APPLICATION OF DIBR AND MAIRCA METHODS IN THE EVALUATION OF THE ECONOMIC PERFORMANCE OF THE ECONOMY OF BOSNIA AND HERZEGOVINA

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Abstract

The issue of analyzing factors of the dynamics of the economic performance of every economy, including Bosnia and Herzegovina (BiH), is continuously very current, challenging, significant, and complex. An adequate control of the key factors can significantly influence the achievement of the target economic performance of BiH's economy. The application of multi-criteria decision-making methods enables an adequate control of the key factors of the economic performance of BiH's economy. Bearing that in mind, this paper analyzes the dynamics of the economic performance of BiH's economy in the period 2013 - 2022 based on the DIBR and MAIRCA methods. The top five years of the economic performance of BiH's economy according to the DIBR and MAIRCA methods fall in the following order: 2021, 2022, 2018, 2019, and 2017. The worst economic performance in BiH's economy was registered in 2020, which was contributed, among other things, by the Covid-19 pandemic. Generally speaking, the economic performance of BiH's economy significantly improved recently. This was influenced by adequate management of the analyzed statistical variables (gross domestic product, inflation, agriculture, industry, export, import, capital, income, taxes, time required to start business – days, and domestic loans provided by the financial sector). The factors such as the geopolitical situation, the economic climate, foreign direct investments, the energy crisis, the digitalization of company's entire operation, the application of sustainable development concept and other others are also important. In any case, the adequate control of these variables can greatly influence the achievement of the target economic performance of BiH's economy.

Keywords: performance, Bosnia and Herzegovina (BiH), DIBR-MAIRCA method

JEL classification: C61. L32

1. Introduction

Research into the factors of the dynamics of the economic performance of every economy, including Bosnia and Herzegovina (BiH), is very challenging, significant, complex, and continuously current. It indicates the critical factors and the measures that should be taken so as to achieve the target economic performance of BiH's economy. Bearing that in mind, this paper analyzes the dynamic factors of the economic performance of BiH economy using the DIBR (Defining Interrelationships Between Ranked criteria) and MAIRCA (MultiAttributive Ideal-Real Comparative Analysis) methods. DIBR and MAIRCA are newer methods of multi-criteria decision-making. Based on a complex analysis using the given methodology, the real situation in terms of the achieved economic performance of BiH's economy can be viewed and relevant measures for improvement in the future can be proposed. Such measures include effective management of gross domestic product growth, inflation, industry, agriculture, import, export, income, taxes, time required to start a business – days, domestic loans provided by the financial sector, *etc*.

There is no doubt that permanent control of the key factors is the basic assumption for improving the economic performance of BiH's economy. In addition to the application of the ratio analysis, statistical analysis, and the multi-criteria decision-making methods, including DIBR and MAIRCA are used. The integrated application of the multi-criteria decision-making methods, specifically DIBR and MAIRCA, gives more accurate results of the achieved economic performance of BiH's economy as the basis for future improvement by applying adequate measures. In this paper, the analysis of the factors of the dynamics of the economic performance of BiH economy is

based on ratio analysis, statistical analysis and the use of DIBR and MAIRCA that enable the ranking of alternatives (in this particular case, the alternatives are the observed years) based on the simultaneous use of several selected relevant economic criteria. Knowing the positioning of the observed alternatives - years is a prerequisite for improvement in the future by applying relevant economic and other measures.

The literature devoted to the analysis of the economic performance of each economy is very rich. In classical literature, the analysis of the economic performance of the economy is mainly based on financial analysis, ratio analysis and statistical analysis. In recent times, multi-criteria decision-making methods (ARAS; MARCOS, PROMETHEE, TOPSIS, WASPAS, *etc*.) are increasingly applied when analyzing company performance (Ayçin & Arsu, 2021; Demir, 2021; Ecer, 2020; Ecer & Aycin, 2022; Glogovic *et al*., 2020; Liao, & Wu, 2020; Mandić *et al*., 2017; Mishra *et al*., 2022; Nguyen *et al*., 2022; Zohreh Moghaddas *et al*., 2022; Pamucar *et al*., 2014, 2018, 2021a,b; Popović *et al*., 2022; Rani *et al*., 2022; Stević *et al*., 2022; Tešić *et al*., 2022; Toslak *et al*., 2022; Lukic, 2020, 2021, 2023, a,b,c,d,e,f,g,h; Stojanović *et al*., 2022). Because multi-criteria decision-making methods lead to more realistic results compared to classical methods (such as, for example, financial analysis and ratio analysis) they serve as the basis for improvement in the future by applying relevant eco-friendly and other measures. Based on that, this paper analyzes the factors of economic performance dynamics of BiH's economy by using, the ratio analysis and statistical analysis, as well as the DIBR and MAIRCA methods. DIBR and MAIRCA are newer methods of multi-criteria decision-making and, compared to classic financial methods (for example the ratio analysis), they give more accurate results as they simultaneously integrate several indicators. This enables the selection of adequate economic and other measures to improve the economic performance of BiH's economy in the future. In this paper, the data from the World Bank are used because they fully correspond to the observed research on the analysis of dynamics factors of the economic performance of BiH economy using DIBR and MAIRCA.

