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ANALYSIS OF METROPOLITAN CITIES EXPORT PERFORMANCE IN TURKEY BY INTEGRATED MCDM METHODS*

TÜRKİYE'DEKİ BÜYÜKŞEHİRLERİN İHRACAT PERFORMANSLARININ BÜTÜNLEŞİK ÇKKV YÖNTEMİ İLE ANALİZİ

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Abstract

Industrialization and export-based growth are very important in the development of emerging economies. In parallel, metropolitan cities have a positive effect on exports with high population density and advanced industrialization. Accordingly, in this study, the export performances of metropolitan cities in Turkey in 2022 was examined using integrated Multi-Criteria Decision Making (MCDM) methods and 30 metropolitan cities were ranked based on their export performances. Initially, five criteria which was affecting export performance were determined by using the relevant literature. These criteria are as follows: the export numbers of metropolitans in 2022, the number of countries exported, the number of exported sectors, the number of exporting companies and the areas covered by warehouses in metropolitan (m2). Then, the evaluation of the export performances of metropolitans were conducted by using CRITIC-based MULTIMOORA-WASPAS methods. The criteria weights were calculated by CRITIC method. Following this, the export performance of metropolitans was ranked by MULTIMOORA and WASPAS methods. The findings indicated that İstanbul, Kocaeli, İzmir and Hatay have the highest export performance during the period of 2022. On the other hand, Diyarbakır, Şanlıurfa, Ordu, Van and Erzurum have the lowest export performance in 2022.

Keywords: Export, Metropolitans, CRITIC, MULTIMOORA, WASPAS

Öz

Gelişmekte olan ekonomilerin kalkınmasında sanayileşme ve ihracata dayalı büyüme önem arz etmektedir. Buna paralel olarak, büyükşehirler, yüksek nüfus yoğunluğu ve gelişmiş sanayileşme ile ihracat üzerinde olumlu bir etkiye sahiptir. Bu çalışmada, Türkiye'deki büyükşehirlerin 2022 yılı ihracat performansları bütünleşik Çok Kriterli Karar Verme (ÇKKV) yöntemleri kullanılarak incelenmiş ve 30 büyükşehir ihracat performanslarına göre sıralanmıştır. Öncelikle ilgili literatürden yararlanılarak ihracat performansını etkileyen beş kriter belirlenmiştir. Bu kriterler; 2022 yılında büyükşehirlerin ihracat rakamları, ihracat yapılan ülke sayısı, ihracat yapılan sektör sayısı, ihracatçı firma sayısı ve büyükşehirde depoların kapsadığı alanlar (m2) şeklindedir. Daha sonra CRITIC tabanlı MULTIMOORA-WASPAS yöntemleri kullanılarak büyükşehirlerin ihracat performanslarının değerlendirilmesi yapılmıştır. Kriter ağırlıkları CRITIC yöntemi ile hesaplanmıştır. Bunu takiben, büyükşehirlerin ihracat performansları MULTIMOORA ve WASPAS yöntemlerine göre sıralanmıştır. Bulgular, 2022 döneminde en yüksek ihracat performansının İstanbul, Kocaeli, İzmir ve Hatay'da olduğunu gösterirken, 2022 yılında en düşük ihracat performansının ise Diyarbakır, Şanlıurfa, Ordu, Van ve Erzurum'da olduğunu gösterdi.

Anahtar Kelime: İhracat, Büyükşehirler, CRITIC, MULTIMOORA, WASPAS

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INTRODUCTION

The role of export in economic development has been widely acknowledged. Export activities help economic growth in various ways. These include linking production and demand on a larger scale, increasing efficiency and productivity, adopting better technology from foreign countries, improving human resources, and enhancing employment (Were et al., 2002, p. 9). Increasing interest in exports is commonly associated with liberalization, integration, and global competition. Parallel to this, as stated by Kotler & Armstrong (2013) exports are the fastest and easiest way for businesses to expand globally. Especially in the last two decades, businesses have begun to use exports frequently in the global market. (Arslandere, 2020, p. 1218). In this context, the evaluation of export performance has gained importance. Export performance plays a critical role in sustainability and economic growth. Additionally, increasing export performance ensures that countries do not stay out of the globalizing world. Particularly, metropolitan cities stand out in export performance because of the effect of population density and industrialization (Maruf & Özdemir, 2021, p. 87). According to the Turkish Exporters Assembly (TİM), metropolitan cities play a major role in the development of exports in Turkey in 2022. In other words, a significant number of export activities in 2022 were carried out by metropolitan cities (TİM, 2023).

Export performance can be affected by many different circumstances. Based on previous research in this field, the export performance was affected by exchange rate and interest rate (Alabı et al., 2022), export revenues and export profitability (Carneiro et al., 2011), business size (Düzgün & Taşçı, 2014), economic crisis (Karagöz, 2016), ICT and information competencies (Mpunga, 2016), marketing strategies, language skills and government support (Safari & Saleh, 2020), export volume, number of exporting countries, number of exporting companies, number of exporting sectors and warehouse area (Maruf & Özdemir, 2021; Yazgan, 2022). In the light of these findings, the evaluation of export performance can be expressed as a complex problem.

Nowadays, complex problems can be solved by using mathematical equations, statistical methods and economic theories, and computer tools that help to calculate and estimate the solutions to complex problems. MCDM is one of the basic decision-making problems which is intended to determine the best alternative by taking into account multiple factors during the selection process. MCDM offers a variety of tools and techniques that can be used in different fields, from engineering design to finance. According to Velasquez & Hester (2013), MCDM is one of the most precise ways to make decisions and it can be referred to as a revolution in

this area. MCDM can be used for everyday problems in human lives (Taherdoost & Madanchian, 2023, p. 77). In daily life, many decisions are made on the basis of different criteria, so it's possible to solve complex problems in the context of MCDM methods (Aruldoss et al., 2013, p. 31). Correspondingly, in the last few decades, there are various types of MCDM methods, including AHP, TOPSIS, VIKOR, MOORA, CRITIC, WASPAS that are developed and applied by many scientists, to solve complex problems. The fundamental differences between MCDM methods are concerned with data type, complexity level of algorithms and the weighting methods for criteria (Bączkiewicz et al., 2021).

In recent years, there has been an increasing interest in MCDM methods for solving the complex problems in business environments. For instance, financial performance of firms at Borsa İstanbul (Meydan et al., 2016; Konak et al., 2018), macroeconomic performances of Turkey and EU countries (Ela et al., 2018), sustainable development of OPEC countries (Ecer et al., 2019), competitiveness of SMEs in the textile industry (Taçoğlu et al., 2019), digital marketing technologies (Mukul et al., 2019), personnel selection strategies (Uslu et al., 2021), performance of the Turkish insurance sector (Bektaş, 2022), the selection of the logistics center location (Özekenci, 2023) has been investigated by using the different MCDM methods.

Accordingly, this paper examines the export performance of metropolitan cities in Turkey for the period of 2022, using the integrated MCDM methods. Data for this study were obtained from the Turkish Statistical Institute (TUIK), the Republic of Turkey Ministry of Trade, Chamber of Commerce and the Turkish Exporter Assembly (TİM). The criteria used in this study were derived from the study of Maruf & Özdemir (2021) and Yazgan (2022). In this study, the export volumes, the number of exporting countries, the number of exporting businesses, the number of exporting sectors and warehouses areas (m^2) were used as criteria. Based on previous literature, no studies have been found examining the export performance of metropolitan cities in Turkey using the CRITIC, MULTIMOORA and WASPAS.

The current study contributes to existing literature in two ways. First, the export performance was evaluated by different MCDM methods. Second, the findings obtained in this study can be compared with the results of studies conducted by Maruf & Özdemir (2021) and Yazgan (2022). Thus, it can be revealed how the export performance of metropolitan cities in Turkey has progressed in the period from 2020-2022. To the best of the author's knowledge, this is the first study to assess the export performance of Metropolitans in Turkey using methods with CRITIC, MULTIMOORA and WASPAS.

