroeconomic developments
C7	Business Freedom	The degree to which the state limits the efficiency of company operations
C8	Labour Freedom	A measure that examines various aspects of the labour market's real and regulatory framework
C9	Monetary Freedom	State measures regarding price stability and price control
C10	Trade Freedom	The extent of customs and non-tariff barriers affecting import and export
C11	Investment Freedom	Degree of free flow of the investment capital
C12	Financial Freedom	Indicator of banking efficiency and independence from government control

Source: Cabello et al. (2021)

After the alternatives and criteria have been determined, the third phase of this research begins, which is determining the weight of the criteria. The primary issue with using MCDM methods is determining criteria weights (Pamučar et al., 2012). In this research, we calculate the weights of the criteria using the Entropy method, particularly the Entropy with double normalisation. Therefore, the following steps are applied:

Step 1. Formation of the initial decision matrix. This step could be considered the first step in every MCDM method (Pamučar, et al., 2016; Božanić, et al., 2016) as all methods apply their steps to the initial decision matrix (Pamučar, et al., 2011a). The initial decision-making matrix is created through criterion-based evaluation of the selected alternatives (Pamučar, et al., 2011b).

Step 2. Normalization of the initial decision matrix. In this research, double normalisation is used, namely simple linear normalisation and vector normalisation. The expressions for simple linear normalisation are the following:

$$n'_{ij} = \frac{x_{ij}}{x_{j\,max}} \text{ , for benefit criteria,} \tag{1}$$

$$n'_{ij} = \frac{x_{j\,min}}{x_{ij}}, \text{for cost criteria.} \tag{2}$$

Where $x_{j\,max}$- s the maximum value of the alternative for a certain criterion, $x_{j\,min}$ – is the minimum value of the alternative for a certain criterion.

The expressions for vector normalisation are the following:

$$n''_{ij} = \frac{x_{ij}}{\sqrt{\sum_{k=1}^n x_{ij}^2}} \text{ , for benefit criteria,} \tag{3}$$

$$n''_{ij} = 1 - \frac{x_{ij}}{\sqrt{\sum_{k=1}^n x_{ij}^2}}, \text{ for cost criteria .} \tag{4}$$

The final value of the normalized decision matrix is formed by calculating the average value for these two normalizations by applying the following expression:

$$n_{ij} = \frac{n'_{ij} + n''_{ij}}{2} \tag{5}$$

Step 3. Determining the entropy value e_j. The logarithmic value of the normalised decision matrix is calculated first. That value is then multiplied by the normalised data, and the product sum is calculated. The results are multiplied by the negative value of the $k -$ constant values, by introducing the k, , calculated based on the expression $k = 1/\ln n$. In this case, "n" represents the number of alternatives used in the research.

$$e_j = -k \sum_{i=1}^n \ln n_{ij} \cdot n_{ij}, \; j = 1,2,\dots,m \tag{6}$$

Step 4. Calculation of the degree of divergence (d_j). This represents the difference between the number 1 and the entropy value.

$$d_j = 1 - e_j, \; j = 1,2,\dots,m \tag{7}$$

Step 5. Calculation of final criteria weights. In this step, individual values of the degree of divergence are divided by the sum of all values of the degree of divergence.

$$w_j = \frac{d_j}{\sum_{j=1}^m d_j} \tag{8}$$

In this way, the weight of the criteria is determined.

The following phase includes determining the order in which the Balkan countries should be ranked as alternatives in this research. The DNCRADIS method, or the CRADIS method with double normalisation, is used to rank these countries, with the note that Puška et al. (2022) pioneered the use of CRADIS method in 2022. This modified CRADIS method consists of the following steps:

Step 1 and Step 2 are identical to the Entropy method`s steps.