2. Research methodology

In this paper, the dynamics factors of the economic performance of BiH economy are methodologically investigated using the DIBR and MAIRCA methods. Their characteristics are showed below.

DIBR (Defining Interrelationships Between Ranked criteria) is based on defining the relationship between the ranked criteria, i.e., adjacent criteria. It consists of five steps (Pamucar *et al*., 2021; Tešić *et al*., 2022):

Step 1. Ranking the criteria according to importance.

On a defined set of n criteria, $C = \{C_1, C_2, \dots, C_n\}$ the criteria are ranked according to their importance as $C_1 > C_2 > C_3 > \cdots > C_n$ (1)

Step 2. Comparison of the criteria and definition of mutual relations.

By comparing the criteria, the values $\lambda_{12}, \lambda_{13}, \dots, \lambda_{n-1,n}$ are obtained and λ_{1n}. Thus, for example, when comparing the criteria C_1 and C_2, the value λ_{12} is obtained, etc. All the compared values must satisfy the condition $\lambda_{n-1,n}, \lambda_{1n} \in [0,1]$. Based on the defined conditions and relationships, the following relationships between the criteria are derived:

$$\mathcal{W}_1 : \mathcal{W}_2 = (1 - \lambda_{12}) : \lambda_{12} \quad (2)$$
$$\mathcal{W}_2 : \mathcal{W}_3 = (1 - \lambda_{23}) : \lambda_{23} \quad (3)$$
$$\dots$$
$$\mathcal{W}_{n-1} : \mathcal{W}_n = (1 - \lambda_{n-1,n}) : \lambda_{n-1,n} \quad (4)$$
$$\mathcal{W}_1 : \mathcal{W}_n = (1 - \lambda_{1,n}) : \lambda_{1,n} \quad (5)$$

Ratios (1-4) and values $\lambda_{n-1,n}$ can be viewed as ratios of the criteria to which the decision-maker assigns the total importance in the interval of 100% for the two observed criteria.

Step 3. Defining equations for calculating the weight criteria.

Based on the relationship from step 2, the expressions for determining the weighting coefficients of the criteria $\mathcal{W}_1, \mathcal{W}_2, \dots, \mathcal{W}_n$ are derived:

$$\mathcal{W}_2 = \frac{\lambda_{12}}{(1-\lambda_{12})}\mathcal{W}_1 \quad (6)$$

$$\mathcal{W}_3 = \frac{\lambda_{23}}{(1-\lambda_{23})}\mathcal{W}_2 = \frac{\lambda_{12}\lambda_{23}}{(1-\lambda_{12})(1-\lambda_{23})}\mathcal{W}_1 \quad (7)$$

$$\mathcal{W}_n = \frac{\lambda_{n-1,n}}{(1-\lambda_{n-1,n})}\mathcal{W}_{n-1} = \frac{\lambda_{12}\lambda_{23}.\dots.\lambda_{n-1,n}}{(1-\lambda_{12})(1-\lambda_{23}).\dots.(1-\lambda_{n-1,n})}\mathcal{W}_1 = \frac{\prod_{i=1}^{n-1}\lambda_{i,i+1}}{\prod_{i=1}^{n-1}(1-\lambda_{i,i+1})}\mathcal{W}_1 \quad (8)$$

Step 4. Calculation of the weight coefficient of the most influential criterion.

Based on equations (6) - (8) and conditions $\sum_{j=1}^{n}\mathcal{W}_j = 1$, the following mathematical relationship is defined

$$\mathcal{W}_1\left(1 + \frac{\lambda_{12}}{(1-\lambda_{12})} + \frac{\lambda_{12}\lambda_{23}}{(1-\lambda_{12})(1-\lambda_{23})} + \dots + \frac{\prod_{i=1}^{n-1}\lambda_{i,i+1}}{\prod_{i=1}^{n-1}(1-\lambda_{i,i+1})}\right) = 1 \quad (9)$$

From expression (9), the final expression for defining the weight coefficient of the most influential criterion is derived:

$$\mathcal{W}_1 = \frac{1}{1 + \frac{\lambda_{12}}{(1-\lambda_{12})}, \frac{\lambda_{12}\lambda_{23}}{(1-\lambda_{12})(1-\lambda_{23})} + \dots + \frac{\prod_{i=1}^{n-1}\lambda_{i,i+1}}{\prod_{i=1}^{n-1}\lambda_{i,i+1}}} \quad (10)$$

Based on the obtained value $\mathcal{W}_1$ and the use of expressions (6) - (8), the weight coefficients of the other criteria $\mathcal{W}_2, \mathcal{W}_3, \dots, \mathcal{W}_n$ are obtained.