The remaining part of the paper is organized as follows: the second section gives a brief overview of previous research. The third section provides information regarding the methodology used for this study. In the fourth section, the numerical application is conducted, and the findings of this research are presented. Finally, the conclusion gives a summary and critique of the findings.

1. Literature Review

Lately, the integrated MCDM methods have been widely used to solve complex decision-making problems. Correspondingly, a considerable amount of literature has been published on various fields using the integrated MCDM methods over the last few years. Some studies are presented in Table 1.

Table 1. The Summary of Previous Research

Author(s)	Year	Topic	Methods	Findings
Karande et al.	2016	Robust MCDM methods for industrial robot selection	MOORA	MOORA is the most robust method being least affected by the modifying weights
Vujičić et al.	2017	Selection of an air conditioner	Integrated MCDM	CRITIC-MOORA combination has the highest correlation between variants.
Genc & Basar	2019	Evaluated the three main credit rating agencies with MOORA method	MOORA	Moody's has the highest value in terms of rating of countries, followed by Standard and Poor's
Jayant et al.	2019	Supplier selection for battery manufacturing industry	MOORA-WASPAS	Supplier named *I* is the best choice for sustainable supply chain management.
Metin & Küçükbay	2019	Explored the most frequently used financing method in exporting	PROMETHEE	The most used export financing method was banks, leasing credits, equity financing and Türk Eximbank loans
Tuş & Adalı	2019	Software selection problem	CRITIC-WASPAS	Alternative named *5* has the highest value, followed by alternative 2 and 4.
Dahooie et al.	2020	Firm export performance	SWARA-ARAS	Strategic dimension was found as the most important criteria in export performance.
Sibel	2021	Innovation performance of 27 European Union (EU) member and 8 non-EU countries	CRITIC-WASPAS	Countries with the highest innovation performance were Switzerland, Sweden, and Finland
Miç & Antmen	2021	University location selection problem	TOPSIS-WASPAS-MULTIMOORA	Konya is the best location for the new university establishment.
Baidya et al.	2021	Selection of 3rd party reverses logistics providers	CRITIC-MULTIMOORA	Alternative named *A3* is the best ranked

Table 1. The Summary of Previous Research (Cont.)

Erdoğan & Kırbaç	2021	Financial performance of logistics companies	ENTROPY-WASPAS	Export is the most important criteria affecting the logistics companies' performance
Utama et al.	2021	Green supplier selection for textile industry in Indonesia	AHP-MOORA	Product price is the most dominant criteria in supplier selection
Maruf & Özdemir	2021	Export performance of metropolitan cities in Turkey	CRITIC-MAUT	İstanbul, Kocaeli, Izmir, Bursa and Ankara have the best export performance.
Çubuk	2022	Health tourism potentials of metropolitan cities in Turkey	CRITIC-WASPAS	İstanbul, Antalya, Ankara, Izmir, and Adana were in the top five ranks
Monajemzadeh et al.	2022	Factors that affect the export of steel products	WASPAS	Skills/knowledge, export problems and transport were found the most important factors.
Yazgan	2022	Export performance of metropolitan cities in Turkey	CRITIC-EDAS	İstanbul, Kocaeli, İzmir, Hatay and Bursa have the best export performance.
Kazak	2023	Financial performance of retail sector in Turkey	DEMATEL-MOORA	BİM supermarket chain has the highest financial performance among the retailers.
Türkoğlu & Duran	2023	The logistics performance of regional comprehensive economic partnership countries	CRITIC-WASPAS-GIA	Japan, New Zealand, and Singapore were in the top three country rankings.

It can be seen above, there has been an increasing amount of literature on various fields by employing the different MCDM methods. Despite of this, a limited number of research has been published in the context of Turkey's export performance using the MCDM methods. For instance, Maruf & Özdemir (2021) and Yazgan (2022) have investigated the export performance of metropolitan cities in Turkey using the different MCDM methods. However, there was no study found on the evaluation of export performance of metropolitan in Turkey using the CRITIC, MULTIMOORA and WASPAS integrated methods. Accordingly, the current study aims to contribute to this growing area of research by employing new MCDM methods.

2. Methodology

In this section, the steps of the methods used in this study are described. Initially, the weight of the criteria is calculated using the CRITIC method. Afterwards, the alternatives are ranked using the MULTIMOORA and WASPAS methods. The application steps for the methods are expressed below.

2.1. Critic

The Criteria Importance Through Intercriteria Correlation (CRITIC) was introduced by Diakoulaki, Mavrotas and Papayannakin in 1995. It mostly utilized to calculate the weight of attributes and it's an objective weighting method. The attributes in the present method do not conflict with one another, and the decision matrix is used to calculate the weights of the attributes. The steps of the CRITIC method as follows (Diakoulaki et al., 1995; Alinezhad & Khalili, 2019):

Step 1. The Normalized Decision Matrix

In order to normalize the positive and negative attributes of decision matrix, Eqs. (1) and (2) are utilized, respectively.

$$x_{ij} = \frac{r_{ij} - r_i^-}{r_i^t - r_i^-}; \qquad i = 1, \dots\dots, m \quad j = 1, \dots\dots, n \tag{1}$$

$$x_{ij} = \frac{r_{ij} - r_i^+}{r_i^- - r_i^+}; \qquad i = 1, \dots\dots, m \quad j = 1, \dots\dots, n \tag{2}$$

where x_{IJ} represents a normalized value of the decision matrix for *i*th alternative in *j*th attribute and $r_i^+ = \max(r_1, r_2, \dots, r_m)$ and $r_i^- = \min(r_1, r_2, \dots, r_m)$.

Step 2. The Correlation Coefficient

Eq. (3) is used to determine the correlation coefficient among attributes.

$$\rho_{jk} = \sum_{i=1}^{m}(x_{ij} - \bar{x}_j)(x_{ik} - \bar{x}_k) / \sqrt{\sum_{i=1}^{m}\left(x_{ij} - \bar{x}_j\right)^2 \sum_{i=1}^{m}(x_{ik} - \bar{x}_k)^2} \tag{3}$$

where $\bar{x}_j$ and $\bar{x}_k$ display the mean of *j*th and *k*th attributes. $\bar{x}_j$ is computed from Eq. (4). Similarly, it is obtained for $\bar{x}_k$. Also, ρ_{jk} is the correlation coefficient between *j*th and *k*th attributes.

$$\bar{x}_j = \frac{1}{n}\sum_{j=1}^{n} x_{ij}; \qquad i = 1, \dots\dots\dots\dots\dots\dots, m \tag{4}$$

Step 3. The Index (C)

At first, the standard deviation of each attribute is estimated by Eq. (5)

$$\sigma_j = \sqrt{\frac{1}{n-1}\sum_{j=1}^{n}\left(x_{ij} - \bar{x}_j\right)^2}; \qquad i = 1, \ldots\ldots\ldots\ldots, m \tag{5}$$

Then, the index (C) is calculated using Eq. (6)

$$C_J = \sigma_j \sum_{k=1}^{n}(1 - \rho_{jk}); \qquad j = 1, \ldots\ldots\ldots\ldots\ldots, n \tag{6}$$

Step 4. The Weight of Attributes

The weights of attributes are determined by Eq. (7).

$$w_j = \frac{C_j}{\sum_{j=1}^{n} C_j}; \qquad j = 1, \ldots\ldots\ldots\ldots\ldots, n \tag{7}$$

For the final ranking, the attribute weights are ranked in descending order.