Step 3. Weighted decision matrices. Here, the values of the normalized decision matrix are multiplied by the corresponding weights for certain criteria using the expression:

$$v_{ij} = n_{ij} \times w_j. \tag{9}$$

Step 4. Determination of ideal and anti-ideal values. The ideal value represents the largest value of v_{ij}, while the anti-ideal value represents the smallest value of v_{ij}:

$$t_i = \max \tilde{v}_{ij} , \tag{10}$$

$$t_{ai} = \min \tilde{v}_{ij} \tag{11}$$

Step 5. Calculation of deviations from ideal and anti-ideal values:

$$d^+ = t_i - \tilde{v}_{ij} \tag{12}$$

$$d^- = \tilde{v}_{ij} - t_{ai} . \tag{13}$$

Step 6. Formation of ideal (A_{ia}) and anti-ideal optimal alternatives (A_{aia}) based on the deviation from the ideal and anti-ideal values. While the anti-ideal alternative is the one that is the furthest from the anti-ideal value for the observed criteria, the ideal alternative represents the alternative that is the least distant from the ideal value for the observed alternatives.

Step 7. Calculation of the sum of individual alternatives' deviations from ideal and anti-ideal values:

$$s_i^+ = \sum_{j=1}^n d^+ \tag{14}$$

$$s_i^- = \sum_{j=1}^n d^- \tag{15}$$

Step 8. Calculation of the utility function for each alternative based on the deviations from the optimal alternatives:

$$K_i^+ = \frac{s_0^+}{s_i^+} , \tag{16}$$

$$K_i^- = \frac{s_i^-}{s_0^-} . \tag{17}$$

Step 9. Determining the values by the CRADIS method:

$$Q_i = \frac{K_i^+ + K_i^+}{2} \tag{18}$$

The values obtained from the CRADIS method are used to rank alternatives. The alternative with the highest Q_i, value is the one that is ranked highest, and the alternative with the lowest Q_i value is the one that is ranked lowest.

Using the CRADIS method, alternatives are ranked, and it is determined which Balkan country has the best and which has the worst indicators according to the IEF.

The fifth phase of the research is the validation of the results. This phase is carried out in such a way that the Balkan countries' rankings are formed using various MCDM methods. Ranking methods such as SAW, ARAS, MABAC (multi-attributive border approximation area comparison), MARCOS, and TOPSIS are used in this research. Balkan countries are ranked using double normalisation and then the normalisation characteristic for the aforementioned methods. In this manner, it will first be established if the DNCRADIS method's results are consistent with the results of other DN methods, and then the rankings obtained by the standard versions of the methods will be compared.

The final stage of this research is to conduct a sensitivity analysis. The weights of the criteria are changed during a sensitivity analysis, and the impact of these changes on the final ranking of the alternative is observed. The weights of individual criteria are reduced by 15, 30, 45, 60, 75, and 90%, while the value of the other criteria remains unchanged (Stojanović et al., 2022). In doing so, it is investigated to what extent one of the criteria influences the ranking of Balkan countries. If the ranking order changes as a result of a criterion being reduced, it implies that the country that dropped in the ranking order had higher values for that criterion than the country that passed it. In this way, guidelines will be provided on how individual countries can improve their economic freedom in order to outperform other Balkan countries in terms of economic freedom.

4. Results

Before establishing a ranking order of Balkan countries in terms of economic freedom, an initial decision-making matrix must be established (Table 2). This matrix is created by entering the IEF value for each of the observed countries' criteria. Prior to ranking the Balkan countries based on this decision-making matrix, the weights of the criteria are calculated.

Table 2. Initial decision matrix

Country	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Albania	55.50	49.80	35.61	89.10	72.10	70.60	70.70	51.07	82.00	82.60	70.00	70.00
BH	49.20	37.20	33.36	94.00	46.20	95.90	66.60	60.22	84.90	68.80	65.00	60.00
Bulgaria	77.30	61.10	45.57	93.90	60.50	96.20	72.10	64.41	81.90	79.20	60.00	60.00
Greece	76.00	69.90	52.33	59.90	17.90	67.60	70.30	61.12	78.60	79.20	55.00	50.00
N.Macedonia	57.40	50.20	38.73	95.00	67.70	69.80	74.40	54.13	78.30	77.80	65.00	60.00
Montenegro	61.30	43.00	46.36	83.90	29.50	11.90	67.10	61.71	85.60	78.80	75.00	50.00
Serbia	58.80	50.40	37.92	90.90	42.50	85.70	74.40	62.90	81.60	77.00	70.00	50.00

When determining the weights of the criteria and the ranking of countries, the data from the initial decision-making matrix must first be normalised (Božanić and Pamučar, 2010). In this case, all of the criteria are of the benefit type, which means that their values should be as high as possible in order for an individual country to rank higher. Simple linear and vector normalisation are used to normalise data (Table 3).

