
TÜRKİYE CUMHURİYETİ'NİN YÜZÜNCÜ YILI
Decision Making Approaches from a
Macroeconomic Perspective
Editor
Muhammed ORDU
BİDGE

BIDGE Publications

Decision Making Approaches from a Macroeconomic Perspective

Editor: Assoc. Prof. Dr. Muhammed ORDU

ISBN: 978-625-372-359-0

Page Layout: Gözde YÜCEL

1st Edition:

Publication Date: 25.12.2024

BIDGE Publications,

Certificate No: 71374

www.bidgeyayinlari.com.tr - bidgeyayinlari@gmail.com

Krc Bilişim Ticaret ve Organizasyon Ltd. Şti.

Güzeltepe Mahallesi Abidin Daver Sokak Sefer Apartmanı No: 7/9 Çankaya / Ankara

Content

Foreign Trade-based Macroeconomic Performance Analysis of E7 Countries 4
Nazlı TEKMAN[1] 4

A Macroeconomic Performance Assessment Regarding Industry and Employment for the Northeastern Anatolia Development Region 20
Nazlı TEKMAN[1] 20

A Macroeconomic Investigation of the Organization of Turkic States by a Hybrid Decision-Making Approach 37
Muhammed ORDU[1] 37
Nazlı TEKMAN[2] 37

CHAPTER I

Foreign Trade-based Macroeconomic Performance Analysis of E7 Countries

Nazlı TEKMAN[1]

1. Introduction

Macroeconomic indicators are key metrics that reflect the economic health of a country and influence investment decisions, as well as various sectors, including banking and government policy. The selection of macroeconomic indicators to assess performance requires a multidimensional approach and encompasses several aspects of economic performance, such as growth, unemployment, inflation, balance of trade, budget balance, and current account balance (Belke, 2020). These indicators provide important information about economic performance and help policy-makers and businesses make informed strategic decisions.

One of the primary goals often considered in macroeconomic policies is the maintenance of external balance. Macroeconomic indicators related to foreign trade, such as exports, imports, and the external balance, are critical components that reflect a country's economic stability, growth potential, and direct involvement in

[1] Lec. Dr., Osmaniye Korkut Ata University, Osmaniye Vocational School, Osmaniye/Turkey, Orcid: 0000-0003-0626-4296, nazlitekman@osmaniye.edu.tr

global markets. Therefore, countries must carefully monitor these relationships and adopt policies that boost exports, optimize imports, and sustain external balance. This is because significant and persistent external openness can increase borrowing potential, leading to long-term economic vulnerabilities. Additionally, in countries that rely on imports for energy and raw materials, a rise in imports can negatively affect gross domestic product (GDP), reduce economic growth, and lead to a decline in production levels.

Foreign direct investment is another important tool that enhances economic cooperation between nations and supports global economic growth. By facilitating capital inflow, it contributes to an increase in production levels and promotes economic growth by boosting income through export-driven investments (Acaravcı & Akyol, 2017). As such, a country's success in achieving these objectives directly impacts its economic performance. This not only provides crucial information about the country's economic structure but also plays a significant role in evaluating its overall performance (Koşaroğlu, 2021). In recent years, the growth of global trade, spurred by globalization and technological advancements, has intensified economic competition among countries. This competition is vital for countries in terms of both optimizing resource use and assessing their economic performance.

Macroeconomic indicators offer valuable insights into a country's economic performance. However, when countries are analyzed based on a single macroeconomic parameter, it may lead to incomplete or misleading conclusions. This is because the economy is a complex system influenced by the interaction of various factors. A single indicator, such as the growth rate, unemployment rate, or balance of trade, may not capture the full scope of the economy. Instead, assessing multiple macroeconomic parameters simultaneously, whether individually or together, can lead to more accurate and reliable results. In this context, a number of studies in the literature have concentrated on analyzing the macroeconomic performance of countries and groups of countries, employing multi-criteria decision-making (MCDM) approaches. For example, Oğuz