2.2. Multimoora

The Multi-Objective Optimization Ratio Analysis (MOORA) method was proposed by Brauers and Zavadskas in 2006. It is considered as an objective (non-subjective) method. Additionally, desirable and undesirable criteria are used simultaneously for ranking to select a superior or higher alternative among different alternatives. The MULTIMOORA method is extended version of the MOORA method and developed by Brauers and Zavadskas in 2010, and in this way, it became more robust. The MULTIMOORA typically considered as a supplement of MOORA which consist of ratio system, the reference point and full multiplicative form. The application steps of the ratio system, the reference point, and full multiplicative form are as follows (Brauers & Zavadskas, 2006, 2010, 2012, 2013; Alinezhad & Khalili, 2019):

2.2.1. The ratio system part of moora method

Step 1. The Normalized Decision Matrix

The normalized decision matrix is computed from Eq. (8).

$$r_{ij}^{*} = \frac{r_{ij}}{\sqrt{\sum_{i=1}^{m} r_{ij}^2}}; \qquad j = 1, \ldots\ldots\ldots\ldots\ldots, n \tag{8}$$

Accordingly, r_{ij}^{*} demonstrates the normalized value of decision matrix of *i*th alternative in *j*th attribute.

Step 2. The Assessment Values

With respect to the weight of attribute (w_1, w_2,…,w_n), the assessment values of each attribute are obtained through Eq. (9).

$$\hat{y} = \sum_{j=1}^{g} r_{ij}^{*}.w_j - \sum_{j=g+1}^{n} r_{ij}^{*}.w_j\,; \qquad i = 1, \dots\dots\dots\dots, m \tag{9}$$

where *g* represents the number of positive attributes and *n* – *g* displays the number of negative attributes, and according to the type of attribute, the ideal points of the *j*th attribute are deducted from all values of the *j*th attribute.

For the final ranking, the values are ranked in a descending order, and the highest amount has the highest rank.

2.2.2. The reference point part of moora method

The reference point theory starts from the already normalized ratios as defined in the MOORA method, namely, Eq. (8). Then, the reference point theory chooses for maximization a reference point, which has as co-ordinates the highest co-ordinate per objective of all the candidate alternatives. For minimization, the lowest co-ordinate is chosen. In order to measure the distance between the alternatives and the reference point, the Tchebycheff Min-Max metric is the most appropriate approach and formulated as (Brauers & Zavadskas, 2006; 2010; Karande & Chakraborty, 2012; Aytaç Adalı & Tuş Isık, 2017):

$$\min_{(j)} \left\{ \max_{(i)} \left| r_i - Nx_{ij} \right| \right\} \tag{10}$$

In this formula, *i* = 1,2,…, *n* are the objectives, *j* = 1,2,…, *m* are the alternatives.

r_i = the i^{th} = co-ordinate of the maximal objective reference point; each co-ordinate of the reference point is selected as the highest corresponding co-ordinate of the alternatives,

Nx_{ij} = the normalized objective *i* of alternative *j*.

Finally, the alternative is ranked, and best alternative is chosen with the minimum total deviation from the reference point.

2.2.3. The full multiplicative form

The full multiplicative form embodies maximization as well as minimization of purely multiplicative utility function. Overall utility of the *i*th alternative can be expressed as a dimensionless number (Brauers & Zavadskas, 2011, 2012; Baležentis & Baležentis, 2014):

$$U_i' = \frac{A_i}{B_i}, \tag{11}$$

where $A_i = \prod_{j=1}^{g} x_{ij},\ i = 1,2,\dots\dots\dots\dots,m$ denotes the product of objectives of the *i*th alternative to be maximized with g = 1,…,n being the number of objectives to be maximized and where = $B_i = \prod_{j=g+1}^{g} x_{ij}$ denotes the product of objectives of the *i*th alternative to be minimized with $n - g$ being the number of objectives to be minimized.

Thus, the dominance theory was proposed to summarize three ranks provided by respective parts of MULTIMOORA into a single one.

2.3. Waspas

The Weighted Aggregates Sum Product Assessment (WASPAS) method was proposed by Zavadskas, Turskis, Antucheviciene, and Zakarevicius in 2012. This method is a combination of Weighted Sum Model (WSM) and Weighted Product Model. Thus, the relative importance of each attribute is simply determined, and then, the alternatives are evaluated and prioritized. The steps of the WASPAS method as follows (Zavadskas et al., 2012; Zavadskas et al., 2013; Alinezhad & Khalili, 2019):

Step 1. The Normalized Decision Matrix

Eq. (12) is used to normalize the positive attributes and normalization the negative attribute is calculated through Eq. (13).

$$r_{ij}^{*} = \frac{r_{ij}}{\max\limits_{i} r_{ij}};\quad i = 1,\dots\dots,m,\quad j = 1,\dots\dots,n \tag{12}$$

$$r_{ij}^{*} = \frac{\min\limits_{i} r_{ij}}{r_{ij}};\quad i = 1,\dots\dots,m,\quad j = 1,\dots\dots,n \tag{13}$$

where r_{ij}^{*} demonstrates the normalized value of the decision matrix of *i*th alternative in *j*th attribute.

Step 2. The Additive Relative Importance

Eq. (14) is used to determine the additive relative importance in the weighted normalized data of each alternative.

$$Q_i^{(1)} \sum_{j=1}^{n} r_{ij}^{*}.w_j; \qquad i = 1, \dots\dots\dots\dots\dots\dots\dots, m \tag{14}$$

where w_j indicates the weight of attribute (w_1, w_2,…,w_n) and $Q_i^{(1)}$ indicates the additive relative importance in the *i*th alternative.

Step 3. The Multiplicative Relative Importance

Eq. (15) is used to determine the multiplicative relative importance of the weighted normalized data of each alternative.

$$Q_i^{(2)} = \prod_{j=1}^{n} (r_{ij}^{*})^{w_j}; \qquad i = 1, \dots\dots\dots\dots\dots, m \tag{15}$$

where $Q_i^{(2)}$ illustrates the multiplicative relative importance of the *i*th alternative.

Step 4. The Joint Generalized Criterion (Q_i)

The joint generalized criterion (Q_i) was proposed for generalizing and integrating additive and multiplicative methods, defined as Eq. (16).

$$Q_i = \frac{1}{2}\left(Q_i^{(1)} + Q_i^{(2)}\right) = \frac{1}{2}\left(\sum_{j=1}^{n} r_{ij}^{*}.w_j + \prod_{j=1}^{n} (r_{ij}^{*})^{w_j}\right); \qquad i = 1, \dots\dots\dots\dots\dots, m \tag{16}$$

Additionally, Eq. (17) was proposed to increase the ranking accuracy.

$$Q_i = \lambda \sum_{j=1}^{n} r_{ij}^{*}.w_j + \ (1-\lambda) \ \prod_{j=1}^{n} (r_{ij}^{*})^{w_j}; \ \ i = 1, \dots\dots\dots\dots, m \ \ \lambda \in [0,1] \tag{17}$$

The joint generalized criterion (Q_i) values obtained from Eqs. (16) and (17) are ranked in a descending order, and the highest amount of joint generalized criterion has the highest rank.

3. Applications and Results

In this study, the criteria were derived from the study of Maruf & Özdemir (2021) and Yazgan (2022). The total of five criteria was examined namely, export volumes, the number of exporting countries, the number of exporting businesses, the number of exporting sectors and warehouses areas (m^2). The export performance of metropolitan was evaluated for the period of 2022. The data was obtained from various official institutions, such as TUİK, TİM and

Republic of Turkey Ministry of Trade. All criteria are considered as beneficial. The brief synopsis of the criteria is presented in Table 2.

Table 2. A Brief Summary of Criteria

Criterion	Code	Year	Data Source	Criteria Type
Export Figures	EF	2022	TUİK	Benefit
Number of Sectors	Sect	2022	TİM	Benefit
Number of Exporting Countries	ExpCoun	2022	TİM	Benefit
Number of Exporting Companies	ExpComp	2022	TİM	Benefit
Warehouse Area (m^2)	Wareh	2022	Ministry of Trade	Benefit

In the current study, 30 metropolitan cities in Turkey were evaluated according to the criteria given in Table 2. The weights of the criteria were determined by the CRITIC method. The criterion weights obtained by the application of this method were used in the MULTIMOORA-WASPAS method, and the export performances of 30 alternatives (Metropolitan cities) were compared.

3.1. Application of critic method

At first, the decision matrix is formed which includes five different criterion values of the thirty alternatives. The decision matrix for export performance is presented in Table 3.