Table 3. Simple linear normalization, vector normalization and double normalization values

Simple linear normalization												
Country	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Albania	0.718	0.712	0.680	0.938	1.000	0.734	0.950	0.793	0.958	1.000	0.933	1.000
BH	0.636	0.532	0.637	0.989	0.641	0.997	0.895	0.935	0.992	0.833	0.867	0.857
Bulgaria	1.000	0.874	0.871	0.988	0.839	1.000	0.969	1.000	0.957	0.959	0.800	0.857
Greece	0.983	1.000	1.000	0.631	0.248	0.703	0.945	0.949	0.918	0.959	0.733	0.714
N. Macedonia	0.743	0.718	0.740	1.000	0.939	0.726	1.000	0.840	0.915	0.942	0.867	0.857
Montenegro	0.793	0.615	0.886	0.883	0.409	0.124	0.902	0.958	1.000	0.954	1.000	0.714
Serbia	0.761	0.721	0.725	0.957	0.589	0.891	1.000	0.977	0.953	0.932	0.933	0.714
Vector normalization												
Country	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Albania	0.320	0.349	0.304	0.358	0.468	0.333	0.355	0.307	0.356	0.375	0.376	0.451
BH	0.284	0.261	0.285	0.377	0.300	0.453	0.334	0.362	0.368	0.312	0.349	0.386
Bulgaria	0.446	0.428	0.389	0.377	0.393	0.454	0.362	0.387	0.355	0.360	0.322	0.386
Greece	0.439	0.490	0.447	0.240	0.116	0.319	0.353	0.368	0.341	0.360	0.295	0.322
N. Macedonia	0.331	0.352	0.331	0.381	0.440	0.329	0.373	0.326	0.340	0.353	0.349	0.386
Montenegro	0.354	0.301	0.396	0.337	0.192	0.056	0.336	0.371	0.371	0.358	0.402	0.322
Serbia	0.339	0.353	0.324	0.365	0.276	0.404	0.373	0.378	0.354	0.350	0.376	0.322
Double normalization												
Country	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Albania	0.519	0.531	0.492	0.648	0.734	0.534	0.652	0.550	0.657	0.688	0.654	0.725
BH	0.460	0.396	0.461	0.683	0.470	0.725	0.615	0.649	0.680	0.573	0.608	0.622
Bulgaria	0.723	0.651	0.630	0.683	0.616	0.727	0.665	0.694	0.656	0.659	0.561	0.622
Greece	0.711	0.745	0.724	0.435	0.182	0.511	0.649	0.658	0.630	0.659	0.514	0.518
N. Macedonia	0.537	0.535	0.535	0.691	0.689	0.527	0.687	0.583	0.627	0.648	0.608	0.622
Montenegro	0.573	0.458	0.641	0.610	0.300	0.090	0.619	0.665	0.686	0.656	0.701	0.518
Serbia	0.550	0.537	0.524	0.661	0.433	0.648	0.687	0.677	0.654	0.641	0.654	0.518

The final value of the normalised decision matrix is calculated using these normalisation values. By computing the values from simple and vector normalisation, the final, or double, normalisation is obtained. In this way, the double normalisation is impacted, and both of these normalisations receive equal attention.

After calculating the double normalisation values, the weight of the criteria is obtained using the Entropy method. This method calculates the entropy value first, then the degree of divergence, and finally the weight of the criteria (table 4). The natural logarithm (ln) of the double normalisation value must be calculated in order to determine the degree of entropy. These tables must then be multiplied, the columns or criteria must be added, and the result is multiplied by the negative value of the constant (k). Subtraction of the entropy value from the value 1 produce the divergence degree. Finally, the final weight of the criteria is calculated by dividing the individual degrees of divergence by their sum. Thus, results show that criterion C2 - Judicial Effectiveness has the greatest weight, while criterion C9 - Monetary Freedom has the least.