Step 5. Defining the degree of satisfaction of the subjective relationships between the criteria.

Based on expression (4), the value of the weighting coefficient of the criterion $\mathcal{W}_n$ is defined preference, and from which the value λ_(1,n)^, is defined, as evident in expression (11):

$$\mathcal{W}_n = \frac{\lambda_{1n}}{(1-\lambda_{1n})}\mathcal{W}_1 \quad (11)$$

Expression (5) is a relation for controlling expression (8), which is intended to check the satisfaction of the decision maker's

$$\lambda'_{1,n} = \frac{w_n}{w_1 + w_n} \quad (12)$$

If the values λ_{1n} $\lambda'_{1,n}$ are approximately equal, it can be concluded that the decision makers' preference is satisfied. If they differ, it is necessary to first check the ratio for λ_{1n}. If the decision-maker considers that the relationship is λ_{1n} well defined, the relationships between the criteria should be redefined and the weighting coefficients of the criteria should be calculated. If this is not the case, it is necessary to redefine the

relationship for λ_{1n}. It is necessary that the deviation of the values λ_{1n} and λ'_{1n} be a maximum of 10%. If this is not the case, it is necessary to redefine the relations between the criteria to satisfy this condition.

MAIRCA consists of defining the gap between the ideal and empirical rating. By summing the gap according to each criterion, the total gap is generated for each considered alternative. At the end of the process, the alternatives are ranked, with the best alternative being the one with the lowest gap value. In other words, the alternative with the smallest total value of the gap is the alternative, according to most criteria, closest to the ideal rating (ideal criterion value). The MAIRCA method is processed through six steps (Pamucar *et al.*, 2014, 2018; Glogovic, 2016):

Step 1. Formulation of the initial decision matrix (X).

The initial decision matrix with the value of the criteria $\left(x_{ij}, i = 1,2, \dots n; j = 1,2, \dots m\right)$ for each observed alternative is expressed as:

$$X = \begin{matrix} \\ A_1 \\ A_2 \\ \cdots \\ A_m \end{matrix} \begin{matrix} \begin{matrix} C_1 & C_2 & \cdots & C_n \end{matrix} \\ \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \end{matrix} \qquad (13)$$

Criteria can be quantitative (measurable) and qualitative (descriptive). The value of the quantitative criteria is obtained by quantifying the real indicators (measure, size) of the criteria. The value of qualitative criteria is determined by the preferences of decision-makers or, in the case of a larger number of experts, by aggregating expert opinions.

Step 2. Defining preferences for choosing alternatives P_{A_i}.

When choosing an alternative, the decision maker is neutral. This means that there is no particular preference for any of the offered alternatives. The assumption is that the decision-maker does not take into account the probability of choosing an alternative and that there is no preference in the process of choosing alternatives.

$$P_{A_i} = \frac{1}{m}; \sum_{i=1}^{m} P_{A_i} = 1, i = 1,2 \dots, m \qquad (14)$$

where m is the total number of selected alternatives. In the analysis of decision-making with a priori probability, the starting point is that the decision-maker is neutral about the probability of choosing each alternative. In that case, all preferences for choosing individual alternatives are equal, that is:

$$P_{A_1} = P_{A_2} = \cdots P_{A_m} \qquad (15)$$

where m is the total number of selected alternatives.

Step 3 . Calculation of the elements of the theoretical rating matrix (*Tp*).

The matrix format of the theoretical rating matrix (*Tp*) is n x m (where n is the total number of criteria and m is the total number of alternatives). The elements of the theoretical rating matrix (*Tpij*) are calculated as the product of the preferences of the selected alternatives $\left(P_{A_i}\right)$ and the weighting coefficients of the criteria (w_i , i =1,2,..., n).