et al. (2020), Orhan (2020), and Yapa et al. (2022) have conducted macroeconomic performance analysis for the European Union using multicriteria decision-making methods. Ersoy (2023), Altay Topçu & Oralhan (2017) focused on OECD countries, while Uludağ and Ümit (2020), Ordu & Tekman (2024), and Tekman & Ordu (2024) have applied similar methods to analyze the economic performance of the Organization of Turkic States. Additionally, Doğan (2022), Al & Demirel (2022), and Ordu (2023a) have analyzed the Turkish economy using multicriteria decision-making approaches. Data Envelopment Analysis (DEA) is also one of the multicriteria decision-making methods and is a non-parametric approach. It is a successful method used for measuring the efficiency scores of decision-making units, that is alternatives, based on input-output relationships through mathematical modeling. Applied in various fields, this method is particularly useful in calculating the efficiency of countries or regions in different areas, especially macroeconomics, and allows for the comparison of alternatives. For instance, Karabulut et al. (2008), Özden (2011), Demireli & Özdemir (2013), and Nazarko (2024) have applied Data Envelopment Analysis (DEA) models to the European economy. Cherchye (2001) and Rabar (2017) focused on the OECD, while Mohanty et al. (2021) and Memarpour et al. (2024) conducted analyses on individual countries. Additionally, Güran and Tosun (2005) and Ordu (2023b) applied DEA models to the Turkish economy and its regions. Although many studies in the literature have conducted macroeconomic performance analysis of countries or country groups using DEA and MCDM methods, this study differs by analyzing the performance of E7 countries based on macroeconomic parameters that are highly correlated with foreign trade parameters. To achieve this, parameters related to foreign trade, such as exports, imports, and the balance of trade, were selected as inputs, whereas parameters highly correlated with these, such as gross domestic product (GDP), manufacturing, total reserves, and foreign direct investment, were chosen as outputs. In the first stage, efficient and inefficient countries were identified. In the next step, the efficient countries were ranked based on their

super-efficiency scores. In the final stage, the E7 countries were ranked according to their efficiency scores.

2. Material and Method

The E7 countries represent seven major emerging economic powers, and they share common features such as their young populations, emphasis on industrialization and infrastructure, contributions to global trade, and increasing influence in the global economy. In this context, the macroeconomic performance of these countries may exert a reinforcing effect on each other, and determining and comparing this is of significant importance. This study aims to compare the macroeconomic performance of E7 countries based on foreign trade. To achieve this, a two-step methodology, as shown in Figure 1, has been adopted. In the first step, the efficiency of alternative countries is determined using the Data Envelopment Analysis (DEA) method. Efficiency scores are calculated based on mathematical modeling within the Input-Output relationship. In the second step, the efficient countries are compared with each other using the super-efficiency method. This allows for a performance ranking of all alternative countries based on their efficiency scores.

In this context, the countries to be compared in terms of their efficiency are Brazil, China, Indonesia, India, Mexico, the Russian Federation, and Turkey. The inputs and outputs are as shown in Figure 2. The inputs include export, import, balance of trade whereas the outputs are gross domestic product (GDP), manufacturing, total reserves and foreign direct investment. The data for these parameters for the year 2023 has been obtained from the World Bank (World Bank, 2024).