Table 4. Calculation of weights using the Entropy method

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
ej	-2.517	-2.594	-2.529	-2.262	-2.401	-2.322	-2.235	-2.308	-2.225	-2.247	-2.378	-2.504
dj	-0.210	-0.247	-0.216	-0.088	-0.155	-0.117	-0.075	-0.110	-0.070	-0.080	-0.144	-0.204
w	0.123	0.144	0.126	0.051	0.090	0.068	0.044	0.064	0.041	0.047	0.084	0.119

The Balkan countries are ranked using the DNCRADIS method after the weights of the criteria have been determined. As previously stated, the first two steps are identical to the Entropy method. This method's third step is to weight the matrix with double normalisation. In this step, the values of this matrix are multiplied with the weights obtained by the entropy method, and a weighted decision matrix is formed (Table 5). From this matrix, the maximum and minimum values representing the ideal and anti-ideal values are sought. The ideal value is the value 0.1073 and it represents the maximum value of all data in this matrix, while the anti-ideal value is 0.0061 and this value represents the minimum value of all data in this decision matrix. The goal is for the alternative to be as far from the anti-ideal solution as possible while remaining as close to the ideal value as possible, and as a result, the deviation from these values is computed (Expressions 12 and 13). Following that, the optimal alternatives are sought, which are the values of the alternatives that are closest to the ideal value for all criteria, i.e., the most distant from the anti-ideal value. Utility functions are then calculated, and the DNCRADIS method's value is calculated afterwards.

Table 5. Weighted decision matrix

Country	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Albania	0.064	0.076	0.062	0.033	0.066	0.036	0.029	0.035	0.027	0.032	0.055	0.086
BH	0.056	0.057	0.058	0.035	0.042	0.049	0.027	0.042	0.028	0.027	0.051	0.074
Bulgaria	0.089	0.094	0.079	0.035	0.055	0.050	0.029	0.044	0.027	0.031	0.047	0.074
Greece	0.087	0.107	0.091	0.022	0.016	0.035	0.028	0.042	0.026	0.031	0.043	0.062
N. Macedonia	0.066	0.077	0.067	0.035	0.062	0.036	0.030	0.037	0.026	0.030	0.051	0.074
Montenegro	0.070	0.066	0.081	0.031	0.027	0.006	0.027	0.043	0.028	0.031	0.059	0.062
Serbia	0.067	0.077	0.066	0.034	0.039	0.044	0.030	0.043	0.027	0.030	0.055	0.062

Using the IEF report from 2022 and the research conducted using the DNEntropy and DNCRADIS methods, the results show that Bulgaria has the best indicators among the Balkan countries, while Montenegro has the worst (Table 6). A validation of the results is performed to confirm these results.

Table 6. Deviation from ideal and anti-ideal solutions and ranking of the alternatives

Country	s^+	s^-	K_i^+	K_i^-	Q_i	RANK
Albania	0.6865	0.5281	0.8308	0.8197	0.8253	2
BH	0.7419	0.4726	0.7687	0.7337	0.7512	6
Bulgaria	0.6342	0.5803	0.8993	0.9008	0.9001	1
Greece	0.6971	0.5174	0.8181	0.8031	0.8106	4
N. Macedonia	0.6962	0.5183	0.8192	0.8046	0.8119	3
Montenegro	0.7579	0.4566	0.7525	0.7088	0.7306	7
Serbia	0.7138	0.5008	0.7990	0.7773	0.7882	5
S_0	0.5703	0.6442				