Table 3. Decision Matrix for Export Performance

Metropolitan Cities	Export Figures (Thousand USD)	Number of Sectors	Number of Exporting Countries	Number of Exporting Companies	Warehouse Area (m²)
Adana	3.116.961	26	183	1.829	256.714,90
Ankara	12.003.747	26	217	6.705	342.667,61
Antalya	2.758.712	26	168	2.345	8.583,12
Aydın	1.199.104	25	150	493	622,75
Balıkesir	934.360	25	165	495	62.724,81
Bursa	12.796.828	26	199	7.137	206.195,71
Denizli	4.451.505	24	193	1.662	67.410,66
Diyarbakır	442.054	25	112	288	16,00
Erzurum	25.207	19	60	64	120,00
Eskişehir	1.305.351	24	161	501	2.081,00
Gaziantep	11.196.596	26	198	3.761	33.965,25
Hatay	4.067.430	26	173	1.563	1.232.921,24
İstanbul	124.627.551	26	241	48.806	1.259.611,651
İzmir	17.018.297	26	215	6.847	592.850,102
Kahraman maraş	1.411.709	23	140	504	12.568,58
Kayseri	3.918.755	24	200	2.360	19.510,80

Table 3. Decision Matrix for Export Performance (Cont.)

Kocaeli	14.436.006	26	201	2.283	1.330.645,038
Konya	3.300.471	25	192	3.420	8.872,00
Malatya	456.234	25	136	227	11.520,29
Manisa	3.152.247	26	186	818	25.674,55
Mardin	1.143.486	26	122	396	0,00
Mersin	6.165.319	26	187	2.225	1.117.471,50
Muğla	1.015.177	23	129	431	5.115,50
Ordu	296.925	23	115	136	12,00
Sakarya	5.274.155	25	172	720	40.248,23
Samsun	1.317.598	24	170	444	190.168,85
Şanlıurfa	313.082	24	118	560	0,00
Tekirdağ	3.049.915	25	178	904	96.664,31
Trabzon	1.090.262	25	141	358	5.551,77
Van	26.196	23	62	85	7.624,69

Based on Eq. (2), the decision matrix was normalized. The normalized decision matrix is presented in Table 4.

Table 4. Normalized Decision Matrix

Metropolitans	**EF**	**Sect**	**ExpCoun**	**ExpComp**	**Wareh**
Adana	0,0248	1,0000	0,6796	0,0362	0,1929
Ankara	0,0961	1,0000	0,8674	0,1362	0,2575
Antalya	0,0219	1,0000	0,5967	0,0468	0,0065
Aydın	0,0094	0,8571	0,4972	0,0088	0,0005
Balıkesir	0,0073	0,8571	0,5801	0,0088	0,0471
Bursa	0,1025	1,0000	0,7680	0,1451	0,1550
Denizli	0,0355	0,7143	0,7348	0,0328	0,0507
Diyarbakır	0,0033	0,8571	0,2873	0,0046	0,0000
Erzurum	0,0000	0,0000	0,0000	0,0000	0,0001
Eskişehir	0,0103	0,7143	0,5580	0,0090	0,0016
Gaziantep	0,0897	1,0000	0,7624	0,0758	0,0255
Hatay	0,0324	1,0000	0,6243	0,0308	0,9266
İstanbul	1,0000	1,0000	1,0000	1,0000	0,9466
İzmir	0,1364	1,0000	0,8564	0,1392	0,4455
Kahraman maraş	0,0111	0,5714	0,4420	0,0090	0,0094
Kayseri	0,0312	0,7143	0,7735	0,0471	0,0147
Kocaeli	0,1157	1,0000	0,7790	0,0455	1,0000
Konya	0,0263	0,8571	0,7293	0,0689	0,0067
Malatya	0,0035	0,8571	0,4199	0,0033	0,0087
Manisa	0,0251	1,0000	0,6961	0,0155	0,0193
Mardin	0,0090	1,0000	0,3425	0,0068	0,0000
Mersin	0,0493	1,0000	0,7017	0,0443	0,8398
Muğla	0,0079	0,5714	0,3812	0,0075	0,0038
Ordu	0,0022	0,5714	0,3039	0,0015	0,0000

Table 4. Normalized Decision Matrix (Cont.)

Sakarya	0,0421	0,8571	0,6188	0,0135	0,0302
Samsun	0,0104	0,7143	0,6077	0,0078	0,1429
Şanlıurfa	0,0023	0,7143	0,3204	0,0102	0,0000
Tekirdağ	0,0243	0,8571	0,6519	0,0172	0,0726
Trabzon	0,0085	0,8571	0,4475	0,0060	0,0042
Van	0,0000	0,5714	0,0110	0,0004	0,0057

According to Eqs. (3) and (4), the mean values of each attribute were computed and shown in Table 5.

Table 5. The Correlation Coefficient

Criteria	EF	Sect	ExpCoun	ExpComp	Wareh
EF	**1,0000**	0,2534	0,4754	0,9935	0,5503
Sect	0,2534	**1,0000**	0,7051	0,2547	0,4129
ExpCoun	0,4754	0,7051	**1,0000**	0,4821	0,4916
ExpComp	0,9935	0,2547	0,4821	**1,0000**	0,5100
Wareh	0,5503	0,4129	0,4916	0,5100	**1,0000**

By using Eqs. (5) and (6), the standard deviation of each attribute was calculated and presented in Table 6.

Table 6. The Index (C)

Criteria	EF	Sect	ExpCoun	ExpComp	Wareh
EF	0,0000	0,7466	0,5246	0,0065	0,4497
Sect	0,7466	0,0000	0,2949	0,7453	0,5871
ExpCoun	0,5246	0,2949	0,0000	0,5179	0,5084
ExpComp	0,0065	0,7453	0,5179	0,0000	0,4900
Wareh	0,4497	0,5871	0,5084	0,4900	0,0000

The weight of the attributes was calculated using Eq. (7) and illustrated in Table 7.

Table 7. The Weight of Attributes

W_j	EF	Sect	ExpCoun	ExpComp	Wareh
	0,1399	0,2318	0,1960	0,1430	0,2893

The weights of all attributes provided by CRITIC method is shown in Table 6. Based on the results, the most critical attribute was warehouse area (Wareh), followed by number of sectors (Sect), number of exporting countries (ExpCoun), number of exporting companies (ExpComp) and export figures (EF). Accordingly, the final ranking of attributes is as follows: Wareh > Sect > ExpCoun > ExpComp > EF.

3.2. Application of multimoora method

In this study, all approaches, including the ratio system, the reference point, and full multiplicative form were applied to obtain the most accurate results. The results of each approach are presented below.

3.2.1. The result on the basis of ratio analysis

According to Eqs. (8) and (9), the decision matrix was normalized, the weighted normalized decision matrix and the assessment values are formed and presented in Table 8-10.