$$T_p = \begin{matrix} \\ P_{A_1} \\ P_{A_2} \\ \cdots \\ P_{A_m} \end{matrix} \begin{matrix} \begin{matrix} w_1 & w_2 & \cdots & w_n \end{matrix} \\ \begin{bmatrix} t_{p11} & t_{p12} & \cdots & t_{p1n} \\ t_{p21} & t_{p22} & \cdots & t_{p2n} \\ \cdots & \cdots & \cdots & \cdots \\ t_{pm1} & t_{pm2} & \cdots & t_{pmn} \end{bmatrix} \end{matrix} = \begin{matrix} \\ P_{A_1} \\ P_{A_2} \\ \cdots \\ P_{A_m} \end{matrix} \begin{matrix} \begin{matrix} w_1 & w_2 & \cdots & w_n \end{matrix} \\ \begin{bmatrix} P_{A_1} . w_1 & P_{A_1} . w_2 & \cdots & P_{A_1} . w_n \\ P_{A_2} . w_1 & P_{A_2} . w_2 & \cdots & P_{A_a} . w_n \\ \cdots & \cdots & \cdots & \cdots \\ P_{A_m} . w_1 & P_{A_m} . w_2 & \cdots & P_{A_m} . w_n \end{bmatrix} \end{matrix} \quad (16)$$

Considering that the decision maker is neutral towards the initial selection of alternatives, preferences (P_{A_i}) are the same for all alternatives. Since the preferences are the same for all alternatives, the theoretical rating matrix ($(P_{A_i})Tp$) can also be rewritten in the form of *n* x 1 (where *n* is the total number of criteria).

$$T_p = P_{A_i} \begin{matrix} \begin{matrix} w_1 & w_2 & \cdots & w_n \end{matrix} \\ [t_{p1} \quad t_{p2} \quad \cdots \quad t_{pn}] \end{matrix} = P_{A_i} \begin{matrix} \begin{matrix} w_1 & w_2 & \cdots & w_n \end{matrix} \\ [P_{A_i} . w_1 \quad P_{A_i} . w_2 \quad \cdots \quad P_{A_i} . w_n] \end{matrix} \quad (17)$$

where *n* is the total number of criteria and *Tpi* is the theoretical rating.

Step 4. Defining the elements of the real rating matrix (*Tr*).

$$T_r = \begin{matrix} \\ A_1 \\ A_2 \\ \cdots \\ A_m \end{matrix} \begin{matrix} \begin{matrix} C_1 & C_2 & \cdots & C_n \end{matrix} \\ \begin{bmatrix} t_{r11} & t_{r12} & \ldots & t_{r1n} \\ t_{r21} & t_{r22} & \cdots & t_{r2n} \\ \cdots & \cdots & \cdots & \cdots \\ t_{rm1} & t_{rm2} & \cdots & t_{rmn} \end{bmatrix} \end{matrix} \quad (18)$$

where *n* represents the total number of criteria and *m* is the total number of alternatives.

When calculating the elements of the real rating matrix (T_r), the elements of the theoretical rating matrix (T_p) are multiplied by the elements of the initial decision matrix (X), using the following formulas:

For beneficial criteria (a high value of the criteria is preferred):

$$t_{rij} = t_{pij} \cdot \left(\frac{x_{ij} - x_i^-}{x_i^+ - x_i^-} \right) \quad (19)$$

For cost types of criteria (preferred lower value of criteria):

$$t_{rij} = t_{pij} \cdot \left(\frac{x_{ij} - x_i^+}{x_i^- - x_i^+} \right) \quad (20)$$

where x_{ij}, x_i^+ and x_i^- represent the elements of the initial decision matrix (X), and x_i^+ and x_i^- are defined as $x_i^+ = max(x_1, x_2, \ldots, x_m)$, representing the maximum value of the observed criterion by alternatives, $x_i^- = min(x_1, x_2, \ldots, x_m)$, representing the minimum value of the observed criterion by alternatives.

Step 5. Calculation of the total gap matrix (*G*).

The elements (*G*) of the matrix are obtained as the difference (gap) between the theoretical (t_{pij}) and real rating (t_{rij}), that is, the matrix of the theoretical rating (T_p) and the matrix of the real rating (T_r).

$$G = T_p - T_r = \begin{bmatrix} g_{11} & g_{12} & \cdots & g_{1n} \\ g_{21} & g_{22} & \cdots & g_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ g_{m1} & g_{m2} & \cdots & g_{mn} \end{bmatrix} = \begin{bmatrix} t_{p11} - t_{r11} & t_{p12} - t_{r12} & \cdots & t_{p1n} - t_{r1n} \\ t_{p21} - t_{r21} & t_{p22} - t_{r22} & \cdots & t_{p2n} - t_{r21} \\ \cdots & \cdots & \cdots & \cdots \\ t_{pm1} - t_{rm1} & t_{pm2} - t_{rm2} & \cdots & t_{pmn} - t_{rmn} \end{bmatrix} \quad (21)$$

where n represents the total number of criteria, and m is the total number of selected alternatives.