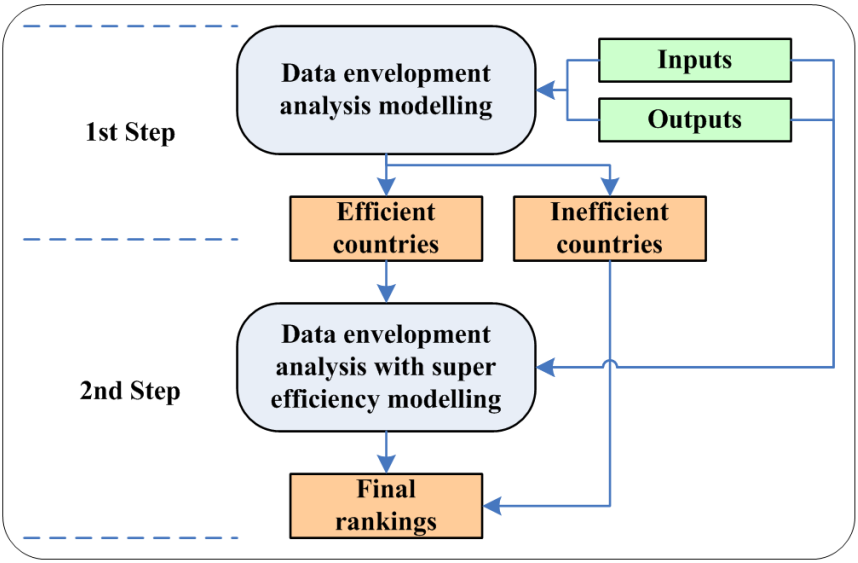

Figure 1: The two-step methodology

The decision criteria employed in the research consist of seven macroeconomic indicators, which were carefully selected to represent the most relevant measures of a country's economic performance. Since it is not practical to use all macroeconomic indicators when ranking the performance of countries, it is necessary to limit the criteria for decision-making in this context (Urfalıoğlu & Genç, 2015). A brief and explanatory summary of the selected decision criteria is as follows. **Export** refers to the sale of goods produced within a country to foreign markets in exchange for foreign currency (Urfalıoğlu & Genç, 2015). **Import** involves the purchase of goods produced outside the country by domestic buyers (Urfalıoğlu & Genç, 2015). **External Balance** indicates the equilibrium in trade between goods and services with other countries, as well as the balance between a country's total expenditures and revenues (Aydın & Beşballı, 2018). **GDP** is the overall monetary value of final goods and services produced in a country's borders during a particular time frame (Tekman, 2023). **Manufacturing** is the process of development of goods and services to meet human needs by utilizing production factors such as raw

materials, energy, and labor, thus producing value. **Total Reserves** is assets that are easily accessible, convertible, controlled by the country's monetary authorities, and accepted as international payment instruments (Memiş et al., 2014). **Direct Foreign Investment** means the development of a production facility or the acquisition of an existing production unit by entities from outside the country to gain economic benefits in another nation (Yılmazer, 2010).

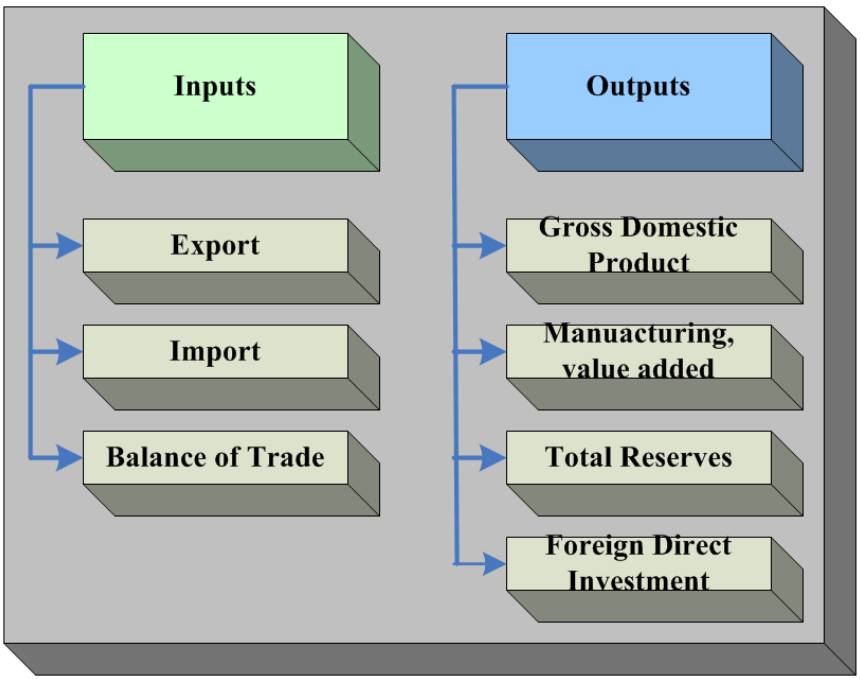

Figure 2: Inputs and Outputs

Table 1 provides the descriptive statistics of the data used. According to this, China holds the highest value for all input and output parameters, while Indonesia demonstrates the lowest performance in both export and import. On the other hand, India has the lowest value for the balance of trade, while Turkey shows the worst performance in terms of GDP, manufacturing, and total

reserves. For foreign direct investment, the lowest value is recorded by Mexico.