The weight values obtained by the Entropy method and the application of double normalisation are used in the validation of the research results. The SAW, ARAS, MABAC, MARCOS, and TOPSIS methodologies using double normalisation are employed. The use of double normalisation in MCDM methods is confirmed by the fact that all of these methods produce the same rank order (figure 1).
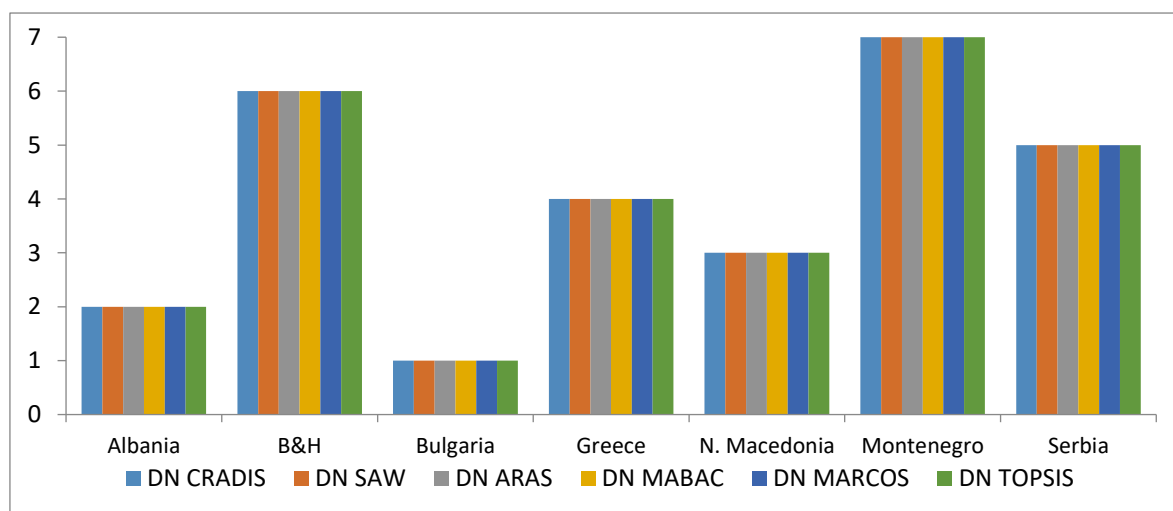
Figure 1. Ranking of Balkan countries using various MCDM methods (double normalisation)

To demonstrate that the use of double normalisation contributes to decision-making stability, the original MCDM methods' normalisations are used in the second part of this phase, having in mind that the TOPSIS method uses vector normalisation (Hwang & Yoon, 1981), the MABAC method uses complex linear normalisation (Božanić et al., 2016), and the ARAS method uses percentage normalisation (Zavadskas & Turskis, 2010). Figure 2 displays the outcomes of these rankings. By applying the original MCDM methods used in the validation of the results, the results showed that with the MABAC method, there was a change in the ranking of the alternatives. This could be explained by the normalisation process, as this method employed a complex linear normalisation that was excluded from the double normalisation. According to a comparison of these two rankings, the use of double normalisation helps stabilise decision-making.
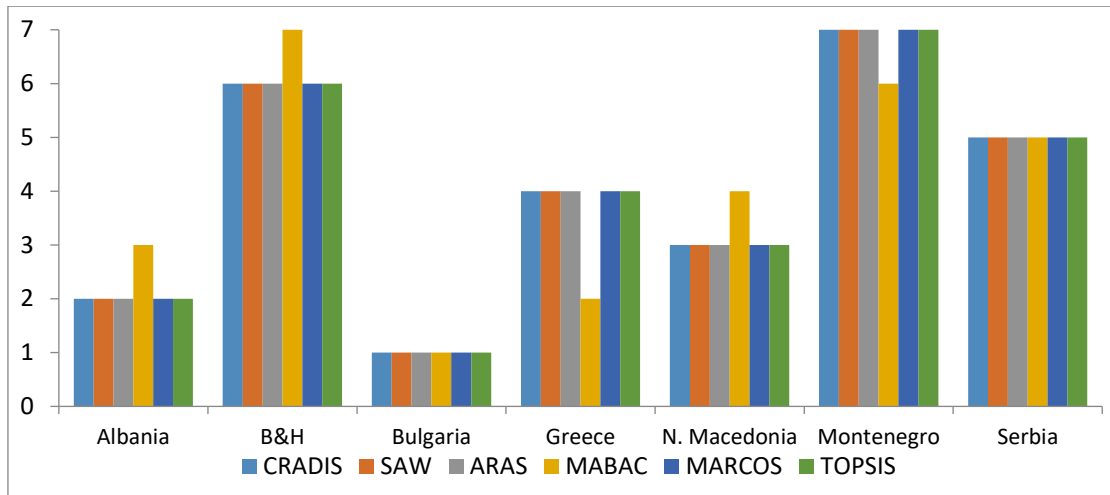
Figure 2. Ranking of Balkan countries using various MCDM methods (standard normalisation)

The sensitivity analysis stands as the last phase of this research, after the results have been validated and compared to traditional settings for different MCDM methods, and this analysis can be used to determine the consistency of research findings (Tešić and Božanić, 2018). The goal of such an analysis is to determine which criterion influences the change in alternative ranking and how. For example, the alternative will be ranked lower if a criterion with a higher initial weight is changed. To conduct the sensitivity analysis, scenarios are created first (Verma, et al., 2022; Bari and Karande, 2022). The basic idea behind this analysis is to freeze all criteria except one (Puška, 2011). In this research, each individual criterion is changed by 15%, resulting in six scenarios for each criterion. Since there are 12 criteria, 72 scenarios are generated.

