İŞLETME ARAŞTIRMALARI DERGİSİ
JOURNAL OF BUSINESS RESEARCH-TURK
2024, 16(1), 166-186
https://doi.org/10.20491/isarder.2024.1784

Analysis of Trade Competitiveness of the World's Leading Textiles Exporters by Hybrid MCDM Methods

İbrahim ÖZAYTÜRK [a] **Emre Kadir ÖZEKENCİ** [b]
[a]Niğde Ömer Halisdemir University, Niğde, Türkiye, ibrahim.ozayturk@ohu.edu.tr
[b]Çağ University, Mersin, Türkiye, ekadirozekenci@cag.edu.tr

ARTICLE INFO

Keywords:
Export
Textile
Trade competitiveness
MCDM

Received 6 October 2023
Revised 14 March 2024
Accepted 20 March 2024

Article Classification:
Research Article

ABSTRACT

Purpose – This paper demonstrates the application of the IDOCRIW-based MABAC and MAIRCA methods in the evaluation of the trade competitiveness of the top fifteen textiles exporters in the world.

Design/methodology/approach – The trade competitiveness index was used for assessing the trade competitiveness of exporters in the textile industry. The IDOCRIW method was used to obtain the weight of criteria. The analysis of the trade competitiveness of exporters was carried out using the new multi-criteria methods, namely the MABAC (Multi-Attributive Border Approximation area Comparison) and the MAIRCA (Multi-Atributive Ideal-Real Comparative Analysis).

Findings – According to the results obtained by the IDOCRIW method, share in the world market (SWM) and net exports (NEX) were determined as the most and least important criteria with weight values of 0,3297 and 0,0816, respectively. After determining the criteria weight, the alternatives were ranked using the MABAC and MAIRCA methods. The results for both methods indicate that China, Italy, Luxembourg, Belgium, and Spain have the highest trade competitiveness, while Croatia, Ireland, the Republic of Cyprus, Malta, and Mexico have the lowest trade competitiveness in the textile industry. The findings demonstrated that MABAC and MAIRCA provided consistent solutions for ranking the alternatives. Additionally, the consistency and robustness of the results were tested using two different scenarios. The overall results revealed that China and Italy have the best trade competitiveness in the textile industry.

Discussion – As expected, China and the European Unioun (EU) countries have the highest trade competitiveness in the world's textile industry. It can also be stated the textile industry is strategic sector for both the EU countries and China.

1. Introduction

The textile industry is one of the global sectors that employs tens of millions of people and provides for the basic needs of daily life (Desore & Narula, 2018: 1440). The textile industry interacts with many sectors from automotive to medicine, from construction to heavy industry. For instance, to get natural fibers including cotton and wool, the textile industry collaborates with the agriculture and livestock industry. For the supply of synthetic fiber, the textile industry cooperates with petrochemical industry (UNDP, 2021: 1). Thus, a variety of products are supplied by the textile industry, such as automotive textiles, geotextiles, medical textiles, sport textiles and industrial textiles (Roy et al., 2020). The world's textile and apparel industries play a significant role in global trade, especially for some developing and least developed nations where a significant number of exports are made up of clothes (McNamara, 2008). According to a study conducted by the Organization for Economic Co-operation and Development (OECD) in 2022, seventy-five million workers globally are employed in the textile and apparel sector, particularly in developing nations. Additionally, the textile industry has a significant contribution to the European market, with employed about 2 million people and a current annual turnover of approximately €165 bn (European Commission, 2020). In 2022, the size of the global textile market was approximately $1.70 trillion, and its revenue is expected to expand 7.6% from 2023 to 2030 (Grandview Research, 2023). According to the World Trade Organization (2022), the European Union (EU) countries and some developing countries, including China, India, Türkiye, Vietnam, Pakistan play a major role for the development of the textile industry. Another recent report published by the European Apparel and

Suggested Citation
Özaytürk, İ., Özekenci, E. K. (2024). Analysis of Trade Competitiveness of the World's Leading Textiles Exporters by Hybrid MCDM Methods, *Journal of Business Research-Turk*, 16 (1), 166-186.

Textile Confederation (EURATEX, 2023a), Europe is the world's second-largest exporter of apparel and textiles, after China. Considering the role of the textile industry in the global economy, the competitiveness of textile exporters is becoming more and more important.

Many scholars have examined the competitiveness of the textile industry for different countries, with various approaches (Ramachandran, 2001; Parrish et al., 2008; Vu & Pham, 2016; Başkol, 2018; Halife, 2022; Akhuand & Abbas, 2023). However, very few studies have investigated the trade competitiveness of countries based on the Multi-Criteria Decision-Making (MCDM) methods, even though MCDM methods have been widely used to analyze the economic performance of nations. Besides, MCDM methods have been significantly used to solve complex problems in the global economy. For instance, personnel selection (Dursun & Karsak, 2010), logistics performance (Martí et al., 2017), supplier selection (Yazdani et al., 2017), renewable energy development (Kumar et al., 2017), financial performance (Konak et al., 2018), macroeconomic performance (Arsu, 2022), or logistics performance (Özekenci, 2023) have been analyzed by MCDM methods.

In this study, the trade competitiveness index which was developed by the International Trade Centre (ITC) was used to evaluate the export performance and competitiveness of nations. The trade competitiveness index consists of five criteria, namely, the value of net export, per capita exports, the world market share, the diversification of products, and the diversification of markets. The criteria were determined based on the expert opinions and literature review (Brenton & Newfarmer, 2009; Farole et al., 2010; Madzova, 2018). Then, the alternatives were selected based on the World Trade Organization (WTO) and the European Apparel and Textile Confederation (EURATEX) reports. According to the WTO and EURATEX, the top 15 textiles exporters in the world are as follows: China, the EU, India, Türkiye, the United States (USA), Vietnam, the Republic of Korea, Pakistan, Taiwan, Japan, Hong Kong, United Kingdom, Thailand, Indonesia, and Mexico.

Correspondingly, the purpose of this study is to evaluate the trade competitiveness of the world's leading textiles exporters using the IDOCRIW-based MABAC and MAIRCA methods. The current study contributes to the existing literature in three ways: (i) determination of the weights of the criteria using two different objective methods (Entropy and CILOS) and aggregate weighting method (IDOCRIW), (ii) to the best of the author's knowledge, this is the first study to analyze the trade competitiveness of the world's leading textile exporters using the IDOCRIW-based MABAC and MAIRCA methods, (iii) the proposed model is confirmed through sensitivity analysis.

2. Literature Review

In recent years, a significant amount of research has been published on assessing the performances of countries using different MCDM methods. Some studies in the relevant field are presented in Table 1.

Table 1. A summary of previous research

Author(s)	Year	Topic	Methods	Findings
Urfalıoğlu & Genç	2013	The comparison of economic performance of European Union (EU) countries and Türkiye.	ELECTRE, PROMOTHEE, TOPSIS	The economic performance of Türkiye was low compared to EU countries based on ELECTRE and PROMETHEE methods.
Tunca et al.	2016	Investigation of the performance of OPEC countries.	ENTROPY & MAUT	Iran has the best performance, followed by Qatar and Saudi Arabia.
Karabıyık & Karabıyık	2018	Evaluating the international trade performance of OECD countries.	AHP & TOPSIS	Norway, Ireland, and Germany are the top three ranked while, Türkiye, the USA, and Greece are the bottom three.
Işık et al.	2018	Assessment of the export performance of emerging market economies.	Fuzzy AHP & TOPSIS	The Philippines has the highest export performance, followed by Malaysia and China.

Koca & Tunca	2019	Analyzing the economic performance of the G20 members.	Grey Relational Analysis	Many countries have been negatively affected by the global financial crisis.
Ayçin & Çakın	2019	Examining the innovation performance of countries in Europe.	ENTROPY & MABAC	Switzerland, Sweden, and Denmark have the highest innovation performance.
Fidan	2021	International target market selection for exporting company in Türkiye.	CRITIC & MAIRCA	The best alternative for international investment was Romania, followed by North Macedonia and Bulgaria.
Kahreman et al.	2021	Investigation of the foreign trade performance of the agricultural sector for selected OECD countries.	Fuzzy AHP & TOPSIS	Italy, the USA, and England showed the highest performance during the period of 2000-2019.
Koşaroğlu	2021	The comparison of the macroeconomic performance of E7 countries.	ENTROPY & ARAS	China has the best economic performance, while Brazil has the worst economic performance.
Hosseini et al.	2022	Determining the variables affecting Iranian citrus exports.	Delphi & Fuzzy DEMATEL	Exchange rate fluctuations have the most, while marketing has the least impact on the development of citrus exports.
Coşkun	2022	Evaluation of macroeconomic performance of BRICS-T countries.	ENTROPY & WASPAS	China has the best economic performance, while South Africa has the worst economic performance.
Munim et al.	2022	Forecasting the competitiveness of transshipment ports	ANP	Singapore has outperformed others in terms of competitiveness.
Miškić et al.	2023	Examining the logistics performance index (LPI) of the EU countries.	MEREC & MARCOS	Germany has the highest logistics performance.
Karaköy et al.	2023	Analysis of the economic freedom of EU countries.	Grey PSI & WEDBA-G	Ireland, Denmark, Netherlands, Finland, and Austria have the best performance.
Kara et al.	2024	Determining sustainable competitiveness levels of Türkiye	MEREC-AROMAN	Resource efficiency and intensity criterion has the highest level of significance.
Öztaş & Öztaş	2024	Innovation performance analyisis of G20 countries	LOPCOW-MAIRCA	Human capital, and research were found to be the most important indicators, and the United States was found to be the country with the best innovation performance.