Table 8. Square Root of Sum of Squares

Metropolitans	EF	Sect	ExpCoun	ExpComp	Wareh
Adana	9.715.445.875.521	676	33.489	3.345.241	65.902.539.882
Ankara	144.089.942.040.009	676	47.089	44.957.025	117.421.090.943
Antalya	7.610.491.898.944	676	28.224	5.499.025	73.669.949
Aydın	1.437.850.402.816	625	22.500	243.049	387.818
Balıkesir	873.028.609.600	625	27.225	245.025	3.934.401.790
Bursa	163.758.806.861.584	676	39.601	50.936.769	42.516.670.822
Denizli	19.815.896.765.025	576	37.249	2.762.244	4.544.197.082
Diyarbakır	195.411.738.916	625	12.544	82.944	256
Erzurum	635.392.849	361	3.600	4.096	14.400
Eskişehir	1.703.941.233.201	576	25.921	251.001	4.330.561
Gaziantep	125.363.761.987.216	676	39.204	14.145.121	1.153.638.208
Hatay	16.543.986.804.900	676	29.929	2.442.969	1.520.094.784.043
İstanbul	15.532.026.468.257.600	676	58.081	2.382.025.636	1.586.621.511.335
İzmir	289.622.432.780.209	676	46.225	46.881.409	351.471.243.441
Kahraman maraş	1.992.922.300.681	529	19.600	254.016	157.969.203
Kayseri	15.356.640.750.025	576	40.000	5.569.600	380.671.317
Kocaeli	208.398.269.232.036	676	40.401	5.212.089	1.770.616.217.154
Konya	10.893.108.821.841	625	36.864	11.696.400	78.712.384
Malatya	208.149.462.756	625	18.496	51.529	132.717.082
Manisa	9.936.661.149.009	676	34.596	669.124	659.182.518
Mardin	1.307.560.232.196	676	14.884	156.816	0
Mersin	38.011.158.371.761	676	34.969	4.950.625	1.248.742.553.312
Muğla	1.030.584.341.329	529	16.641	185.761	26.168.340
Ordu	88.164.455.625	529	13.225	18.496	144
Sakarya	27.816.710.964.025	625	29.584	518.400	1.619.920.018
Samsun	1.736.064.489.604	576	28.900	197.136	36.164.191.510
Şanlıurfa	98.020.338.724	576	13.924	313.600	0
Tekirdağ	9.301.981.507.225	625	31.684	817.216	9.343.988.828
Trabzon	1.188.671.228.644	625	19.881	128.164	30.822.150
Van	686.230.416	529	3.844	7.225	58.135.898

Table 9. Normalized Decision Matrix

Metropolitans	EF	Sect	ExpCoun	ExpComp	Wareh
Adana	75315,51752	4,97422	36,358713	65,80114494	25343,85099
Ankara	1117005,714	4,97422	51,124114	884,3081016	45156,11442
Antalya	58997,61507	4,97422	30,642549	108,1662401	28,33092945
Aydın	11146,42072	4,59895	24,428052	4,780792319	0,149141301
Balıkesir	6767,841887	4,59895	29,557943	4,819660389	1513,035656
Bursa	1269481,55	4,97422	42,994458	1001,930121	16350,4498
Denizli	153615,6486	4,23839	40,440912	54,3335496	1747,54196
Diyarbakır	1514,859579	4,59895	13,618911	1,631514789	9,84488E-05
Erzurum	4,92565569	2,65635	3,9084884	0,080568632	0,005537745
Eskişehir	13209,19466	4,23839	28,142202	4,937208763	1,665384868
Gaziantep	971837,704	4,97422	42,563439	278,2356061	443,6495904
Hatay	128251,3375	4,97422	32,493652	48,05338606	584576,1903
İstanbul	120406477,1	4,97422	63,058032	46854,62546	610160,0823
İzmir	2245194,27	4,97422	50,186077	922,1608813	135163,756
Kahraman maraş	15449,41698	3,89255	21,279548	4,996514043	60,74952428
Kayseri	119046,8621	4,23839	43,427649	109,5544557	146,3931002
Kocaeli	1615533,008	4,97422	43,863011	102,5221871	680918,1201
Konya	84444,92809	4,59895	40,022921	230,0690777	30,27007661
Malatya	1613,604225	4,59895	20,080945	1,01357935	51,03842656
Manisa	77030,40977	4,97422	37,560573	13,16171998	253,4989324
Mardin	10136,3928	4,97422	16,159428	3,084582649	0,000000
Mersin	294667,9032	4,97422	37,965536	97,37917034	480223,4519
Muğla	7989,236316	3,89255	18,066988	3,653933001	10,06344394
Ordu	683,463393	3,89255	14,358266	0,363817727	5,53774E-05
Sakarya	215639,0977	4,59895	32,119089	10,19696743	622,9655431
Samsun	13458,21871	4,23839	31,376476	3,877680116	13907,50466
Şanlıurfa	759,8675998	4,23839	15,117165	6,168535855	0,000000
Tekirdağ	72110,28296	4,59895	34,399041	16,07470088	3593,37684
Trabzon	9214,74834	4,59895	21,584627	2,520995629	11,85313922
Van	5,319755736	3,89255	4,173397	0,1421163	22,3570674

Table 10. Weighted Normalized Decision Matrix

Metropolitan	EF	Sect	ExpCoun	ExpComp	Wareh
Adana	10536,6409	1,15302	7,1263078	9,409563726	7331,976091
Ankara	156269,0994	1,15302	10,020326	126,4560585	13063,6639
Antalya	8253,766348	1,15302	6,0059396	15,46777233	8,19613789
Aydın	1559,384259	1,06604	4,7878983	0,683653302	0,043146578
Balıkesir	946,82108	1,06604	5,7933569	0,689211436	437,7212154
Bursa	177600,4688	1,15302	8,4269138	143,2760073	4730,185126
Denizli	21490,82925	0,98246	7,9264188	7,769697593	505,5638889
Diyarbakır	211,9288551	1,06604	2,6693065	0,233306615	2,84812E-05
Erzurum	0,689099231	0,61574	0,7660637	0,011521314	0,00160207
Eskişehir	1847,966333	0,98246	5,5158716	0,706020853	0,481795842
Gaziantep	135960,0948	1,15302	8,3424339	39,78769167	128,3478265
Hatay	17942,36212	1,15302	6,3687559	6,871634207	169117,8918

Table 10. Weighted Normalized Decision Matrix (Cont.)

İstanbul	16844866,15	1,15302	12,359374	6700,211441	176519,3118
İzmir	314102,6784	1,15302	9,836471	131,869006	39102,87461
Kahraman maraş	2161,373435	0,90229	4,1707914	0,714501508	17,57483738
Kayseri	16654,65601	0,98246	8,5118191	15,66628716	42,35152389
Kocaeli	226013,0678	1,15302	8,5971501	14,66067276	196989,6121
Konya	11813,84544	1,06604	7,8444925	32,89987812	8,757133163
Malatya	225,743231	1,06604	3,9358652	0,144941847	14,7654168
Manisa	10776,55433	1,15302	7,3618724	1,882125957	73,33724114
Mardin	1418,081352	1,15302	3,1672479	0,441095319	0,00000000
Mersin	41224,03965	1,15302	7,4412451	13,92522136	138928,6446
Muğla	1117,694161	0,90229	3,5411296	0,522512419	2,911354333
Ordu	95,61652868	0,90229	2,8142202	0,052025935	1,60207E-05
Sakarya	30167,90976	1,06604	6,2953414	1,458166343	180,2239316
Samsun	1882,804798	0,98246	6,1497893	0,554508257	4023,441099
Şanlıurfa	106,3054772	0,98246	2,9629642	0,882100627	0,00000000
Tekirdağ	10088,22859	1,06604	6,7422119	2,298682227	1039,56392
Trabzon	1289,143293	1,06604	4,2305869	0,360502375	3,429113176
Van	0,744233827	0,90229	0,8179858	0,020322631	6,467899598

According to the positive and negative state of attribute, the reference point is computed and shown in Table 10.

3.2.2. The result on the basis of reference point

Based on Eq. (10). MOORA-Reference point matrix was computed and presented in Table 11.

Table 11. Reference Point Matrix

Metropolitans	EF	Sect	ExpCoun	ExpComp	Wareh
Adana	16834329,5101	0,0000	5,2331	6690,8019	189657,6360
Ankara	16688597,0516	0,0000	2,3390	6573,7554	183925,9482
Antalya	16836612,3846	0,0000	6,3534	6684,7437	196981,4160
Aydın	16843306,7667	0,0870	7,5715	6699,5278	196989,5690
Balıkesir	16843919,3299	0,0870	6,5660	6699,5222	196551,8909
Bursa	16667265,6821	0,0000	3,9325	6556,9354	192259,4270
Denizli	16823375,3217	0,1706	4,4330	6692,4417	196484,0482
Diyarbakır	16844654,2221	0,0870	9,6901	6699,9781	196989,6121
Erzurum	16844865,4619	0,5373	11,5933	6700,1999	196989,6105
Eskişehir	16843018,1846	0,1706	6,8435	6699,5054	196989,1303
Gaziantep	16708906,0562	0,0000	4,0169	6660,4237	196861,2643
Hatay	16826923,7888	0,0000	5,9906	6693,3398	27871,7203
İstanbul	0,0000	0,0000	0,0000	0,0000	20470,3003
İzmir	16530763,4726	0,0000	2,5229	6568,3424	157886,7375
Kahraman maraş	16842704,7775	0,2507	8,1886	6699,4969	196972,0373
Kayseri	16828211,4949	0,1706	3,8476	6684,5452	196947,2606

Table 11. Reference Point Matrix (Cont.)