The findings of this analysis show that Bulgaria took first place in all scenarios (Figure 3), revealing that this country has the best indicators of economic freedom of any Balkan country. Similarly, this analysis revealed that, with the exception of the 72nd scenario, Montenegro was ranked last in all scenarios. North Macedonia, Greece, and Serbia experienced the greatest changes in the rankings. Greece came in second place in seven of the scenarios, while Albania came in second place in the rest. North Macedonia was ranked third in the most scenarios, while Serbia was ranked fifth, and Bosnia and Herzegovina followed.
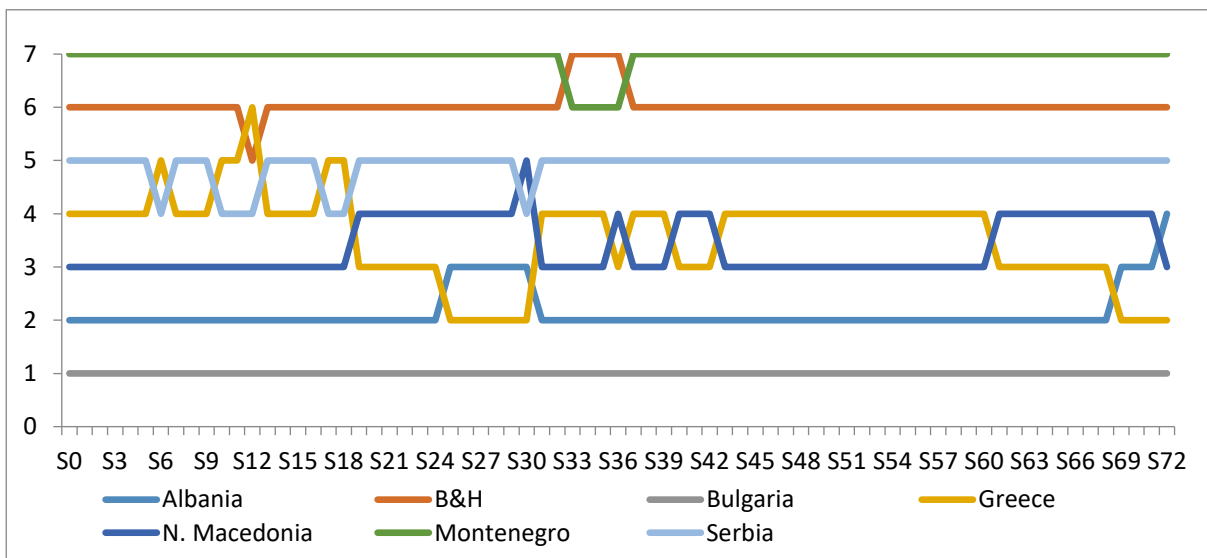

Figure 3. Results of the sensitivity analysis

5. Discussion

Economic freedom must dominate the country for it to draw in foreign investors and boost the domestic economy, as they are the foundation for increasing that country's competitiveness (Shahnazi and Dehghan Shabani, 2021). A guarantee of greater economic freedom is that all market participants will experience equal conditions (Harkati et al., 2020). Due to the fact that the Balkan nations, particularly those that were once part of Yugoslavia, are in a state of transition and are vying for foreign investment to spur economic growth, it was necessary to investigate the state of economic freedoms in those countries. The data used in this paper were derived from the Heritage Foundation's IEF report for the year 2022.

According to IEF data for 2022, there are 12 economic freedom indicators, and they were used as criteria in this research. Since there were multiple alternatives representing the Balkan countries and several criteria, this issue was addressed using a MCDM method (Rozman et al., 2016). As the first step in any MCDM method is to create the initial decision matrix, in this particular research, the decision-making matrix was designed with data on economic freedoms for Balkan countries taken from the IEF report for 2022. Entropy was used as an objective method to calculate the weights since they were not determined by experts but rather by the data from the initial decision matrix. The values of the natural logarithm are used in this method to determine the relationship between alternatives based on certain criteria. Along with Entropy, the CRADIS method was used to rank the Balkan countries in terms of economic freedom.