Previous studies have shown that MCDM methods are widely used for performance measurement. Much of the current literature on relevant fields has focused on evaluating the economic performance of countries. Despite this, very few studies have investigated the trade performance of countries using MCDM methods. So far, no studies have been found which examine the trade competitiveness of the world's leading textile exporters using the IDOCRIW-based MABAC and MAIRCA methods. Thus, this study contributes to existing literature by providing a new hybrid MCDM model.

3. Methodology

This section describes the methods used in this study, including the calculation of criteria weights by the IDOCRIW method and the ranking of alternatives using the MABAC and MAIRCA methods.

3.1. IDOCRIW

Zavadskas and Podvezko proposed the Integrated Determination of Objective CRIteria Weights (IDOCRIW) method in 2016. This method utilizes the Entropy and Criterion Impact LOSs (CILOS) techniques to calculate the relative impact loss and attribute weighting in conjunction with two other methods. The application steps of the IDOCRIW method are as follows (Zavadskas & Podvezko, 2016; Zavadskas et al., 2017; Alinezhad & Khalili, 2019).

Step 1. Eq. (1) is used to determine the normalized values of the decision matrix.

$$\bar{r}_{ij} = \frac{r_{ij}}{\sum_{i=1}^{n} r_{ij}}; \quad j = 1, \ldots\ldots\ldots\ldots, n \tag{1}$$

Step 2. The degree of Entropy is calculated by Eq. (2).

$$E_j = -\frac{1}{\ln n} \sum_{i=1}^{n} r_{ij} . \ln \bar{r}_{ij} \quad j = 1, \ldots\ldots\ldots\ldots, n \quad 0 \leq E_j \leq 1 \tag{2}$$

Step 3. Based on the Eqs. (3) and (4), the deviation rate of the degree of the Entropy, and the Entropy weight is computed, respectively.

$$d_j = 1 - E_j; \quad j = 1, \ldots\ldots\ldots\ldots, n \tag{3}$$

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \tag{4}$$

Step 4. According to the Eqs. (5) and (6), the decision matrix's negative attributes are transformed into positive, and the square matrix values are calculated, respectively.

$$\hat{r}_{ij} = \frac{\min\limits_{i} r_{ij}}{r_{ij}}; \quad i, j \in \{1, \ldots\ldots\ldots, n\} \tag{5}$$

$$a_j = \max\limits_{i} \bar{r}_{ij} = a_{k_i j}; \quad i, j \in \{1, \ldots\ldots\ldots, n\} \tag{6}$$

Step 5. Eq. (7) is used to determine the relative impact loss matrix.

$$p_{ij} = \frac{a_{jj} - a_{ij}}{a_{jj}}; \quad i, j \in \{1, \ldots\ldots\ldots, n\} \quad p_{ij} = 0 \tag{7}$$

Step 6. Based on the Eq. (8), the weight system matrix is formed.

$$F = \begin{pmatrix} -\sum_{i=1}^{n} P_{\text{İ}1} & \cdots & P_{1n} \\ \vdots & \ddots & \vdots \\ P_{n1} & \cdots & -\sum_{i=1}^{n} P_{\text{İ}n} \end{pmatrix}_{nXn} \tag{8}$$

Step 7. Eq. (9) is used to calculate the criterion impact loss weight.

$$Fq^T = 0 \tag{9}$$

Step 8. According to the Entropy weight and CILOS weight, the aggregate weight value is obtained from the Eq. (10).

$$\omega_j = \frac{q_j.w_j}{\sum_{j=1}^{n} q_j.w_j} \tag{10}$$

For the final ranking, the aggregate weights of attributes are arranged in a descending order and are ranked accordingly.

3.2. MABAC

Pamucar and Cirovic proposed The Multi-Attributive Border Approximation area Comparison (MABAC) method in 2015. The fundamental idea of this approach is to determine the distance of the alternatives from the border approximation area. The ranking of each alternative is determined by stating the difference between the distances. The application steps of the MABAC method are as follows (Pamučar & Ćirović, 2015; Alinezhad & Khalili, 2019):

Step 1. Based on the Eqs. (11) and (12), the positive and negative attributes of the decision matrix are normalized, respectively.

$$r_{ij}^* = \frac{r_{ij} - r_i^-}{r_i^+ - r_i^-}; \qquad i = 1, \ldots\ldots, m \qquad j = 1, \ldots\ldots\ldots\ldots, n \tag{11}$$

$$r_{ij}^* = \frac{r_{ij} - r_i^+}{r_i^- - r_i^+}; \qquad i = 1, \ldots\ldots, m \qquad j = 1, \ldots\ldots\ldots\ldots, n \tag{12}$$

Step 2. Eq. (13) is used to determine the weighted normalized decision matrix.

$$\hat{r}_{ij} = w_j + r_{ij}^* w_j; \qquad i = 1, \ldots\ldots, m \qquad j = 1, \ldots\ldots\ldots\ldots, n \tag{13}$$

Step 3. According to the Eq. (14), the values of the border approximation area matrix are formed.

$$g_j = \left(\prod_{i=1}^{m} \hat{r}_{ij}\right)^{1/m}; \qquad j = 1, \ldots\ldots\ldots\ldots, n \tag{14}$$

Step 4. Eq. (15) is used to determine the distance from the border approximation area.

$$q_{ij} = \hat{r}_{ij} - g_i; \qquad i = 1, \ldots\ldots, m \qquad j = 1, \ldots\ldots\ldots\ldots, n \tag{15}$$

Step 5. Eq. (16) is used to calculate the total distance from the border approximate area.

$$S_i = \sum_{j=1}^{n} q_{ij}; \qquad i = 1, \ldots\ldots\ldots\ldots, m \tag{16}$$

The final ranking of alternatives is arranged in a descending order.

3.3. MAIRCA

The Multi Attributive Ideal-Real Comparative Analysis (MAIRCA) proposed by the Center for Logistics Research at the University of Defence in 2014. The determination of the difference between ideal and empirical weights is the basic assumption of the MAIRCA approach. By summing the gap for each criterion gives the total gap for each alternative observed. At the end, ranking the alternatives where the best-ranked alternative is the one with the smallest value for the total gap. The application steps of the MAIRCA method are as follows (Pamučar et al., 2014; Gigović et al., 2016; Pamučar et al., 2018):

Step 1. At first, initial decision matrix is formed. Based on the Eq. (17), initial decision matrix determines the criteria values for each alternative observed.

$$= \begin{matrix} A_1 \\ A_2 \\ \vdots \\ A_m \end{matrix} \overset{\begin{matrix} C_1 & C_2 & \cdots & C_n \end{matrix}}{\begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1n} \\ X_{21} & X_{22} & \cdots & X_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ X_{m1} & X_{m2} & \cdots & X_{mn} \end{bmatrix}} \tag{17}$$

Step 2. Eq. (18) is used to determine the preferences for the choice of alternatives P_{Ai}

$$P_{A_i} = \frac{1}{m}\,; \sum_{i=1}^{m} P_{A_i} = i = 1,2, \ldots\ldots\ldots\ldots, m \tag{18}$$

Step 3. According to Eq. (19), the calculation of the elements of theoretical ponders (T_p) is obtained.

$$T_p = P_{A_i} \lfloor t_{p1} \;\; t_{p2} \;\; \cdots \;\; t_{pn} \rfloor = P_{A_i} \lfloor P_{A_1}.w_1 \;\; P_{A_2}.w_2 \;\; \ldots \;\; P_{A_n}.w_n \rfloor \tag{19}$$

Step 4. Eq. (20) is used to determine the elements of actual ponders (T_r) matrix

$$t_{rij} = t_{rij} \cdot \left(\frac{X_{ij} - X_i^-}{X_i^+ - X_i^-} \right) \tag{20}$$

Step 5. Eq. (21) is utilized to calculate the total gap matrix (G). The matrix's elements are determined by the difference between the theoretical (T_p) and actual ponders (T_r).

$$G = T_p - T_r \tag{21}$$

Step 6. Based on the Eq. (22), the final values of criteria functions (Q_i) by alternatives are calculated.

$$Q_i = \sum_{j=1}^{n} g_{ij} \tag{22}$$

4. Application and Results

In this part, the results obtained from the proposed model are presented. In this study, the trade competitiveness of the world's leading textiles exporters is examined using hybrid MCDM methods. Table 2 illustrates the brief overview of the criteria.