Kocaeli	16618853,0832	0,0000	3,7622	6685,5508	0,000000
Konya	16833052,3055	0,0870	4,5149	6667,3116	196980,8550
Malatya	16844640,4077	0,0870	8,4235	6700,0665	196974,8467
Manisa	16834089,5966	0,0000	4,9975	6698,3293	196916,2749
Mardin	16843448,0696	0,0000	9,1921	6699,7703	196989,6121
Mersin	16803642,1113	0,0000	4,9181	6686,2862	58060,9675
Muğla	16843748,4568	0,2507	8,8182	6699,6889	196986,7008
Ordu	16844770,5344	0,2507	9,5452	6700,1594	196989,6121
Sakarya	16814698,2412	0,0870	6,0640	6698,7533	196809,3882
Samsun	16842983,3462	0,1706	6,2096	6699,6569	192966,1710
Şanlıurfa	16844759,8455	0,1706	9,3964	6699,3293	196989,6121
Tekirdağ	16834777,9224	0,0870	5,6172	6697,9128	195950,0482
Trabzon	16843577,0077	0,0870	8,1288	6699,8509	196986,1830
Van	16844865,4067	0,2507	11,5414	6700,1911	196983,1442

3.2.3. The result on the basis of full multiplicative form

According to Eq. (11). MOORA-Full multiplicative form was calculated, and the results obtained by multiplying the benefit-based criteria with each other is presented in Table 12.

Table 12. Full Multiplicative

Metropolitans	Results
Adana	6,96339E+18
Ankara	1,55604E+20
Antalya	2,42536E+17
Aydın	1,38054E+15
Balıkesir	1,19669E+17
Bursa	9,7437E+19
Denizli	2,31012E+18
Diyarbakır	5,70356E+12
Erzurum	2,20692E+11
Eskişehir	5,25865E+15
Gaziantep	7,36313E+18
Hatay	3,52561E+19
İstanbul	4,80081E+22
İzmir	3,86165E+20
Kahramanmaraş	2,8795E+16
Kayseri	8,66117E+17
Kocaeli	2,29184E+20
Konya	4,8069E+17
Malatya	4,05654E+15
Manisa	3,20157E+17
Mardin	0,00000E+00
Mersin	7,4531E+19
Muğla	6,64087E+15

Table 12. Full Multiplicative (Cont.)

Ordu	1,28172E+12
Sakarya	6,57205E+17
Samsun	4,53905E+17
Şanlıurfa	0,00000E+00
Tekirdağ	1,18599E+18
Trabzon	7,63844E+15
Van	2,421E+13

3.2.4. The result on the basis of multimoora

The dominance comparisons of alternatives and final MULTIMOORA rankings are presented in Table 13. As stated by Brauers (2012), MULTIMOORA enables the summarize of the three distinct approaches.

Table 13. Dominance Comparisons of MOORA and MULTIMOORA

Metropolitans	MOORA Ratio System	Rank	MOORA Reference Point	Rank	MOORA Full Multiplicative	Rank	MULTI-MOORA	Rank
Adana	İstanbul	1	İstanbul	1	İstanbul	1	İstanbul	1
Ankara	Kocaeli	2	İzmir	2	İzmir	2	İzmir	2
Antalya	İzmir	3	Kocaeli	3	Kocaeli	3	Kocaeli	3
Aydın	Hatay	4	Bursa	4	Ankara	4	Hatay	4
Balıkesir	Bursa	5	Ankara	5	Bursa	5	Bursa	5
Bursa	Mersin	6	Gaziantep	6	Mersin	6	Mersin	6
Denizli	Ankara	7	Mersin	7	Hatay	7	Ankara	7
Diyarbakır	Gaziantep	8	Sakarya	8	Gaziantep	8	Gaziantep	8
Erzurum	Sakarya	9	Denizli	9	Adana	9	Sakarya	9
Eskişehir	Denizli	10	Hatay	10	Denizli	10	Denizli	10
Gaziantep	Adana	11	Kayseri	11	Tekirdağ	11	Adana	11
Hatay	Kayseri	12	Konya	12	Kayseri	12	Kayseri	12
İstanbul	Konya	13	Manisa	13	Sakarya	13	Konya	13
İzmir	Tekirdağ	14	Adana	14	Konya	14	Tekirdağ	14
Kahraman maraş	Manisa	15	Tekirdağ	15	Samsun	15	Manisa	15
Kayseri	Antalya	16	Antalya	16	Manisa	16	Antalya	16
Kocaeli	Samsun	17	Kahraman maraş	17	Antalya	17	Samsun	17
Konya	Kahraman maraş	18	Samsun	18	Balıkesir	18	Kahraman maraş	18
Malatya	Eskişehir	19	Eskişehir	19	Kahraman maraş	19	Eskişehir	19
Manisa	Aydın	20	Aydın	20	Trabzon	20	Aydın	20
Mardin	Mardin	21	Mardin	21	Muğla	21	Mardin	21
Mersin	Balıkesir	22	Trabzon	22	Eskişehir	22	Balıkesir	22
Muğla	Trabzon	23	Muğla	23	Malatya	23	Trabzon	23
Ordu	Muğla	24	Balıkesir	24	Aydın	24	Muğla	24
Sakarya	Malatya	25	Malatya	25	Van	25	Malatya	25

Table 13. Dominance Comparisons of MOORA and MULTIMOORA (Cont.)

Samsun	Diyarbakır	26	Diyarbakır	26	Diyarbakır	26	Diyarbakır	26
Şanlıurfa	Şanlıurfa	27	Şanlıurfa	27	Ordu	27	Şanlıurfa	27
Tekirdağ	Ordu	28	Ordu	28	Erzurum	28	Ordu	28
Trabzon	Van	29	Van	29	Mardin	29	Van	29
Van	Erzurum	30	Erzurum	30	Şanlıurfa	30	Erzurum	30

As a result of MULTIMOORA method, İstanbul, İzmir, Kocaeli, Hatay and Bursa are in the top five ranking with the highest export performance during the period of 2022. On the other hand, Diyarbakır, Şanlıurfa, Ordu, Van and Erzurum are in the last five ranking with the lowest export performance in 2022.

3.3. Application of waspas method

According to Eq. (12), the decision matrix was normalized. The normalized decision matrix is presented in Table 14.

Table 14. Normalized Decision Matrix

Metropolitans	EF	Sect	ExpCoun	ExpComp	Wareh
Adana	0,0250	1,0000	0,7593	0,0375	0,1929
Ankara	0,0963	1,0000	0,9004	0,1374	0,2575
Antalya	0,0221	1,0000	0,6971	0,0480	0,0065
Aydın	0,0096	0,9615	0,6224	0,0101	0,0005
Balıkesir	0,0075	0,9615	0,6846	0,0101	0,0471
Bursa	0,1027	1,0000	0,8257	0,1462	0,1550
Denizli	0,0357	0,9231	0,8008	0,0341	0,0507
Diyarbakır	0,0035	0,9615	0,4647	0,0059	0,0000
Erzurum	0,0002	0,7308	0,2490	0,0013	0,0001
Eskişehir	0,0105	0,9231	0,6680	0,0103	0,0016
Gaziantep	0,0898	1,0000	0,8216	0,0771	0,0255
Hatay	0,0326	1,0000	0,7178	0,0320	0,9266
İstanbul	1,0000	1,0000	1,0000	1,0000	0,9466
İzmir	0,1366	1,0000	0,8921	0,1403	0,4455
Kahraman maraş	0,0113	0,8846	0,5809	0,0103	0,0094
Kayseri	0,0314	0,9231	0,8299	0,0484	0,0147
Kocaeli	0,1158	1,0000	0,8340	0,0468	1,0000
Konya	0,0265	0,9615	0,7967	0,0701	0,0067
Malatya	0,0037	0,9615	0,5643	0,0047	0,0087
Manisa	0,0253	1,0000	0,7718	0,0168	0,0193
Mardin	0,0092	1,0000	0,5062	0,0081	0,0000
Mersin	0,0495	1,0000	0,7759	0,0456	0,8398
Muğla	0,0081	0,8846	0,5353	0,0088	0,0038
Ordu	0,0024	0,8846	0,4772	0,0028	0,0000
Sakarya	0,0423	0,9615	0,7137	0,0148	0,0302
Samsun	0,0106	0,9231	0,7054	0,0091	0,1429

Table 14. Normalized Decision Matrix (Cont.)