Gap g_{ij} takes the value from the interval $g_{ij} \in [0, \infty]$, i.e.,

$$g_{ij} = t_{pij} - t_{rij} \quad (22)$$

The preferred option is for g_{ij} to gravitate towards zero $(g_{ij} \to 0)$, since the alternative with a small difference between the theoretical rating (t_{pij}) and the real rating is chosen (t_{rij}). If for the criterion C_i alternative A_i has a theoretical rating value that is equal to the value of real rating $(t_{pij} = t_{rij})$, the gap for alternative A_i according to criterion C_i is $g_{ij} = 0$. In other words, the alternative A_i is, according to the criterion C_i, the best (ideal) alternative(A_i^+). If, according to the criterion C_i, the alternative A_i has the value of theoretical rating T_{pij}, and the real rating $T\,r_{ij} = 0$, the gap for the alternative A_i, according to the criterion C_i, is $g_{ij} = T_{pij}$. In other words, the alternative A_i is a worse (anti-ideal) alternative (A_i^-) according to the criterion C_i.

Step 6. Calculation of the final value of the criterion function (Q_i) by alternatives.
The value of the criterion function is obtained by summing the gap (g_{ij}) by alternatives, i.e., the elements (G) of the matrix by columns:

$$Q_i = \sum_{j=1}^{n} g_{ij}\,, \qquad i = 1,2,\ldots,m \quad (23)$$

n is the total number of criteria, and m is the total number of selected alternatives.

3. Results and discussion

To analyze the economic performance of every economy, including Bosnia and Herzegovina, different indicators can be used as criteria in multi-criteria decision-making models, including DIBRA-MAIRCA.

In this paper, the indicators (criteria) according to the statistics of the World Bank were used to analyze the economic performance of Bosnia and Herzegovina.

They were used comparatively for the comparative analysis of the economy of certain comparable countries.

The 12 indicators (gross domestic product, inflation, agriculture, industry, export, import, capital, income, taxes, time required to start business - days and domestic loans provided by the financial sector) used as the criteria according to the statistics of the World Bank were a measure of the quality of the economy of Bosnia and Herzegovina.

To research the problem treated in this paper, the relevant elements (criteria C1 – C12, alternatives A1 – A10 and initial empirical data) are showed in Table 1.

Table 1. *Initial data*

		GDP (current US$) (billion)	GDP growth (annual %)	Inflation, GDP deflator (annual %)	Agriculture, forestry, and fishing, value added (% of GDP)	Industry (including construction), value added (% of GDP)	Exports of goods and services (% of GDP)	Imports of goods and services (% of GDP)	Gross capital formation (% of GDP)	Revenue, excluding grants (% of GDP)	Tax revenue (% of GDP)	Time required to start a business (days)	Domestic credit provided by the financial sector (% of GDP)
		C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**
A1	2013	18.19	2.35	-0.22	6.84	22.32	33.74	54.19	21.23	38.45	19.75	82	65.07
A2	2014	18.56	1.15	1	5.95	22.16	33.99	56.56	22.53	39.42	19.78	82	65.2
A3	2015	16.4	4.31	1.36	6.04	21.73	35.11	53.18	21.69	38.13	19.7	82	63.19
A4	2016	17.12	3.24	1.33	6.16	22.34	35.91	52.33	22.71	37.69	19.71	80	62.03
A5	2017	18.33	3.24	1.78	5.43	23.12	40.32	56.32	24.63	38.19	19.99	80	61.55
A6	2018	20.48	3.82	2.79	5.72	23.71	41.98	56.45	24.41	38.33	20.14	80	59.88
A7	2019	20.48	2.88	2.47	5.45	23.2	40.04	54.48	24.48	37.56	19.83	80	59.67
A8	2020	20.23	-3.02	0.06	5.91	23.78	34.18	47.93	23.11	37.45	18.75	0	61.79
A9	2021	23.65	7.39	4.86	5.02	24.77	42.15	53.91	26.03	36.81	19.12	0	55.95
A10	2022	24.53	3.9	12.24	4.71	25.21	46.25	60.89	28.12	0	0	0	51.36

Statistics													
		C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**
N	Valid	10	10	10	10	10	10	10	10	10	10	10	10
	Missing	0	0	0	0	0	0	0	0	0	0	0	0
Mean		19.7970	2.9260	2.7670	5.7230	23.2340	38.3670	54.6240	23.8940	34.2030	17.6770	56.6000	60.5690
Std. Deviation		2.65284	2.63799	3.63009	.60612	1.14760	4.35715	3.36811	2.09243	12.03798	6.22457	39.06746	4.22409
The minimum		16.40	-3.02	-.22	4.71	21.73	33.74	47.93	21.23	.00	.00	.00	51.36
Maximum		24.53	7.39	12.24	6.84	25.21	46.25	60.89	28.12	39.42	20.14	82.00	65.20

Note: Author's statistics
Source: The World Bank, World Development Indicators.