Table 2. A brief synopsis of criteria

Indicators	Code	Definition	Values	Criteria Type	Source
Net exports	NEX	The algebraic sum of exports less imports	in thousand US$	Benefit	ITC Trade Map & COMTRADE
Per capita exports	PEX	The ratio of exports to inhabitants.	US$/inhabitant	Benefit	ITC Trade Map & COMTRADE
Share in world market	SWM	The ratio of the country's exports to total world's exports	Percentage (%)	Benefit	ITC Trade Map & COMTRADE
Product diversification	PDV	The inverse of the Herfindal Index.	N° of equivalent products	Benefit	ITC Trade Map & COMTRADE
Market diversification	MDV	The inverse of the Herfindal Index.	N° of equivalent markets	Benefit	ITC Trade Map & COMTRADE

It can be seen from the table above, five criteria, namely net exports, per capita exports, share in the world market, product diversification and market diversification were used to investigate the trade competitiveness of selected countries. All criteria are considered beneficial. Initially, a total of 41 countries, regarded as the world's leading textile exporters were included in the study. However, Hong-Kong was extracted due to insufficient data. Therefore, a total of 40 countries were examined in this study. Twenty-seven of forty-one countries are composed of European Union (EU) countries. Table 3 demonstrates the initial decision matrix of alternatives and attributes, which is based on information gathered from the ITC Trade Map and COMTRADE.

Table 3. The initial decision matrix

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	132.202,17	104.8	40.41	52	26	Estonia	-106,529	179.1	0.07	21	11
India	16.845,60	15,8	6.08	46	10	Finland	-596,74	53.4	0.08	15	17
Türkiye	9.360,72	187.3	4.33	25	25	France	-3.963,08	79.9	1.48	54	17
USA	-27.187,74	41.8	3.78	47	7	Germany	-550,232	189.8	4.31	38	23
Vietnam	-7.160,05	119.3	3.17	30	8	Greece	-374,675	75.0	0.22	21	15
Korea, Republic of	2.290,36	169.7	2.40	37	10	Hungary	27,536	149.7	0.40	9	19
Pakistan	7.649,65	39.8	2.52	16	12	Ireland	-631,565	40.0	0.05	23	8
Taiwan	6.680,80	0.0	2.35	26	9	Italy	3.089,42	206.8	3.34	88	23
Japan	-2.269,41	56.5	1.94	31	7	Latvia	19,162	163.3	0.08	12	18
United Kingdom	-5.597,77	45.6	0.84	59	18	Lithuania	-76,654	284.4	0.22	23	19
Thailand	-52,249	49.7	0.97	54	19	Luxemburg	348,212	987.2	0.17	4	9
Indonesia	-3.562,32	13,1	0.98	38	20	Malta	-10,01	86.2	0.01	2	3
Mexico	-2.284,31	24,8	0.86	10	1	Netherlands	159,611	384.6	1.84	28	10
EU (27)						Poland	-1.041,38	125.8	1.30	15	10
Austria	-641,702	242.6	0.59	30	9	Portugal	-97,128	249.9	0.70	32	12
Belgium	2.159,15	586.9	1.86	32	10	Romania	-1.602,69	91.4	0.48	28	13
Bulgaria	-529,587	106.7	0.20	30	14	Slovakia	151,6	213.3	0.32	13	10
Croatia	-382,095	62.7	0.07	21	8	Slovenia	107,174	318.7	0.18	18	13
Republic of Cyprus	-79,839	1,7	0.00	6	8	Spain	-613,566	110.7	1.43	89	10
Czech Republic	987,163	401.1	1.15	13	9	Sweden	-482,709	144.5	0.41	10	12
Denmark	-189,067	260.2	0.42	28	15						

4.1. The results obtained by IDOCRIW method.

As mentioned in the methods section, the IDOCRIW method consists of a combination of Entropy and CILOS methods. Therefore, the weights of criteria were determined by Entropy and CILOS methods, respectively.

Firstly, all the negative values were transformed into positive one. Then, the entropy weights (w_j) were calculated by Eqs. (1)-(4) and the results are shown in Table 4-7, respectively.

Table 4. Adjusted decision matrix

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	159.389,91	105,8	41,41	52	26	Estonia	27.081,21	180,1	1,07	21	11
India	44.033,34	16,8	7,08	46	10	Finland	27.187,14	54,4	1,08	15	17
Türkiye	36.548,46	188,3	5,33	25	25	France	23.224,66	80,9	2,48	54	17
USA	1	42,8	4,78	47	7	Germany	26.637,51	190,8	5,31	38	23
Vietnam	20.027,69	120,3	4,17	30	8	Greece	26.813,06	76	1,22	21	15
Korea, Republic of	29.478,09	170,7	3,4	37	10	Hungary	27.187,77	150,7	1,4	9	19
Pakistan	34.837,39	40,8	3,52	16	12	Ireland	26.556,17	41	1,05	23	8
Taiwan	33.868,53	1	3,35	26	9	Italy	30.277,16	207,8	4,34	88	23
Japan	24.918,33	57,5	2,94	31	7	Latvia	27.187,76	164,3	1,08	12	18
United Kingdom	21.589,97	46,6	1,84	59	18	Lithuania	27.187,66	285,4	1,22	23	19
Thailand	27.135,49	50,7	1,97	54	19	Luxemburg	27.535,95	988,2	1,17	4	9
Indonesia	23.625,42	14,1	1,98	38	20	Malta	27.787,73	87,2	1,01	2	3
Mexico	24.903,43	25,8	1,86	10	1	Netherlands	27.347,35	385,6	2,84	28	10
EU (27)						Poland	26.146,36	126,8	2,3	15	10
Austria	26.546,04	243,6	1,59	30	9	Portugal	27.187,64	250,8	1,7	32	12
Belgium	29.346,89	587,9	2,86	32	10	Romania	25.585,05	92,4	1,48	28	13
Bulgaria	26.658,15	107,7	1,2	30	14	Slovakia	27.187,89	214,3	1,32	13	10
Croatia	26.805,64	63,7	1,07	21	8	Slovenia	27.294,91	318,7	1,18	18	13
Republic of Cyprus	27.107,90	2,7	1	6	8	Spain	26.574,17	111,7	2,43	89	10
Czech Republic	28.174,90	402,1	2,15	13	9	Sweden	26.705,03	145,5	1,41	10	12
Denmark	26.998,67	261,2	1,42	28	15						

Table 5. Normalized decision matrix

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	0,1317	0,0158	0,3137	0,0443	0,0503	Estonia	0,0224	0,0269	0,0081	0,0179	0,0213
India	0,0364	0,0025	0,0536	0,0392	0,0193	Finland	0,0225	0,0081	0,0082	0,0128	0,0329
Türkiye	0,0302	0,0281	0,0404	0,0213	0,0484	France	0,0192	0,0121	0,0188	0,046	0,0329
USA	0,0000	0,0064	0,0362	0,0400	0,0135	Germany	0,022	0,0285	0,0402	0,0324	0,0445
Vietnam	0,0165	0,0179	0,0316	0,0256	0,0155	Greece	0,0221	0,0113	0,0092	0,0179	0,029
Korea, Republic of	0,0243	0,0255	0,0258	0,0315	0,0193	Hungary	0,0225	0,0225	0,0106	0,0077	0,0368
Pakistan	0,0288	0,0061	0,0267	0,0136	0,0232	Ireland	0,0219	0,0061	0,008	0,0196	0,0155
Taiwan	0,0280	0,0001	0,0254	0,0221	0,0174	Italy	0,025	0,031	0,0329	0,075	0,0445
Japan	0,0206	0,0086	0,0223	0,0264	0,0135	Latvia	0,0225	0,0245	0,0082	0,0102	0,0348
United Kingdom	0,0178	0,0070	0,0139	0,0503	0,0348	Lithuania	0,0225	0,0426	0,0092	0,0196	0,0368
Thailand	0,0224	0,0076	0,0149	0,0460	0,0368	Luxemburg	0,0227	0,1474	0,0089	0,0034	0,0174
Indonesia	0,0195	0,0021	0,0150	0,0324	0,0387	Malta	0,023	0,013	0,0077	0,0017	0,0058
Mexico	0,0206	0,0038	0,0141	0,0085	0,0019	Netherlands	0,0226	0,0575	0,0215	0,0239	0,0193
EU (27)						Poland	0,0216	0,0189	0,0174	0,0128	0,0193
Austria	0,0219	0,0363	0,012	0,0256	0,0174	Portugal	0,0225	0,0374	0,0129	0,0273	0,0232
Belgium	0,0242	0,0877	0,0217	0,0273	0,0193	Romania	0,0211	0,0138	0,0112	0,0239	0,0251
Bulgaria	0,022	0,0161	0,0091	0,0256	0,0271	Slovakia	0,0225	0,032	0,01	0,0111	0,0193
Croatia	0,0221	0,0095	0,0081	0,0179	0,0155	Slovenia	0,0225	0,0475	0,0089	0,0153	0,0251
Republic of Cyprus	0,0224	0,0004	0,0076	0,0051	0,0155	Spain	0,0219	0,0167	0,0184	0,0758	0,0193