Şanlıurfa	0,0025	0,9231	0,4896	0,0115	0,0000
Tekirdağ	0,0245	0,9615	0,7386	0,0185	0,0726
Trabzon	0,0087	0,9615	0,5851	0,0073	0,0042
Van	0,0002	0,8846	0,2573	0,0017	0,0057

The Additive Relative Importance of each alternative was computed using Eq. (14) and presented in Table 15.

Table 15. The Additive Relative Importance $(Q_i^{(1)})$

Metropolitans	EF	Sect	ExpCoun	ExpComp	Wareh	$Q_i^{(1)}$
Adana	0,0035	0,2318	0,1488	0,0054	0,0558	0,4453
Ankara	0,0135	0,2318	0,1765	0,0196	0,0745	0,5159
Antalya	0,0031	0,2318	0,1366	0,0069	0,0019	0,3803
Aydın	0,0013	0,2229	0,1220	0,0014	0,0001	0,3478
Balıkesir	0,0010	0,2229	0,1342	0,0015	0,0136	0,3732
Bursa	0,0144	0,2318	0,1618	0,0209	0,0448	0,4737
Denizli	0,0050	0,2140	0,1570	0,0049	0,0147	0,3955
Diyarbakır	0,0005	0,2229	0,0911	0,0008	0,0000	0,3153
Erzurum	0,0000	0,1694	0,0488	0,0002	0,0000	0,2184
Eskişehir	0,0015	0,2140	0,1309	0,0015	0,0005	0,3483
Gaziantep	0,0126	0,2318	0,1610	0,0110	0,0074	0,4238
Hatay	0,0046	0,2318	0,1407	0,0046	0,2681	0,6497
İstanbul	0,1399	0,2318	0,1960	0,1430	0,2739	0,9846
İzmir	0,0191	0,2318	0,1749	0,0201	0,1289	0,5747
Kahraman maraş	0,0016	0,2051	0,1139	0,0015	0,0027	0,3247
Kayseri	0,0044	0,2140	0,1627	0,0069	0,0042	0,3922
Kocaeli	0,0162	0,2318	0,1635	0,0067	0,2893	0,7075
Konya	0,0037	0,2229	0,1561	0,0100	0,0019	0,3947
Malatya	0,0005	0,2229	0,1106	0,0007	0,0025	0,3372
Manisa	0,0035	0,2318	0,1513	0,0024	0,0056	0,3946
Mardin	0,0013	0,2318	0,0992	0,0012	0,0000	0,3335
Mersin	0,0069	0,2318	0,1521	0,0065	0,2430	0,6403
Muğla	0,0011	0,2051	0,1049	0,0013	0,0011	0,3135
Ordu	0,0003	0,2051	0,0935	0,0004	0,0000	0,2993
Sakarya	0,0059	0,2229	0,1399	0,0021	0,0088	0,3795
Samsun	0,0015	0,2140	0,1383	0,0013	0,0413	0,3964
Şanlıurfa	0,0004	0,2140	0,0960	0,0016	0,0000	0,3119
Tekirdağ	0,0034	0,2229	0,1448	0,0026	0,0210	0,3947
Trabzon	0,0012	0,2229	0,1147	0,0010	0,0012	0,3410
Van	0,0000	0,2051	0,0504	0,0002	0,0017	0,2574

The Multiplicative Relative Importance of each alternative was calculated using Eq. (15) and shown in Table 16.

Table 16. The Multiplicative Relative Importance ($Q_i^{(2)}$)

Metropolitans	EF	Sect	ExpCoun	ExpComp	Wareh	$Q_i^{(2)}$
Adana	0,5969	1,0000	0,9475	0,6252	0,6212	0,2197
Ankara	0,7208	1,0000	0,9796	0,7529	0,6754	0,3591
Antalya	0,5868	1,0000	0,9317	0,6479	0,2324	0,0823
Aydın	0,5222	0,9909	0,9113	0,5184	0,1088	0,0266
Balıkesir	0,5043	0,9909	0,9284	0,5187	0,4132	0,0994
Bursa	0,7273	1,0000	0,9632	0,7596	0,5831	0,3103
Denizli	0,6274	0,9816	0,9574	0,6167	0,4219	0,1534
Diyarbakır	0,4542	0,9909	0,8605	0,4800	0,0377	0,0070
Erzurum	0,3042	0,9299	0,7615	0,3871	0,0676	0,0056
Eskişehir	0,5285	0,9816	0,9240	0,5195	0,1543	0,0384
Gaziantep	0,7138	1,0000	0,9622	0,6931	0,3460	0,1647
Hatay	0,6195	1,0000	0,9371	0,6113	0,9782	0,3472
İstanbul	1,0000	1,0000	1,0000	1,0000	0,9843	0,9843
İzmir	0,7569	1,0000	0,9779	0,7551	0,7914	0,4423
Kahramanmaraş	0,5343	0,9720	0,8990	0,5200	0,2596	0,0630
Kayseri	0,6163	0,9816	0,9641	0,6484	0,2948	0,1115
Kocaeli	0,7397	1,0000	0,9651	0,6454	1,0000	0,4607
Konya	0,6017	0,9909	0,9564	0,6838	0,2347	0,0915
Malatya	0,4562	0,9909	0,8939	0,4639	0,2531	0,0475
Manisa	0,5978	1,0000	0,9505	0,5573	0,3191	0,1011
Mardin	0,5188	1,0000	0,8751	0,5024	0,0000	0,0000
Mersin	0,6567	1,0000	0,9515	0,6430	0,9507	0,3820
Muğla	0,5102	0,9720	0,8847	0,5085	0,2001	0,0446
Ordu	0,4296	0,9720	0,8650	0,4312	0,0347	0,0054
Sakarya	0,6425	0,9909	0,9360	0,5472	0,3635	0,1185
Samsun	0,5292	0,9816	0,9339	0,5107	0,5696	0,1411
Şanlıurfa	0,4328	0,9816	0,8694	0,5279	0,0000	0,0000
Tekirdağ	0,5951	0,9909	0,9423	0,5653	0,4683	0,1471
Trabzon	0,5153	0,9909	0,9003	0,4952	0,2049	0,0466
Van	0,3059	0,9720	0,7664	0,4031	0,2246	0,0206

Based on Eqs. (16) and (17), the joint generalized criterion values for each alternative were computed. Here, coefficient of combined optimality is taken as $\lambda = 0.5$. According to Q_i value, the following ranking was formed and shown in Table 17.

Table 17. The Joint Generalized Criterion (Q_i)

Metropolitans	$Q_i^{(1)}$	$Q_i^{(2)}$	Q_i	Rank
Adana	0,4453	0,2197	0,3325	8
Ankara	0,5159	0,3591	0,4375	6
Antalya	0,3803	0,0823	0,2313	18
Aydın	0,3478	0,0266	0,1872	23
Balıkesir	0,3732	0,0994	0,2363	17
Bursa	0,4737	0,3103	0,3920	7

Table 17. The Joint Generalized Criterion (Cont.)