Table 1: Descriptive statistics of the parameters (values in billion US Dollar)

Parameters		Mean	Standard Deviation	Maximum		Minimum	
				Country	Value	Country	Value
Inputs	EXP	922.00	1069.38	China	3513.24	Indonesia	298.18
	IMP	861.44	944.84		3127.20		268.33
	BoT	60.56	142.25		386.04	India	-73.51
Outputs	GDP	4258.27	5573.47		17794.78	Turkey	1108.02
	MAN	926.81	1525.42		4658.78		215.04
	TR	790.16	1101.49		3449.54		140.86
	FDI	35.40	61.61		185.30	Mexico	0.76

Source: World Bank (2024)

The Data Envelopment Analysis (DEA) method has been widely applied in various research fields. DEA is a useful method for assessing the relative efficiency of decision-making units (DMUs) (Ordu et al., 2021). This study employs the output-oriented CCR model to evaluate the efficiency of each DMU by maximizing output while maintaining fixed input levels. The model identifies which units are operating efficiently and which are underperforming, providing valuable insights into areas where improvements can be made for the less efficient units. The general DEA model for the first DMU (i.e. Brasil) in this study is described as follows. The objective function (1) aims to maximize the output-input ratio. Constraint (2) ensures that the input of the related DMU equals 1. Constraint (3) guarantees that the ratio for each DMU does not exceed 1. Constraints (4) and (5) require that the variables remain positive.

$$Max\ \theta = \mu_1 y_{11} + \mu_2 y_{21} + \mu_3 y_{31} + \mu_4 y_{41} \quad (1)$$

$$v_1 x_{11} + v_2 x_{21} + v_3 x_{31} = 1 \quad (2)$$

$$\mu_1 y_{1j} + \mu_2 y_{2j} + \mu_3 y_{3j} + \mu_4 y_{4j} \leq v_1 x_{1j} + v_2 x_{2j} + v_3 x_{3j} \quad (3)$$

$$v_1, v_2, v_3 \geq 0 \quad (4)$$

$$\mu_1, \mu_2, \mu_3, \mu_4 \geq 0 \quad (5)$$

The DEA method computes the maximum efficiency scores for decision-making units (DMUs) as 1. However, DMUs with the maximum efficiency score can still be ranked using the super-efficiency method. To do this, the constraint (see Eq. 3) corresponding to the relevant DMU must be removed (Tekman & Ordu, 2024).

3. Results and Discussion

This study examines the macroeconomic performance of the E7 countries in the context of foreign trade. A multi-criteria analysis was performed to evaluate how similar or different the E7 countries, which share several common characteristics, are on a macroeconomic level. The analysis was carried out in two phases: the first phase involved assessing the efficiency of the countries, while the second phase focused on calculating and comparing the super-efficiency scores of the efficient countries. In the first stage, inputs and outputs were carefully defined, and it was considered that they have high correlation values with each other. As shown in Table 2, the correlation values between the inputs and outputs are above 90%, indicating a positive correlation. In the next phase, a mathematical model was developed for each decision-making unit by considering the objective function and constraints from Equation (1) to (5). The efficiency scores are presented in Table 3, where four countries were identified as efficient. The highest efficiency score is 1.0000, while the lowest is 0.7356. Therefore, the efficient countries make up 57.14% of the total countries.

Table 2: Correlation coefficients of parameters

	GDP	MAN	TR	FDI
EXP	0.9960	0.9947	0.9895	0.9811
IMP	0.9904	0.9871	0.9805	0.9689
BoT	0.9097	0.9216	0.9256	0.9401

In the second phase, super-efficiency data envelopment models were developed for the efficient countries. In this context, the constraint in Eq. (3) was removed in the model developed for each decision-making unit. According to these results, the most efficient country is India, followed by China, the Russian Federation, and Brazil. After these, although they are not considered efficient countries, Turkey, Indonesia, and Mexico rank next.

Table 3: The results of DEA modellling

DMUs	Efficiency Score	Super Efficiency Score
Brazil	1.0000	1.2402
China	1.0000	1.6127
Indonesia	0.8787	-
India	1.0000	2.4591
Mexico	0.7356	-
Russian Federation	1.0000	1.4288
Turkey	0.9157	-

It is essential to identify the differences between economies in terms of macroeconomic performance. India, China, Russia, and Brazil have high efficiency scores, indicating strong economic performance, while Turkey, Indonesia, and Mexico have low efficiency scores, reflecting weaker economic performance. For Turkey, Indonesia, and Mexico to strengthen their economic performance, they need to boost capital inflows, increase investments, and enhance capacity utilization in the industrial sector. In addition to traditional product manufacturing, these countries should focus more on value-added production by increasing Research&Development spending. This strategy would lead to higher GDP levels and improved efficiency scores alongside production growth. By expanding exports and attracting private investments, these countries should stimulate economic growth and

bolster domestic demand. Higher wealth levels and increased total reserves should lead to more investment, fostering confidence and attracting foreign investments. They must also pursue import substitution policies to achieve a balance in foreign trade, while promoting stability and growth in production. These three countries should prioritize policies to increase exports, optimize imports, and maintain a sustainable external balance.