Czech Republic	0,0233	0,06	0,0163	0,0111	0,0174	Sweden	0,0221	0,0217	0,0107	0,0085	0,0232
Denmark	0,0223	0,039	0,0108	0,0239	0,029						

Table 6. The degree of entropy (e_j)

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	-0,2669	-0,0655	-0,3637	-0,1381	-0,1504	Estonia	-0,085	-0,0972	-0,039	-0,072	-0,0819
India	-0,1205	-0,015	-0,1569	-0,1269	-0,0763	Finland	-0,0852	-0,0391	-0,0393	-0,0557	-0,1123
Türkiye	-0,1057	-0,1004	-0,1296	-0,082	-0,1465	France	-0,0758	-0,0533	-0,0747	-0,1416	-0,1123
USA	0,0000	-0,0323	-0,1202	-0,1288	-0,0582	Germany	-0,084	-0,1013	-0,1293	-0,111	-0,1385
Vietnam	-0,0679	-0,0722	-0,1091	-0,0937	-0,0645	Greece	-0,0844	-0,0508	-0,0433	-0,072	-0,1027
Korea, Republic of	-0,0905	-0,0935	-0,0942	-0,109	-0,0763	Hungary	-0,0852	-0,0853	-0,0482	-0,0373	-0,1214
Pakistan	-0,1021	-0,0311	-0,0966	-0,0585	-0,0873	Ireland	-0,0838	-0,0312	-0,0385	-0,077	-0,0645
Taiwan	-0,1001	-0,0013	-0,0932	-0,0844	-0,0705	Italy	-0,0922	-0,1077	-0,1123	-0,1942	-0,1385
Japan	-0,0799	-0,0408	-0,0847	-0,096	-0,0582	Latvia	-0,0852	-0,0909	-0,0393	-0,0468	-0,1169
United Kingdom	-0,0718	-0,0345	-0,0596	-0,1503	-0,1169	Lithuania	-0,0852	-0,1344	-0,0433	-0,077	-0,1214
Thailand	-0,0851	-0,0369	-0,0627	-0,1416	-0,1214	Luxemburg	-0,0861	-0,2822	-0,0419	-0,0194	-0,0705
Indonesia	-0,0768	-0,013	-0,063	-0,111	-0,1258	Malta	-0,0866	-0,0565	-0,0373	-0,0109	-0,0299
Mexico	-0,0799	-0,0214	-0,0601	-0,0406	-0,0121	Netherlands	-0,0856	-0,1643	-0,0826	-0,0891	-0,0763
EU (27)						Poland	-0,0828	-0,0751	-0,0706	-0,0557	-0,0763
Austria	-0,0838	-0,1205	-0,0532	-0,0937	-0,0705	Portugal	-0,0852	-0,1229	-0,056	-0,0982	-0,0873
Belgium	-0,0902	-0,2135	-0,083	-0,0982	-0,0763	Romania	-0,0815	-0,0591	-0,0503	-0,0891	-0,0926
Bulgaria	-0,084	-0,0664	-0,0427	-0,0937	-0,0977	Slovakia	-0,0852	-0,1101	-0,046	-0,0499	-0,0763
Croatia	-0,0844	-0,0442	-0,039	-0,072	-0,0645	Slovenia	-0,0855	-0,1448	-0,0422	-0,0641	-0,0926
Republic of Cyprus	-0,0851	-0,0031	-0,037	-0,027	-0,0645	Spain	-0,0838	-0,0682	-0,0735	-0,1956	-0,0763
Czech Republic	-0,0875	-0,1688	-0,0671	-0,0499	-0,0705	Sweden	-0,0841	-0,0831	-0,0485	-0,0406	-0,0873
Denmark	-0,0848	-0,1265	-0,0488	-0,0891	-0,1027						

Table 7. The entropy weight (w_j)

ej	0,9532	0,8774	0,8134	0,9375	0,9660
dj	0,0468	0,1226	0,1866	0,0625	0,0340
wj	0,1035	0,2709	0,4124	0,1380	0,0752

Afterwards, CILOS weights (q_j) were obtained by Eqs. (5)-(9) and the results are presented in Table 8-11, respectively.

Table 8. The square matrix

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	1,0837	0,0157	0,4392	0,0443	0,0503	Estonia	-0,0009	0,0269	0,0008	0,0179	0,0213
India	0,1381	0,0024	0,0661	0,0392	0,0193	Finland	-0,0049	0,0080	0,0009	0,0128	0,0329
Türkiye	0,0767	0,0281	0,0471	0,0213	0,0484	France	-0,0325	0,0120	0,0161	0,0460	0,0329
USA	-0,2229	0,0063	0,0411	0,0400	0,0135	Germany	-0,0045	0,0285	0,0468	0,0324	0,0445
Vietnam	-0,0587	0,0179	0,0345	0,0256	0,0155	Greece	-0,0031	0,0113	0,0024	0,0179	0,0290
Korea, Republic of	0,0188	0,0255	0,0261	0,0315	0,0193	Hungary	0,0002	0,0225	0,0043	0,0077	0,0368
Pakistan	0,0627	0,0060	0,0274	0,0136	0,0232	Ireland	-0,0052	0,0060	0,0005	0,0196	0,0155
Taiwan	0,0548	0,0000	0,0255	0,0221	0,0174	Italy	0,0253	0,0310	0,0363	0,0750	0,0445
Japan	-0,0186	0,0085	0,0211	0,0264	0,0135	Latvia	0,0002	0,0245	0,0009	0,0102	0,0348
United Kingdom	-0,0459	0,0068	0,0091	0,0503	0,0348	Lithuania	-0,0006	0,0427	0,0024	0,0196	0,0368

Thailand	-0,0004	0,0075	0,0105	0,046	0,0368	Luxemburg	0,0029	0,1481	0,0018	0,0034	0,0174
Indonesia	-0,0292	0,0020	0,0107	0,0324	0,0387	Malta	-0,0001	0,0129	0,0001	0,0017	0,0058
Mexico	-0,0187	0,0037	0,0093	0,0085	0,0019	Netherlands	0,0013	0,0577	0,0200	0,0239	0,0193
EU (27)						Poland	-0,0085	0,0189	0,0141	0,0128	0,0193
Austria	-0,0053	0,0364	0,0064	0,0256	0,0174	Portugal	-0,0008	0,0375	0,0076	0,0273	0,0232
Belgium	0,0177	0,0881	0,0202	0,0273	0,0193	Romania	-0,0131	0,0137	0,0052	0,0239	0,0251
Bulgaria	-0,0043	0,0160	0,0022	0,0256	0,0271	Slovakia	0,0012	0,0320	0,0035	0,0111	0,0193
Croatia	-0,0031	0,0094	0,0008	0,0179	0,0155	Slovenia	0,0009	0,0478	0,0020	0,0153	0,0251
Republic of Cyprus	-0,0007	0,0003	0,0000	0,0051	0,0155	Spain	-0,0050	0,0166	0,0155	0,0758	0,0193
Czech Republic	0,0081	0,0602	0,0125	0,0111	0,0174	Sweden	-0,0040	0,0217	0,0045	0,0085	0,0232
Denmark	-0,0015	0,0390	0,0046	0,0239	0,0290						

Table 9. The relative impact loss matrix

	NEX	PEX	SWM	PDV	MDV
NEX	1,0837	0,0157	0,4392	0,0443	0,0503
PEX	0,0029	0,1481	0,0018	0,0034	0,0174
SWM	1,0837	0,0157	0,4392	0,0443	0,0503
PDV	-0,0050	0,0166	0,0155	0,0758	0,0193
MDV	1,0837	0,0157	0,4392	0,0443	0,0503

Table 10. The weight system matrix

	NEX	PEX	SWM	PDV	MDV
NEX	0,0000	0,8939	0,0000	0,4155	0,0000
PEX	0,9973	0,0000	0,9959	0,9551	0,6540
SWM	0,0000	0,8939	0,0000	0,4155	0,0000
PDV	1,0046	0,8879	0,9647	0,0000	0,6163
MDV	0,0000	0,8939	0,0000	0,4155	0,0000
Total	**2,0019**	**3,5696**	**1,9606**	**2,2016**	**1,2703**

Table 11. The criterion impact loss weight

	NEX	PEX	SWM	PDV	MDV
NEX	-2,0019	0,8939	0,0000	0,4155	0,0000
PEX	0,9973	-3,5696	0,9959	0,9551	0,6540
SWM	0,0000	0,8939	-1,9606	0,4155	0,0000
PDV	1,0046	0,8879	0,9647	-2,2016	0,6163
MDV	0,0000	0,8939	0,0000	0,4155	-1,2703
$Q_i(w)$	0,1465	0,1996	0,1486	0,2760	0,2293

Finally, the aggregate weights (IDOCRIW) were determined using the Eq. (10). The results of criteria weight for the three methods are illustrated in Table 12.