Figure 1 shows the evaluation and determined weighting coefficients of the criteria at the bottom of the DIBR method.

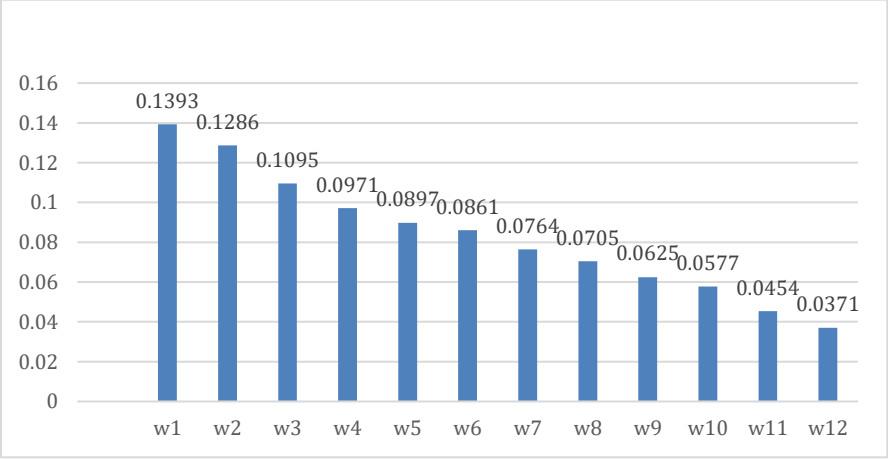

Figure 1. *Weight coefficients of criteria*
Source: Author's own work

Of all the criteria observed, the most important criterion in this particular case is C1 - GDP. A significant improvement in BiH's economic performance can be achieved by effective management of the gross domestic product. Certainly, the same applies to other criteria treated as factors of BiH's economic performance. In the specific case of calculation, the results of DIBR and MAIRCA applications are showed in Tables 2 - 6, and in Figure 2.

Table 2. *Initial Matrix*

Preferences for the Selection of Alternatives (Pai) 0.1000												
Initial Matrix												
weights of criteria	0.1393	0.1286	0.1095	0.0971	0.0897	0.0861	0.0764	0.0705	0.0625	0.0577	0.0454	0.0371
kind of criteria	1	1	1	1	1	1	1	1	1	1	1	1
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**
A1	18.19	2.35	-0.22	6.84	22.32	33.74	54.19	21.23	38.45	19.75	82	65.07
A2	18.56	1.15	1	5.95	22.16	33.99	56.56	22.53	39.42	19.78	82	65.2
A3	16.4	4.31	1.36	6.04	21.73	35.11	53.18	21.69	38.13	19.7	82	63.19
A4	17.12	3.24	1.33	6.16	22.34	35.91	52.33	22.71	37.69	19.71	80	62.03
A5	18.33	3.24	1.78	5.43	23.12	40.32	56.32	24.63	38.19	19.99	80	61.55
A6	20.48	3.82	2.79	5.72	23.71	41.98	56.45	24.41	38.33	20.14	80	59.88
A7	20.48	2.88	2.47	5.45	23.2	40.04	54.48	24.48	37.56	19.83	80	59.67
A8	20.23	-3.02	0.06	5.91	23.78	34.18	47.93	23.11	37.45	18.75	0	61.79
A9	23.65	7.39	4.86	5.02	24.77	42.15	53.91	26.03	36.81	19.12	0	55.95
A10	24.53	3.9	12.24	4.71	25.21	46.25	60.89	28.12	0	0	0	51.36
MAX	24.53	7.39	12.24	6.84	25.21	46.25	60.89	28.12	39.42	20.14	82	65.2
MIN	16.4	-3.02	-0.22	4.71	21.73	33.74	47.93	21.23	0	0	0	51.36