For efficient countries like India, China, Russia, and Brazil, it is crucial to continue developing the macroeconomic policies they have implemented to maintain and improve their current efficiency and economic performance. They should strengthen their performance with expansionary monetary policies, structural reforms, and sound fiscal policies, while also benefiting from favorable global economic conditions. As globalization and technological advancements accelerate global trade, increasing economic competition, these countries must continue to efficiently utilize their resources and adopt policies that further enhance their economic performance.

4. Conclusion

The E7 countries are a group of seven major emerging economies with common traits, such as young populations, an emphasis on industrialization and infrastructure, substantial roles in global trade, and increasing influence in the global economy. In this context, the macroeconomic performance of these nations may have a positive impact on each other, making it crucial to evaluate and compare their performance. This study focuses on assessing the macroeconomic performance of the E7 countries in relation to foreign trade. In this study, a multi-criteria analysis was conducted to determine the extent to which the E7 countries, which share many common characteristics, resemble each other on a macroeconomic scale and how much they differ from one another. This analysis was carried out in two stages: In the first stage, the efficiency of the countries was assessed, and in the second stage, the efficiency scores of the efficient countries were calculated and compared with each other.

This study can be conducted with the specific aim of comparing countries within a distinct framework, making it easier to identify inefficient countries. In particular, it will provide an opportunity to determine and guide how weaker members of economic unions formed by certain countries can be strengthened.

This study has some limitations. For instance, it focuses solely on the E7 countries, uses data from 2023, and conducts an analysis specifically on foreign trade. Future studies could explore different groups of countries or compare the macroeconomic strengths of countries using a different theme rather than foreign trade. Additionally, performance across different years could be examined, allowing for performance analysis over a distinct period.

References

Acaravcı, A., & Akyol, M. (2017). Türkiye'de doğrudan yabancı yatırımlar, dış ticaret ve ekonomik büyüme ilişkisi. *Uluslararası Ekonomi ve Yenilik Dergisi*, *3* (1), 17-33.

Al, İ., & Demirel, S. R. (2022). Türkiye'nin makroekonomik performansının TOPSIS yöntemiyle değerlendirilmesi: 2002-2019 dönemi. *Mehmet Akif Ersoy Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *9* (1), 202-222. Doi: 10.30798/makuiibf.860476

Altay Topçu, B., & Oralhan, B. (2017). Türkiye ve OECD ülkelerinin temel makroekonomik göstergeler açısından çok kriterli karar verme yöntemleri ile karşılaştırılması. *International Journal of Academic Value Studies*, *3* (14), 260-277.

Arsu, T. (2022). Assessment of macroeconomic performances and human development levels of BRICS and MINT countries using CRITIC and COPRAS methods. *Pacific Business Review*, *14* (10), 1-19.

Aydın, M. K., & Beşballı, S. G. (2018). Türkiye'nin cari açık sorunu üzerine bir değerlendirme. *Bilgi*, *20* (1), 1-14.

Belke, M. (2020). CRITIC ve MAIRCA yöntemleriyle G7 ülkelerinin makroekonomik performansının değerlendirilmesi. *İstanbul Ticaret Üniversitesi Sosyal Bilimler Dergisi*, *19*, 120-139.

Cherchye, L. (2001). Using data envelopment analysis to assess macroeconomic policy perform. *Applied Economics*, *33* (3), 407-416. Doi: 10.1080/00036840122353

Doğan, H. (2022). Türkiye'nin makroekonomik performansının 2010-2020 yılları için CRITIC temelli ARAS yöntemi ile değerlendirilmesi. *Akademik Sosyal Araştırmalar*, *6* (19), 189-202. Doi: 10.31455/asya.1027906

Demireli, E., & Özdemir, A. Y. (2013). Seçilmiş Avrupa ülkelerinde makroekonomik performans ölçümü: Şans kısıtlı veri zarflama analizi ile bir uygulama. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*, *37*, 303-320.