Table 12. Weights obtained by Entropy, CILOS and Aggregate (IDOCRIW) methods.

Criterion	NEX	PEX	SWM	PDV	MDV
Weights obtained by Entropy method					
w	0,1035	0,2709	0,4124	0,1380	0,0752
Rank	**4**	**2**	**1**	**3**	**5**
Weights obtained by CILOS method					
w	0,1465	0,1996	0,1486	0,2760	0,2293
Rank	**5**	**3**	**4**	**1**	**2**
Aggregate IDOCRIW weights					
w	0,0816	0,2910	0,3297	0,2050	0,0927
Rank	**5**	**2**	**1**	**3**	**4**

According to the results of the Entropy method, share in the world market (SWM) and market diversification (MDV) were determined as the most and least important criteria with weight values of 0,4124 and 0,0752, respectively. Based on the results of the CILOS method, product diversification (PDV) and net exports (NEX) were determined as the most and least important criteria with weight values of 0,2760 and 0,1465, respectively. According to the aggregate (IDOCRIW) method, share in the world market (SWM) and net exports (NEX) were determined as the most and least important criteria with weight values of 0,3297 and 0,0816, respectively.

4.2. The results obtained by MABAC method.

Based on the Eqs. (11) and (16), a weighted normalized decision matrix, the values of the border approximation area (g_j), the distances from the border approximation area (q_{ij}) and the total distances from the border approximate area (S_i) were calculated, and the results are shown in Table 13-16, respectively.

Table 13. Weighted normalized decision matrix

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	0,1631	0,3219	0,6595	0,3228	0,1855	Estonia	0,0954	0,3438	0,3303	0,2498	0,1298
India	0,1041	0,2956	0,3794	0,3087	0,1261	Finland	0,0952	0,3067	0,3304	0,2356	0,1521
Türkiye	0,1003	0,3462	0,3651	0,2592	0,1817	France	0,0934	0,3145	0,3418	0,3275	0,1521
USA	0,0816	0,3033	0,3606	0,311	0,115	Germany	0,0952	0,3469	0,3649	0,2898	0,1743
Vietnam	0,0918	0,3261	0,3556	0,271	0,1187	Greece	0,0953	0,3131	0,3315	0,2498	0,1447
Korea, Republic of	0,0966	0,341	0,3493	0,2874	0,1261	Hungary	0,0955	0,3351	0,333	0,2215	0,1595
Pakistan	0,0994	0,3027	0,3503	0,238	0,1335	Ireland	0,0952	0,3028	0,3302	0,2545	0,1187
Taiwan	0,0989	0,291	0,3489	0,2615	0,1224	Italy	0,0971	0,3519	0,357	0,4076	0,1743
Japan	0,0943	0,3076	0,3456	0,2733	0,115	Latvia	0,0955	0,3391	0,3304	0,2285	0,1558
United Kingdom	0,0926	0,3044	0,3366	0,3393	0,1558	Lithuania	0,0954	0,3748	0,3315	0,2545	0,1595
Thailand	0,0954	0,3056	0,3377	0,3275	0,1595	Luxemburg	0,0957	0,582	0,3311	0,2097	0,1224
Indonesia	0,0937	0,2948	0,3377	0,2898	0,1632	Malta	0,0955	0,3164	0,3298	0,205	0,1001
Mexico	0,0943	0,2983	0,3368	0,2238	0,0927	Netherlands	0,0956	0,4043	0,3448	0,2662	0,1261
EU (27)						Poland	0,0949	0,3281	0,3404	0,2356	0,1261
Austria	0,0951	0,3625	0,3346	0,271	0,1224	Portugal	0,0954	0,3646	0,3355	0,2757	0,1335
Belgium	0,0966	0,464	0,3449	0,2757	0,1261	Romania	0,0947	0,3179	0,3337	0,2662	0,1372
Bulgaria	0,0952	0,3224	0,3314	0,271	0,1409	Slovakia	0,0956	0,3539	0,3324	0,2309	0,1261
Croatia	0,0953	0,3095	0,3303	0,2498	0,1187	Slovenia	0,0955	0,3849	0,3312	0,2427	0,1372
Republic of Cyprus	0,0954	0,2915	0,3297	0,2144	0,1187	Spain	0,0952	0,3236	0,3414	0,41	0,1261
Czech Republic	0,096	0,4092	0,3391	0,2309	0,1224	Sweden	0,0952	0,3336	0,3331	0,2238	0,1335
Denmark	0,0954	0,3677	0,3332	0,2662	0,1447						

Table 14. The border approximation area matrix (g_j)

	NEX	PEX	SWM	PDV	MDV
g_j	0,1022	0,3458	0,3551	0,2746	0,1421

Table 15. The distance from the border approximation area (q_{ij})

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	0,0609	-0,0239	0,3044	0,0482	0,0433	Estonia	-0,0068	-0,002	-0,0248	-0,0248	-0,0123
India	0,0018	-0,0502	0,0243	0,0341	-0,016	Finland	-0,0071	-0,0391	-0,0247	-0,039	0,01
Türkiye	-0,002	0,0004	0,01	-0,0154	0,0396	France	-0,0088	-0,0313	-0,0133	0,0529	0,01
USA	-0,0207	-0,0425	0,0055	0,0364	-0,0271	Germany	-0,0071	0,0011	0,0098	0,0152	0,0322
Vietnam	-0,0104	-0,0196	0,0005	-0,0036	-0,0234	Greece	-0,007	-0,0327	-0,0235	-0,0248	0,0025
Korea, Republic of	-0,0056	-0,0048	-0,0058	0,0129	-0,016	Hungary	-0,0068	-0,0107	-0,0221	-0,0531	0,0174

Pakistan	-0,0029	-0,0431	-0,0048	-0,0366	-0,0086	Ireland	-0,0071	-0,043	-0,0249	-0,0201	-0,0234
Taiwan	-0,0034	-0,0548	-0,0062	-0,0131	-0,0197	Italy	-0,0052	0,0061	0,0019	0,133	0,0322
Japan	-0,0079	-0,0382	-0,0095	-0,0013	-0,0271	Latvia	-0,0068	-0,0067	-0,0247	-0,046	0,0137
United Kingdom	-0,0096	-0,0414	-0,0185	0,0647	0,0137	Lithuania	-0,0068	0,029	-0,0235	-0,0201	0,0174
Thailand	-0,0068	-0,0402	-0,0174	0,0529	0,0174	Luxemburg	-0,0066	0,2362	-0,024	-0,0649	-0,0197
Indonesia	-0,0086	-0,0509	-0,0173	0,0152	0,0211	Malta	-0,0068	-0,0294	-0,0253	-0,0696	-0,042
Mexico	-0,0079	-0,0475	-0,0183	-0,0508	-0,0494	Netherlands	-0,0067	0,0586	-0,0103	-0,0083	-0,016
EU (27)						Poland	-0,0073	-0,0177	-0,0147	-0,039	-0,016
Austria	-0,0071	0,0167	-0,0205	-0,0036	-0,0197	Portugal	-0,0068	0,0188	-0,0196	0,0011	-0,0086
Belgium	-0,0057	0,1182	-0,0102	0,0011	-0,016	Romania	-0,0076	-0,0279	-0,0214	-0,0083	-0,0049
Bulgaria	-0,007	-0,0234	-0,0237	-0,0036	-0,0012	Slovakia	-0,0067	0,0081	-0,0227	-0,0437	-0,016
Croatia	-0,007	-0,0363	-0,0248	-0,0248	-0,0234	Slovenia	-0,0067	0,0391	-0,0239	-0,0319	-0,0049
Republic of Cyprus	-0,0068	-0,0543	-0,0253	-0,0602	-0,0234	Spain	-0,0071	-0,0222	-0,0137	0,1354	-0,016
Czech Republic	-0,0063	0,0634	-0,016	-0,0437	-0,0197	Sweden	-0,007	-0,0122	-0,022	-0,0508	-0,0086
Denmark	-0,0069	0,0219	-0,0219	-0,0083	0,0025						

Table 16. Total distances from the border approximate area (*S_i*)

Exporters	S_i	Rank	Exporters	S_i	Rank
China	0,4329	1	Estonia	-0,0708	26
India	-0,0060	13	Finland	-0,0999	34
Türkiye	0,0326	7	France	0,0095	9
USA	-0,0484	21	Germany	0,0513	6
Vietnam	-0,0566	22	Greece	-0,0855	30
Korea, Republic of	-0,0193	16	Hungary	-0,0753	27
Pakistan	-0,0959	32	Ireland	-0,1186	37
Taiwan	-0,0971	33	Italy	0,1681	2
Japan	-0,0840	29	Latvia	-0,0705	25
United Kingdom	0,0089	10	Lithuania	-0,0041	12
Thailand	0,0059	11	Luxemburg	0,1210	3
Indonesia	-0,0406	20	Malta	-0,1730	39
Mexico	-0,1739	40	Netherlands	0,0172	8
EU (27)			Poland	-0,0948	31
Austria	-0,0343	19	Portugal	-0,0151	15
Belgium	0,0874	4	Romania	-0,0701	24
Bulgaria	-0,0589	23	Slovakia	-0,0811	28
Croatia	-0,1163	36	Slovenia	-0,0283	18
Republic of Cyprus	-0,1701	38	Spain	0,0764	5
Czech Republic	-0,0222	17	Sweden	-0,1006	35
Denmark	-0,0127	14			

According to the results of the MABAC method, China, Italy, Luxembourg, Belgium, and Spain have the highest trade competitiveness in the textiles industry. On the other hand, Croatia, Ireland, the Republic of Cyprus, Malta, and Mexico have the lowest trade competitiveness in the textiles industry.