Source: Author's own work

Table 3. *Theoretical Ratings Matrix (Tp)*

Theoretical Ratings Matrix (Tp)												
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**
A1	0.0139	0.0129	0.0110	0.0097	0.0090	0.0086	0.0076	0.0071	0.0063	0.0058	0.0045	0.0037
A2	0.0139	0.0129	0.0110	0.0097	0.0090	0.0086	0.0076	0.0071	0.0063	0.0058	0.0045	0.0037
A3	0.0139	0.0129	0.0110	0.0097	0.0090	0.0086	0.0076	0.0071	0.0063	0.0058	0.0045	0.0037
A4	0.0139	0.0129	0.0110	0.0097	0.0090	0.0086	0.0076	0.0071	0.0063	0.0058	0.0045	0.0037
A5	0.0139	0.0129	0.0110	0.0097	0.0090	0.0086	0.0076	0.0071	0.0063	0.0058	0.0045	0.0037
A6	0.0139	0.0129	0.0110	0.0097	0.0090	0.0086	0.0076	0.0071	0.0063	0.0058	0.0045	0.0037
A7	0.0139	0.0129	0.0110	0.0097	0.0090	0.0086	0.0076	0.0071	0.0063	0.0058	0.0045	0.0037
A8	0.0139	0.0129	0.0110	0.0097	0.0090	0.0086	0.0076	0.0071	0.0063	0.0058	0.0045	0.0037
A9	0.0139	0.0129	0.0110	0.0097	0.0090	0.0086	0.0076	0.0071	0.0063	0.0058	0.0045	0.0037
A10	0.0139	0.0129	0.0110	0.0097	0.0090	0.0086	0.0076	0.0071	0.0063	0.0058	0.0045	0.0037

Source: Author's own work

Table 4. *Real Ratings Matrix (Tr)*

Real Ratings Matrix (Tr)												
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**
A1	0.0031	0.0066	0.0000	0.0097	0.0015	0.0000	0.0037	0.0000	0.0061	0.0057	0.0045	0.0037
A2	0.0037	0.0052	0.0011	0.0057	0.0011	0.0002	0.0051	0.0013	0.0063	0.0057	0.0045	0.0037
A3	0.0000	0.0091	0.0014	0.0061	0.0000	0.0009	0.0031	0.0005	0.0060	0.0056	0.0045	0.0032
A4	0.0012	0.0077	0.0014	0.0066	0.0016	0.0015	0.0026	0.0015	0.0060	0.0056	0.0044	0.0029
A5	0.0033	0.0077	0.0018	0.0033	0.0036	0.0045	0.0049	0.0035	0.0061	0.0057	0.0044	0.0027
A6	0.0070	0.0084	0.0026	0.0046	0.0051	0.0057	0.0050	0.0033	0.0061	0.0058	0.0044	0.0023
A7	0.0070	0.0073	0.0024	0.0034	0.0038	0.0043	0.0039	0.0033	0.0060	0.0057	0.0044	0.0022
A8	0.0066	0.0000	0.0002	0.0055	0.0053	0.0003	0.0000	0.0019	0.0059	0.0054	0.0000	0.0028
A9	0.0124	0.0129	0.0045	0.0014	0.0078	0.0058	0.0035	0.0049	0.0058	0.0055	0.0000	0.0012
A10	0.0139	0.0085	0.0110	0.0000	0.0090	0.0086	0.0076	0.0071	0.0000	0.0000	0.0000	0.0000

Source: Author's own work

Table 5. *Total Gap Matrix (G)*

Total Gap Matrix (G)												
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
A1	0.0109	0.0062	0.0110	0.0000	0.0074	0.0086	0.0039	0.0071	0.0002	0.0001	0.0000	0.0000
A2	0.0102	0.0077	0.0099	0.0041	0.0079	0.0084	0.0026	0.0057	0.0000	0.0001	0.0000	0.0000
A3	0.0139	0.0038	0.0096	0.0036	0.0090	0.0077	0.0045	0.0066	0.0002	0.0001	0.0000	0.0005
A4	0.0127	0.0051	0.0096	0.0031	0.0074	0.0071	0.0050	0.0055	0.0003	0.0001	0.0001	0.0008
A5	0.0106	0.0051	0.0092	0.0064	0.0054	0.0041	0.0027	0.0036	0.0002	0.0000	0.0001	0.0010
A6	0.0069	0.0044	0.0083	0.0051	0.0039	0.0029	0.0026	0.0038	0.0002	0.0000	0.0001	0.0014
A7	0.0069	0.0056	0.0086	0.0063	0.0052	0.0043	0.0038	0.0037	0.0003	0.0001	0.0001	0.0015
A8	0.0074	0.0129	0.0107	0.0042	0.0037	0.0083	0.0076	0.0051	0.0003	0.0004	0.0045	0.0009
A9	0.0015	0.0000	0.0065	0.0083	0.0011	0.0028	0.0041	0.0021	0.0004	0.0003	0.0045	0.0025
A10	0.0000	0.0043	0.0000	0.0097	0.0000	0.0000	0.0000	0.0000	0.0063	0.0058	0.0045	0.0037