The normalisation of the data from the initial decision matrix is the second step in every MCDM method. The research presented in this paper takes a unique approach by employing double normalisation. This indicates the application of two types of normalization: simple linear and vector normalization. These normalisations are used in the DNMA method (Liao and Wu, 2020), which is why they were chosen specifically. Ivanović et al. (2022) used the DNMARCOS method in their research and also employed these normalisations. However, when applying them, their study adopted a different strategy, i.e., the MARCOS method's steps were corrected using the DNMARCOS method. In the research presented in this paper, the final normalised decision-making matrix was formed using these two normalisations, and these normalisations had an equal influence on the formation of the final decision-making matrix.

The results of this approach showed that by using the DNEntropy method, results indicated that criterion C2 - Judicial Effectiveness has the most weight, while criterion C9 - Monetary Freedom has the least weight. The weights of these criteria differed to the point where criterion C2 had three times the weight of criterion C9. This was due to the fact that the values in criterion C2 are more dispersed among themselves than the values in criterion C9. When using objective weighting methods, it can be stated that a criterion's weight increases as its dispersion increases, and vice versa (Mukhametzyanov, 2021). Using the DNCRADIS method, it was reported that Bulgaria has the highest indicators of economic freedom, while Montenegro has the lowest.

The validation of the results analysis revealed that the use of double normalisation contributes to the stability of the alternatives` ranking order. Using this normalisation resulted in the same ranking order for different MCDM methods. However, when using standard practices, the MABAC method's ranking changed. These differences occurred as a result of the complex linear normalisation used by the MABAC method that was not considered in the double normalisation procedure. The same ranking order of alternatives was maintained for the other methods. This leads to the conclusion that using double normalisation results in more reliable outcomes for MCDM methods.

Sensitivity analysis supported the results of this research as well. A more in-depth examination reveals that, when compared to Greece, Albania has significantly better indicators for criteria C5 - Government Spending and C12 - Financial Freedom, and that when the weight of those criteria was reduced, Greece ranked higher. Similarly, in comparison to Montenegro, Bosnia and Herzegovina has significantly better indicators for criterion

C9 - Monetary Freedom, and with the weight of this criterion reduced, Montenegro had better indicators. This means that in order for Montenegro to surpass Bosnia and Herzegovina, it must first improve criterion C9. Then, in order to outperform Greece, Bosnia and Herzegovina must improve the C2 criterion, etc. Therefore, wherever a country was ranked higher than another, it was imperative to improve on that specific criterion in order to move up in the ranking relative to other countries. The sensitivity analysis also revealed that Bulgaria had no bad indicators, which means that none of them deviate significantly from the others and are consistently good. That is the reason Bulgaria ranked first in every scenario. In the case of other countries, this analysis has revealed which indicators of economic freedom need to be improved in order to be ranked higher.

6. Conclusion

This paper's research examines economic freedoms using the Balkan countries as an example. The MCDM method with two normalisations was used to accomplish this. Both Entropy, which determined the weights of the criteria, and CRADIS, which ranked the Balkan countries, used these normalisations. The results of this methodology revealed that the most weight was given to criterion C9 - Monetary Freedom, which had the greatest dispersion in the country evaluations. Using the DNCRADIS method, results showed that Bulgaria has the best indicators of economic freedom when compared to other Balkan countries. Validating the results and conducting a sensitivity analysis confirmed these findings.

The limitations of this study could be identified in the preference of normalisations used for the double normalisation approach, as it was demonstrated that there was a difference in the ranking orders using the MABAC method. However, these normalisations were used based on the DNMA and DNMARCOS methods. The role that individual normalisations play in the final ranking of alternatives must therefore be investigated in future research. This leads to the conclusion that two or more normalisations should be used to ensure the highest level of stability for the ranking order of MCDM methods.

With the help of this research's example, it was demonstrated that MCDM methods could be used to evaluate a country's level of economic freedom, while it was also proven that the double normalisation helps to maintain stability in the ranking of alternatives. In this manner, the intended research objectives were achieved.

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