4.3. The results obtained by MAIRCA method.

According to the Eqs. (17) and (22), the preferences for the choice of alternatives (P_{Ai}), theoretical ponders (T_p), actual ponders (T_r), total gap matrix (G) and the final values of criteria functions (Q_i) by alternatives were determined and the results are presented in Table 17-22, respectively.

Table 17. Initial decision matrix

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
w	0,0816	0,2910	0,3297	0,2050	0,0927	*w*	0,0816	0,2910	0,3297	0,2050	0,0927
max	132.202,17	987,2	40,41	89	26	**max**	132.202,17	987,2	40,41	89	26
min	-27.187,74	0	0	2	1	**min**	-27.187,74	0	0	2	1
China	132.202,17	104.8	40.41	52	26	Estonia	-106,529	179.1	0.07	21	11
India	16.845,60	15,8	6.08	46	10	Finland	-596,74	53.4	0.08	15	17
Türkiye	9.360,72	187.3	4.33	25	25	France	-3.963,08	79.9	1.48	54	17
USA	-27.187,74	41.8	3.78	47	7	Germany	-550,232	189.8	4.31	38	23
Vietnam	-7.160,05	119.3	3.17	30	8	Greece	-374,675	75.0	0.22	21	15
Korea, Republic of	2.290,36	169.7	2.40	37	10	Hungary	27,536	149.7	0.40	9	19
Pakistan	7.649,65	39.8	2.52	16	12	Ireland	-631,565	40.0	0.05	23	8
Taiwan	6.680,80	0.0	2.35	26	9	Italy	3.089,42	206.8	3.34	88	23
Japan	-2.269,41	56.5	1.94	31	7	Latvia	19,162	163.3	0.08	12	18
United Kingdom	-5.597,77	45.6	0.84	59	18	Lithuania	-76,654	284.4	0.22	23	19
Thailand	-52,249	49.7	0.97	54	19	Luxemburg	348,212	987.2	0.17	4	9
Indonesia	-3.562,32	13,1	0.98	38	20	Malta	-10,01	86.2	0.01	2	3
Mexico	-2.284,31	24,8	0.86	10	1	Netherlands	159,611	384.6	1.84	28	10
EU (27)						Poland	-1.041,38	125.8	1.30	15	10
Austria	-641,702	242.6	0.59	30	9	Portugal	-97,128	249.9	0.70	32	12
Belgium	2.159,15	586.9	1.86	32	10	Romania	-1.602,69	91.4	0.48	28	13
Bulgaria	-529,587	106.7	0.20	30	14	Slovakia	151,6	213.3	0.32	13	10
Croatia	-382,095	62.7	0.07	21	8	Slovenia	107,174	318.7	0.18	18	13
Republic of Cyprus	-79,839	1,7	0.00	6	8	Spain	-613,566	110.7	1.43	89	10
Czech Republic	987,163	401.1	1.15	13	9	Sweden	-482,709	144.5	0.41	10	12
Denmark	-189,067	260.2	0.42	28	15						

After the initial decision matrix was formulated, the preferences for the alternatives P_{Ai} were defined as follows:

$$P_{Ai} = 1/m = 1/41 = 0.02439$$

The calculation of the theoretical ratings matrix's components is shown in Table 18.

Table 18. Theoretical rating matrix *(T_p)*

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	0,0020	0,0071	0,0080	0,0050	0,0023	Estonia	0,0020	0,0071	0,0080	0,0050	0,0023
India	0,0020	0,0071	0,0080	0,0050	0,0023	Finland	0,0020	0,0071	0,0080	0,0050	0,0023
Türkiye	0,0020	0,0071	0,0080	0,0050	0,0023	France	0,0020	0,0071	0,0080	0,0050	0,0023
USA	0,0020	0,0071	0,0080	0,0050	0,0023	Germany	0,0020	0,0071	0,0080	0,0050	0,0023
Vietnam	0,0020	0,0071	0,0080	0,0050	0,0023	Greece	0,0020	0,0071	0,0080	0,0050	0,0023
Korea, Republic of	0,0020	0,0071	0,0080	0,0050	0,0023	Hungary	0,0020	0,0071	0,0080	0,0050	0,0023
Pakistan	0,0020	0,0071	0,0080	0,0050	0,0023	Ireland	0,0020	0,0071	0,0080	0,0050	0,0023
Taiwan	0,0020	0,0071	0,0080	0,0050	0,0023	Italy	0,0020	0,0071	0,0080	0,0050	0,0023
Japan	0,0020	0,0071	0,0080	0,0050	0,0023	Latvia	0,0020	0,0071	0,0080	0,0050	0,0023
United Kingdom	0,0020	0,0071	0,0080	0,0050	0,0023	Lithuania	0,0020	0,0071	0,0080	0,0050	0,0023
Thailand	0,0020	0,0071	0,0080	0,0050	0,0023	Luxemburg	0,0020	0,0071	0,0080	0,0050	0,0023
Indonesia	0,0020	0,0071	0,0080	0,0050	0,0023	Malta	0,0020	0,0071	0,0080	0,0050	0,0023
Mexico	0,0020	0,0071	0,0080	0,0050	0,0023	Netherlands	0,0020	0,0071	0,0080	0,0050	0,0023
EU (27)						Poland	0,0020	0,0071	0,0080	0,0050	0,0023

Austria	0,0020	0,0071	0,0080	0,0050	0,0023	Portugal	0,0020	0,0071	0,0080	0,0050	0,0023
Belgium	0,0020	0,0071	0,0080	0,0050	0,0023	Romania	0,0020	0,0071	0,0080	0,0050	0,0023
Bulgaria	0,0020	0,0071	0,0080	0,0050	0,0023	Slovakia	0,0020	0,0071	0,0080	0,0050	0,0023
Croatia	0,0020	0,0071	0,0080	0,0050	0,0023	Slovenia	0,0020	0,0071	0,0080	0,0050	0,0023
Republic of Cyprus	0,0020	0,0071	0,0080	0,0050	0,0023	Spain	0,0020	0,0071	0,0080	0,0050	0,0023
Czech Republic	0,0020	0,0071	0,0080	0,0050	0,0023	Sweden	0,0020	0,0071	0,0080	0,0050	0,0023
Denmark	0,0020	0,0071	0,0080	0,0050	0,0023						

Then, the actual ratings matrix was calculated. This matrix was calculated by multiplying the components of the theoretical ratings matrix and the normalized decision matrix. Table 19 and 20 illustrates the values of normalized decision matrix and actual rating matrix, respectively.