Denizli	0,3955	0,1534	0,2744	10
Diyarbakır	0,3153	0,0070	0,1612	26
Erzurum	0,2184	0,0056	0,1120	30
Eskişehir	0,3483	0,0384	0,1934	21
Gaziantep	0,4238	0,1647	0,2943	9
Hatay	0,6497	0,3472	0,4984	5
İstanbul	0,9846	0,9843	0,9844	1
İzmir	0,5747	0,4423	0,5085	4
Kahraman maraş	0,3247	0,0630	0,1939	19
Kayseri	0,3922	0,1115	0,2518	13
Kocaeli	0,7075	0,4607	0,5841	2
Konya	0,3947	0,0915	0,2431	16
Malatya	0,3372	0,0475	0,1923	22
Manisa	0,3946	0,1011	0,2478	15
Mardin	0,3335	0,0000	0,1667	25
Mersin	0,6403	0,3820	0,5111	3
Muğla	0,3135	0,0446	0,1791	24
Ordu	0,2993	0,0054	0,1524	28
Sakarya	0,3795	0,1185	0,2490	14
Samsun	0,3964	0,1411	0,2687	12
Şanlıurfa	0,3119	0,0000	0,1560	27
Tekirdağ	0,3947	0,1471	0,2709	11
Trabzon	0,3410	0,0466	0,1938	20
Van	0,2574	0,0206	0,1390	29

As a result of the WASPAS method, İstanbul, Kocaeli, Mersin, İzmir and Hatay are in the top five rankings with the highest export performance during the period of 2022. On the other hand, Diyarbakır, Şanlıurfa, Ordu, Van and Erzurum are in the last five ranking with the lowest export performance in 2022. Also, the final ranking and comparison of MULTIMOORA and WASPAS methods is presented in Table 18.

Table 18. Comparison of MULTIMOORA and WASPAS Rankings

Metropolitan	**MULTIMOORA**	**Metropolitan**	**WASPAS**
Adana	11	Adana	8
Ankara	7	Ankara	6
Antalya	16	Antalya	18
Aydın	20	Aydın	23
Balıkesir	22	Balıkesir	17
Bursa	5	Bursa	7
Denizli	10	Denizli	10
Diyarbakır	26	Diyarbakır	26
Erzurum	30	Erzurum	30
Eskişehir	19	Eskişehir	21

Table 18. Comparison of MULTIMOORA and WASPAS Rankings (Cont.)

Gaziantep	8	Gaziantep	9
Hatay	4	Hatay	5
İstanbul	1	İstanbul	1
İzmir	2	İzmir	4
Kahramanmaraş	18	Kahramanmaraş	19
Kayseri	12	Kayseri	13
Kocaeli	3	Kocaeli	2
Konya	13	Konya	16
Malatya	25	Malatya	22
Manisa	15	Manisa	15
Mardin	21	Mardin	25
Mersin	6	Mersin	3
Muğla	24	Muğla	24
Ordu	28	Ordu	28
Sakarya	9	Sakarya	14
Samsun	17	Samsun	12
Şanlıurfa	27	Şanlıurfa	27
Tekirdağ	14	Tekirdağ	11
Trabzon	23	Trabzon	20
Van	29	Van	29

When the results of the MULTIMOORA and WASPAS methods were compared, the different results were obtained. However, the top five and last five rankings were found to be almost the same. For instance, İstanbul, Kocaeli, İzmir and Hatay are in the top five ranks in both methods. Additionally, the last five ranks were found to be the same in both methods. For instance, Diyarbakır, Şanlıurfa, Ordu, Van and Erzurum are in the last five ranks in both methods.

DISCUSSION AND CONCLUSION

With the help of globalization and information technology, the volume of exporting activities has significantly increased all around the world. In particularly, over the past two decades, developing countries such as China, Brazil, India, Mexico, Indonesia, and Turkey have notably gained from the exporting activities. Improving export performance has a positive impact on economic stability, foreign direct investment, employment, and inflation. Therefore, many countries focus on export-led growth in today's global economic system and naturally encourage the increase of exports throughout the country. At this point, metropolitan cities play a crucial role in the export performance of countries. Correspondingly, in this study, the export performance of 30 metropolitan in Turkey was examined using the integrated MCDM methods. Export performance evaluation was carried out within the framework of five criteria which was applied successfully by previous research (Maruf & Özdemir, 2021; Yazgan, 2022). The criteria

weight was determined using the CRITIC method. The export performance of metropolitans was ranked based on MULTIMOORA-WASPAS methods. The data used in this study was obtained from TUIK, TİM and the Republic of Turkey Ministry of Trade.

Firstly, the weights of criteria were calculated with the CRITIC method and the importance levels of the criteria were determined. Based on the results of CRITIC, the most significant criteria were warehouse area m^2 (0.2893), followed by number of exported sectors (0.2318), the number of exporting countries (0.1960), the number of exporting companies (0.1430) and export figures (0.1399). It was concluded that while the warehouse area (m^2) has the highest criterion weight; export figures performed in 2022 has the lowest criterion weight. In contrast to earlier findings (Maruf & Özdemir, 2021; Yazgan 2022), warehouse area (m^2) was found the most significant criterion in this study. Previous studies stated that the number of exported sectors was the most important criterion, followed by warehouse area (m^2).

Once determining the weights of criteria, the export performance of metropolitans in Turkey was evaluated using MULTIMOORA-WASPAS methods. According to the results of MULTIMOORA, İstanbul, İzmir, Kocaeli, Hatay and Bursa were found to have the highest export performance in 2022. These findings are parallel to results obtained by the WASPAS method. Based on the WASPAS method, İstanbul, Kocaeli, Mersin, İzmir and Hatay were found to have the highest export performance during the period of 2022. On the other hand, Diyarbakır, Şanlıurfa, Ordu, Van and Erzurum were found to have the lowest export performance in 2022, for both methods. It was concluded that the Marmara region has a significant contribution to improvement of exports, followed by the Mediterranean region. Additionally, the contribution of the Eastern and South-eastern Anatolia regions to improvement of exports is limited. This result may be explained by the fact that the Marmara region has relatively high level of industrial operations, such as automotive, textiles, steel, ceramics, paper, etc. compared to the rest of Turkey. Also, the Marmara region is close to the labor market and a transportation route. The Mediterranean region is mainly associated with agricultural exports. In particular, European and Middle East markets meet their agricultural needs of this region. However, the export performance of the Eastern and South-eastern Anatolia regions still hasn't reached the optimum level due to insufficient raw materials, socio-demographic complexity, natural resources scarcity and low investment rate. Overall, metropolitans with a high level of industrialization and population density play a key role in exporting activities. Furthermore, geopolitical position plays an important role in the development of export performance. For instance, İstanbul, Kocaeli, Bursa and İzmir are

located very close to the European market, while Hatay is very close to the Gulf and Middle East market. Over the past few decades, the European, Middle East and Gulf markets have become Turkey's main export markets. Finally, the findings of the current study are consistent with those of Maruf & Özdemir (2021) and Yazgan (2022) who examined the export performance of metropolitan in Turkey between 2020 and 2021. In accordance with the present results, previous studies have demonstrated that İstanbul, İzmir, Kocaeli, Bursa and Hatay are considered as critical cities in the development of export performance for Turkey.

The present study makes several noteworthy contributions to the current literature. Firstly, it guides the metropolitan's decision makers who want to increase their export performance on which areas they should focus more on. In this way, decision makers can perform more effective strategic plan within the scope of determined criteria and metropolitans. Secondly, the MULTIMOORA method combines three different ranking approaches, namely the ratio system, the reference point and the full multiplicative form, as mentioned above. Thus, the robustness of the method was scrutinized, and the integrated methods seem to be appropriate tools for ranking the best alternatives. Finally, no research has been found that examined the export performance of metropolitans using the CRITIC-based MULTIMOORA-WASPAS methods. In these aspects, the current study differs from other studies in the related field.

Several limitations to this study need to be acknowledged. The current study was limited to 30 metropolitan cities. A further study could be repeated for all cities in Turkey. Additionally, cities could be categorized into regions and compared export performance by region. Lastly, further study could be performed using the different MCDM.

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