Source: Author's own work

Table 6. *Ranking*

	ALTERNATIVES	Qi	Final Values of Criteria Functions (Qi)	RANKING
2013	A1	0.0554	0.0554	6
2014	A2	0.0565	0.0565	7
2015	A3	0.0596	0.0596	9
2016	A4	0.0570	0.0570	8
2017	A5	0.0484	0.0484	5
2018	A6	0.0397	0.0397	3
2019	A7	0.0464	0.0464	4
2020	A8	0.0661	0.0661	10
2021	A9	0.0342	0.0342	1
2022	A10	0.0343	0.0343	2

Source: Author's own work

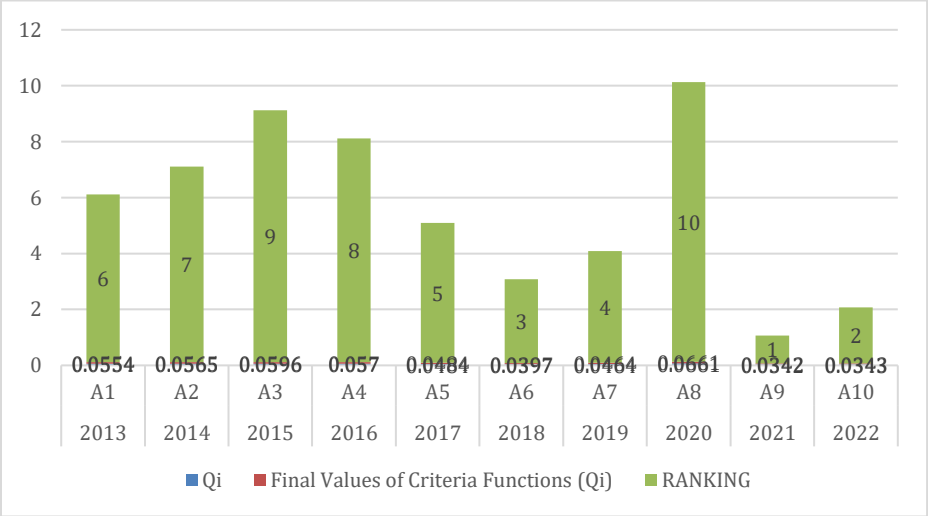

Figure 2. *Ranking*

Source: Author's own work

The results of the research show that the top five years in terms of BiH's economic performance are in the following order: 2021, 2022, 2018, 2019 and 2017. The worst economic performance of BiH was registered in 2020, which was certainly linked to the Covid-19 pandemic. Generally speaking, BiH's economic performance significantly improved. This was influenced by adequate management of the analyzed statistical variables treated as factors (gross domestic product, inflation, agriculture, industry,

export, import, capital, income, taxes, time required to start business - days, and domestic loans provided by the financial sector). In any case, the adequate control of these factors can greatly influence the achievement of the target economic performance of BiH.

The research in this paper showed that the application of multi-criteria decision-making methods, including DBR and MAIRCA, contributes to a better understanding of the dynamics of BiH's economic performance compared to the classical methodology (for example, the ratio analysis).

This provides a realistic basis for improving BiH's economic performance through the application of relevant economic and other measures. For these reasons, the application of multi-criteria decision-making methods in the analysis of BiH's economic performance is recommended.

As far as we know, there are no similar studies in the literature, so it is impossible to compare the results of this study with other similar results. It is hence recommended that the analysis of BiH's economic performance be performed using other multi-criteria decision-making methods (ARAS, TOPSIS, MARCOS, WASPAS, etc.). In that case, the reality of the dynamic ranking of BiH's economic performance can be better understood and, if necessary, relevant measures can be taken for improvement in the future.

4. Conclusion

The empirical research presented out in this paper shows that the top five years in terms of the achieved economic performance of BiH are: 2021, 2022, 2018, 2019 and 2017. The worst economic performance was registered in 2020 and it was affected, by the Covid-19 pandemic.

The economic performance of BiH significantly improved in the recent period. Adequate management of the analyzed statistical variables (gross domestic product, inflation, agriculture, industry, export, import, capital, income, taxes, time required to start business - days, and domestic loans provided by the financial sector) contributed to this.
In terms of the methodology, the analysis of BiH's economic performance can be done in different ways.

The advantage of the applied methodological approach presented in this work is that several indicators - criteria (in this particular case 12) were used in an integrated manner for the needs of dynamic ranking of BiH's economic performance. In this way, more precise results were obtained by individual observed years as an alternative in multi-criteria decision-making models, including DIBR-MAIRCA method. This enableed a better insight into when and what measures should be taken to improve BiH economic performance. For these reasons, it is recommended to apply the DIBR-MAIRCA method in the dynamic ranking of BiH's economic performance.

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