Table 19. Normalized decision matrix

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	1,0000	0,1062	1,0000	0,5747	1,0000	Estonia	0,1699	0,1814	0,0017	0,2184	0,4000
India	0,2763	0,0160	0,1505	0,5057	0,3600	Finland	0,1668	0,0541	0,0020	0,1494	0,6400
Türkiye	0,2293	0,1897	0,1072	0,2644	0,9600	France	0,1457	0,0809	0,0366	0,5977	0,6400
USA	0,0000	0,0423	0,0935	0,5172	0,2400	Germany	0,1671	0,1923	0,1067	0,4138	0,8800
Vietnam	0,1257	0,1208	0,0784	0,3218	0,2800	Greece	0,1682	0,0760	0,0054	0,2184	0,5600
Korea, Republic of	0,1849	0,1719	0,0594	0,4023	0,3600	Hungary	0,1707	0,1516	0,0099	0,0805	0,7200
Pakistan	0,2186	0,0403	0,0624	0,1609	0,4400	Ireland	0,1666	0,0405	0,0012	0,2414	0,2800
Taiwan	0,2125	0,0000	0,0582	0,2759	0,3200	Italy	0,1900	0,2095	0,0827	0,9885	0,8800
Japan	0,1563	0,0572	0,0480	0,3333	0,2400	Latvia	0,1707	0,1654	0,0020	0,1149	0,6800
United Kingdom	0,1355	0,0462	0,0208	0,6552	0,6800	Lithuania	0,1701	0,2881	0,0054	0,2414	0,7200
Thailand	0,1702	0,0503	0,0240	0,5977	0,7200	Luxemburg	0,1728	1,0000	0,0042	0,0230	0,3200
Indonesia	0,1482	0,0133	0,0243	0,4138	0,7600	Malta	0,1705	0,0873	0,0002	0,0000	0,0800
Mexico	0,1562	0,0251	0,0213	0,0920	0,0000	Netherlands	0,1716	0,3896	0,0455	0,2989	0,3600
EU (27)						Poland	0,1640	0,1274	0,0322	0,1494	0,3600
Austria	0,1665	0,2457	0,0146	0,3218	0,3200	Portugal	0,1700	0,2531	0,0173	0,3448	0,4400
Belgium	0,1841	0,5945	0,0460	0,3448	0,3600	Romania	0,1605	0,0926	0,0119	0,2989	0,4800
Bulgaria	0,1673	0,1081	0,0049	0,3218	0,5200	Slovakia	0,1715	0,2161	0,0079	0,1264	0,3600
Croatia	0,1682	0,0635	0,0017	0,2184	0,2800	Slovenia	0,1712	0,3228	0,0045	0,1839	0,4800
Republic of Cyprus	0,1701	0,0017	0,0000	0,0460	0,2800	Spain	0,1667	0,1121	0,0354	1,0000	0,3600
Czech Republic	0,1768	0,4063	0,0285	0,1264	0,3200	Sweden	0,1675	0,1464	0,0101	0,0920	0,4400
Denmark	0,1694	0,2636	0,0104	0,2989	0,5600						

Table 20. Actual rating matrix *(T_r)*

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	0,0020	0,0008	0,0080	0,0029	0,0023	Estonia	0,0003	0,0013	0,0000	0,0011	0,0009
India	0,0005	0,0001	0,0012	0,0025	0,0008	Finland	0,0003	0,0004	0,0000	0,0007	0,0014
Türkiye	0,0005	0,0013	0,0009	0,0013	0,0022	France	0,0003	0,0006	0,0003	0,0030	0,0014
USA	0,0000	0,0003	0,0008	0,0026	0,0005	Germany	0,0003	0,0014	0,0009	0,0021	0,0020
Vietnam	0,0002	0,0009	0,0006	0,0016	0,0006	Greece	0,0003	0,0005	0,0000	0,0011	0,0013
Korea, Republic of	0,0004	0,0012	0,0005	0,0020	0,0008	Hungary	0,0003	0,0011	0,0001	0,0004	0,0016
Pakistan	0,0004	0,0003	0,0005	0,0008	0,0010	Ireland	0,0003	0,0003	0,0000	0,0012	0,0006
Taiwan	0,0004	0,0000	0,0005	0,0014	0,0007	Italy	0,0004	0,0015	0,0007	0,0049	0,0020
Japan	0,0003	0,0004	0,0004	0,0017	0,0005	Latvia	0,0003	0,0012	0,0000	0,0006	0,0015
United Kingdom	0,0003	0,0003	0,0002	0,0033	0,0015	Lithuania	0,0003	0,0020	0,0000	0,0012	0,0016
Thailand	0,0003	0,0004	0,0002	0,0030	0,0016	Luxemburg	0,0003	0,0071	0,0000	0,0001	0,0007

Indonesia	0,0003	0,0001	0,0002	0,0021	0,0017	Malta	0,0003	0,0006	0,0000	0,0000	0,0002
Mexico	0,0003	0,0002	0,0002	0,0005	0,0000	Netherlands	0,0003	0,0028	0,0004	0,0015	0,0008
EU (27)						Poland	0,0003	0,0009	0,0003	0,0007	0,0008
Austria	0,0003	0,0017	0,0001	0,0016	0,0007	Portugal	0,0003	0,0018	0,0001	0,0017	0,0010
Belgium	0,0004	0,0042	0,0004	0,0017	0,0008	Romania	0,0003	0,0007	0,0001	0,0015	0,0011
Bulgaria	0,0003	0,0008	0,0000	0,0016	0,0012	Slovakia	0,0003	0,0015	0,0001	0,0006	0,0008
Croatia	0,0003	0,0005	0,0000	0,0011	0,0006	Slovenia	0,0003	0,0023	0,0000	0,0009	0,0011
Republic of Cyprus	0,0003	0,0000	0,0000	0,0002	0,0006	Spain	0,0003	0,0008	0,0003	0,0050	0,0008
Czech Republic	0,0004	0,0029	0,0002	0,0006	0,0007	Sweden	0,0003	0,0010	0,0001	0,0005	0,0010
Denmark	0,0003	0,0019	0,0001	0,0015	0,0013						

After forming the actual ratings matrix, the total gap matrix was calculated. This matrix is calculated as a difference between the theoretical ratings and actual ratings. The results of the total gap matrix are presented in Table 21.

Table 21. Total gap matrix *(G)*

Exporters	NEX	PEX	SWM	PDV	MDV	Exporters	NEX	PEX	SWM	PDV	MDV
China	0,0000	0,0063	0,0000	0,0021	0,0000	Estonia	0,0017	0,0058	0,0080	0,0039	0,0014
India	0,0014	0,0070	0,0068	0,0025	0,0014	Finland	0,0017	0,0067	0,0080	0,0043	0,0008
Türkiye	0,0015	0,0058	0,0072	0,0037	0,0001	France	0,0017	0,0065	0,0077	0,0020	0,0008
USA	0,0020	0,0068	0,0073	0,0024	0,0017	Germany	0,0017	0,0057	0,0072	0,0029	0,0003
Vietnam	0,0017	0,0062	0,0074	0,0034	0,0016	Greece	0,0017	0,0066	0,0080	0,0039	0,0010
Korea, Republic of	0,0016	0,0059	0,0076	0,0030	0,0014	Hungary	0,0016	0,0060	0,0080	0,0046	0,0006
Pakistan	0,0016	0,0068	0,0075	0,0042	0,0013	Ireland	0,0017	0,0068	0,0080	0,0038	0,0016
Taiwan	0,0016	0,0071	0,0076	0,0036	0,0015	Italy	0,0016	0,0056	0,0074	0,0001	0,0003
Japan	0,0017	0,0067	0,0077	0,0033	0,0017	Latvia	0,0016	0,0059	0,0080	0,0044	0,0007
United Kingdom	0,0017	0,0068	0,0079	0,0017	0,0007	Lithuania	0,0017	0,0051	0,0080	0,0038	0,0006
Thailand	0,0017	0,0067	0,0078	0,0020	0,0006	Luxemburg	0,0016	0,0000	0,0080	0,0049	0,0015
Indonesia	0,0017	0,0070	0,0078	0,0029	0,0005	Malta	0,0017	0,0065	0,0080	0,0050	0,0021
Mexico	0,0017	0,0069	0,0079	0,0045	0,0023	Netherlands	0,0016	0,0043	0,0077	0,0035	0,0014
EU (27)						Poland	0,0017	0,0062	0,0078	0,0043	0,0014
Austria	0,0017	0,0054	0,0079	0,0034	0,0015	Portugal	0,0017	0,0053	0,0079	0,0033	0,0013
Belgium	0,0016	0,0029	0,0077	0,0033	0,0014	Romania	0,0017	0,0064	0,0079	0,0035	0,0012
Bulgaria	0,0017	0,0063	0,0080	0,0034	0,0011	Slovakia	0,0016	0,0056	0,0080	0,0044	0,0014
Croatia	0,0017	0,0066	0,0080	0,0039	0,0016	Slovenia	0,0016	0,0048	0,0080	0,0041	0,0012
Republic of Cyprus	0,0017	0,0071	0,0080	0,0048	0,0016	Spain	0,0017	0,0063	0,0078	0,0000	0,0014
Czech Republic	0,0016	0,0042	0,0078	0,0044	0,0015	Sweden	0,0017	0,0061	0,0080	0,0045	0,0013
Denmark	0,0017	0,0052	0,0080	0,0035	0,0010						

At the end, the values of criteria functions by alternatives were calculated by the sum of the matrix components by columns. Preferably, the alternative should have the smallest value of the total gap. Table 22 presents the final ranking among the alternatives.

Table 22. The alternatives ranked by the MAIRCA method.

Exporters	(Q_i)	Rank	Exporters	(Q_i)	Rank
China	0,0085	1	Estonia	0,0208	26
India	0,0192	13	Finland	0,0215	34
Türkiye	0,0182	7	France	0,0188	9
USA	0,0202	21	Germany	0,0178	6
Vietnam	0,0204	22	Greece	0,0211	30

Korea, Republic of	0,0195	16	Hungary	0,0209	27
Pakistan	0,0214	32	Ireland	0,0219	37
Taiwan	0,0214	33	Italy	0,0149	2
Japan	0,0211	29	Latvia	0,0207	25
United Kingdom	0,0188	10	Lithuania	0,0191	12
Thailand	0,0189	11	Luxemburg	0,0161	3
Indonesia	0,0200	20	Malta	0,0232	39
Mexico	0,0233	40	Netherlands	0,0186	8
EU (27)			Poland	0,0213	31
Austria	0,0199	19	Portugal	0,0194	15
Belgium	0,0169	4	Romania	0,0207	24
Bulgaria	0,0205	23	Slovakia	0,0210	28
Croatia	0,0219	36	Slovenia	0,0197	18
Republic of Cyprus	0,0232	38	Spain	0,0172	5
Czech Republic	0,0196	17	Sweden	0,0215	35
Denmark	0,0193	14			

Based on the results obtained from the MAIRCA method, China, Italy, Luxembourg, Belgium, and Spain are identified as having the highest trade competitiveness in the textiles industry. Conversely, Croatia, Ireland, the Republic of Cyprus, Malta, and Mexico are found to have the lowest trade competitiveness in the textiles industry. These findings appear to align with the results obtained by the MABAC method. However, the weight coefficient values of the evaluation criteria have a significant impact on the outcomes of the MCDM methods. Sometimes, modifying the weight coefficients may alter the ranking of the alternatives, thereby influencing the sensitivity analysis conducted during the MCDM process (Božanić et al., 2016; Pamučar et al., 2017). Accordingly, in the following section, a sensitivity analysis was conducted to observe the level of consistency and robustness in the overall ranking of the alternatives.

4.4. Sensitivity Analysis

In this study, the sensitivity analysis was carried out under the two scenarios. The first is the scenario where the weights of the criteria are considered as equal. The second is the scenario where the weight values of the criterion for the highest weight and the criterion for the lowest weight are interchanged. The results obtained from the two different scenarios are shown in Table 23.

Table 23. Sensitivity analysis

Exporters	**Proposed Model**		**Scenario 1**		**Scenario 2**	
	MABAC	**MAIRCA**	**MABAC**	**MAIRCA**	**MABAC**	**MAIRCA**
China	**1**	**1**	**1**	**1**	**1**	**1**
India	13	13	13	13	14	14
Türkiye	7	7	4	4	7	7
USA	21	21	30	30	35	35
Vietnam	22	22	28	28	27	27
Korea, Republic of	16	16	17	17	18	18
Pakistan	32	32	29	29	30	30
Taiwan	33	33	32	32	31	31
Japan	29	29	34	34	29	29
United Kingdom	10	10	7	7	10	10
Thailand	11	11	6	6	9	9
Indonesia	20	20	12	12	20	20
Mexico	**40**	**40**	**40**	**40**	**40**	**40**

EU (27)						
Austria	19	19	22	22	19	19
Belgium	4	4	8	8	4	4
Bulgaria	23	23	21	21	21	21
Croatia	**36**	**36**	**36**	**36**	**36**	**36**
Republic of Cyprus	**38**	**38**	**38**	**38**	**38**	**38**
Czech Republic	17	17	23	23	16	16
Denmark	14	14	14	14	13	13
Estonia	26	26	27	27	23	23
Finland	34	34	26	26	32	32
France	9	9	10	10	12	12
Germany	6	6	3	3	6	6
Greece	30	30	25	25	28	28
Hungary	27	27	20	20	25	25
Ireland	**37**	**37**	**37**	**37**	**37**	**37**
Italy	**2**	**2**	**2**	**2**	**2**	**2**
Latvia	25	25	19	19	22	22
Lithuania	12	12	11	11	11	11
Luxemburg	3	3	9	9	3	3
Malta	**39**	**39**	**39**	**39**	**39**	**39**
Netherlands	8	8	15	15	8	8
Poland	31	31	35	35	34	34
Portugal	15	15	16	16	15	15
Romania	24	24	24	24	24	24
Slovakia	28	28	31	31	26	26
Slovenia	18	18	18	18	17	17
Spain	**5**	**5**	**5**	**5**	**5**	**5**
Sweden	35	35	33	33	33	33

Based on the results of sensitivity analysis, the rank of alternatives has slightly changed with the modifying of criteria weight. Thus, it can be concluded that the proposed model is sensitive to the changes of criteria weight. However, no significant change was observed in the ranking. For instance, a comparison between the top-ranked alternatives under the two scenarios, the results shows that the first two ranked alternatives are identical. The top five ranked position is also not very changes for the two scenarios. For instance, China, Italy, and Spain have remained the best-ranked alternatives in the top five positions. Besides that, the bottom five ranked positions do not change under the two scenarios. Croatia, Ireland, the Republic of Cyprus, Malta, and Mexico have remained the worst-ranked alternatives throughout the two scenarios. Therefore, the sensitivity analysis confirms the validity and robustness of the ranking obtained by the proposed IDOCRIW-based MABAC and MAIRCA model. This suggests that modifying the criteria weight could help confirm these rankings.

5. Conclusion and Discussion

This paper demonstrates the application of the hybrid model in the evaluation of the trade competitiveness of the world's leading textile exporters. The IDOCRIW method was used to determine the weights of the criteria, and the new multi-criteria methods, namely the MABAC and MAIRCA, were used to evaluate the alternatives. In this study, the trade competitiveness index was used to evaluate the export performance and competitiveness of countries, and the alternatives (40 countries) were selected based on the WTO and the EURATEX reports. Based on pevious research, objective weighting methods have been applied significantly in various fields, including Entropy method (Zou et al., 2006), CRITIC method (Diakoulaki et al., 1995), CILOS method (Zavadskas & Podvezko, 2016), MEREC method (Keshavarz-Ghorabaee et al., 2021), LOPCOW (Ecer & Pamucar, 2022). The Entropy method is the most reported and used approach in MCDM applications.

However, relying solely on the Entropy method for determining criteria weights may lead to the overestimation of one alternative over others. (Zhu et al., 2020). According to Alao et al. (2021), the application of the IDOCRIW method may improve the large weight disparity among the criteria. Therefore, the IDOCRIW method was used to determine the criteria weight in this study. The results of the IDOCRIW method revealed that the share in the world market (SWM) and net exports (NEX) were identified as the most and least important criteria, with weight values of 0,3297 and 0,0816, respectively.

Once the determination of criteria weight, the alternatives were ranked using the MABAC and MAIRCA methods. The results obtained by the MABAC method showed that the countries with the highest trade competitiveness in the textiles sector are China, Italy, Luxembourg, Belgium, and Spain, while the countries with the lowest trade competitiveness are Croatia, Ireland, the Republic of Cyprus, Malta, and Mexico. According to the results of the MAIRCA method, China, Italy, Luxembourg, Belgium, and Spain have the highest trade competitiveness in the textiles industry. On the other hand, Croatia, Ireland, the Republic of Cyprus, Malta, and Mexico have the lowest trade competitiveness in the textiles industry. A notable finding from this study is the similarity in results obtained from the MABAC and MAIRCA methods. Following the application of the MABAC and MAIRCA methods, a sensitivity analysis was conducted under two scenarios.. In scenario one, the weights of the criteria were assigned equally (w = 0,20). In scenario two, the weight values of the criterion for the highest weight (w = 0,3297) and the criterion for the lowest weight (w = 0,0816) were replaced. The results of sensitivity analysis revealed that both methods (MABAC and MAIRCA) provide similar ranking. Correspondingly, it can be concluded that the robustness and validity of the proposed model is confirmed.

The overall results revealed that China has the best trade competitiveness in the textile industry, followed by Italy. As expected, China and the EU countries exhibit the highest trade competitiveness in the world's textile industry. China is the world's largest manufacturer in terms of overall production, exports, and retail, accounting for more than 50 percent of world's total (Jun, 2022). Besides, the EU countries have played significant role in the development of textiles industry (Gligorijević & Ćorović; 2020). According to recent report published by the EURATEX (2023b), in the last decades, the EU countries have revised their policies and strategies with the scope of sustainability and digital transformation. Correspondingly, the textile industry has been made priority by the EU commission. Thus, the textile industry is recognized as a strategic sector for both the EU countries and China. Moreover, Asian countries such as Türkiye, Thailand, and India exhibit significant trade competitiveness in the world's textile industry, following China and the EU countries. The present findings seem to be consistent with other research which found that Türkiye and other Asian countries have a great trade competitiveness in the world's textile industry (Bostan et al., 2010; Erkan, 2013; Guan et al., 2019; Gautam & Lal, 2020; Halife, 2022). It is believed that the findings obtained from this study provide valuable insights into the trade competitiveness of nations for decision-makers and policymakers in the textile industry.

Several limitations to this study need to be acknowledged. This study could be expanded to include other sectors such as energy, agriculture, construction, and food using different criteria. Furthermore, it would be valuable to conduct comparative analyses between the findings of this study and those derived from employing other MCDM methods, such as fuzzy logic and gray approaches. Such comparisons could offer deeper insights into the robustness and applicability of different decision-making techniques across diverse industries, contributing to a more comprehensive understanding of competitiveness dynamics and strategic decision-making processes.

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