Ersoy, N. (2023). MEREC-MULTIMOOSRAL modeli ile OECD ülkelerinin makroekonomik performanslarının değerlendirilmesi. *Gümüşhane Üniversitesi Sosyal Bilimler Dergisi*, *14* (2), 471-491.

Güran, M. C., & Tosun, M. U. (2005). Türkiye ekonomisinin makro ekonomik performansı: 1951-2003 dönemi için parametrik olmayan bir ölçüm. *Ankara Üniversitesi SBF Dergisi*, *60* (4), 89-115.

Karabulut, K., Ersungur, Ş. M., & Polat, Ö. (2008). Avrupa Birliği ülkeleri ve Türkiye'nin ekonomik performanslarının karşılaştırılması: Veri zarflama analizi. *İktisadi ve İdari Bilimler Dergisi*, *22* (1), 1-11.

Koşaroğlu, Ş. M. (2021). E7 ülkelerinin makroekonomik performanslarının ENTROPİ ve ARAS yöntemleriyle karşılaştırılması. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*, *68*, 203-221. Doi: 10.51290/dpusbe.833885

Memarpour, M., Hafezalkotobb, A., Khalilzadeh, M., Saghaei, A., & Soltani, R. (2024). Modelling the effect of monetary policies of central bank on macroeconomic indicators in Iran using system dynamics and fuzzy multi-criteria decision-making techniques. *Advances in Mathematical Finance & Applications*, *9* (1), 1-32. Doi: 10.22034/AMFA.2022.1959354.1752

Memiş, H., Paksoy, S., & Yöntem, T. (2014). Merkez bankası rezervleri ve makro ekonomik değişkenler arasındaki ilişki: 1989-2013 dönemi üzerine bir uygulama. *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *19* (4), 93-108.

Mohanty, R. K., Sahoo, B. K., & Chaudhury, P. K. (2021). Assessing the (eco)macroeconomic performance index of India: A data envelopment analysis approach. *Journal of Public Affairs*, *21*, e2122. Doi: 10.1002/pa.2122

Nazarko, B. (2024). Performance evaluation in macroeconomics based on DEA Malmquist index with a new

approach for the efficiency evaluation in a two-stage process. *WSEAS Transactions on Information Science and Applications*, *21*, 169-185. Doi: 10.37394/23209.2024.21.17

Oğuz, S., Çetiner, Ö., & Yalçıntaş, D. (2020). Avrupa Birliği'ne aday ve potansiyel aday ülkelerin ekonomik göstergelerinin TOPSIS yöntemi ile değerlendirilmesi. *Çağ Üniversitesi Sosyal Bilimler Dergisi*, *17* (2), 17-28.

Ordu, M. (2023a). A hybrid decision-making approach for determining the optimal tourism period based on tourism income-expenditure. *Eurasia International Scientific Research and Innovation Congress*, 21-22 July 2023, Guba, Azerbaijan, pp. 175-180.

Ordu, M. (2023b). Evaluating occupational accidents and diseases-based sustainable performances of the Turkish development regions using a hybrid MCDM approach. Mishra, B. K. (Ed.), *Intelligent Engineering Applications and Applied Sciences for Sustainability* (ss. 190-207). IGI Global. Doi: 10.4018/979-8-3693-0044-2.ch011

Ordu, M., Kirli Akin, H., & Demir, E. (2021). Healthcare systems and Covid-19: Lessons to be learnt from efficient countries. *International Journal of Health Planning and Management*, *36* (5), 1476-1485. Doi: 10.1002/hpm.3187

Ordu, M., & Tekman, N. & (2024). Unity or separation? Macroeconomic power of the Organization of Turkic States. *3rd International Korkut Ata Scientific Research Conference*, 22-24 November 2024, Osmaniye, Turkey, pp. 632-646.

Orhan, M. (2020). Avrupa Birliği ülkeleri ile Avrupa Birliği üyeliğine aday olan ülkelerin makroekonomik performanslarının ARAS yöntemi ile kıyaslanması. *Journal of Humanities and Tourism Research*, *10* (1), 115-129. Doi: 10.14230/johut786

Özden, Ü. H. (2011). Faktör analizi ve veri zarflama analizi ile Avrupa Birliği'ne üye ve seçilmiş bazı ülkelerin karşılaştırmalı

analizi. *Trakya Üniversitesi Sosyal Bilimler Dergisi*, *13* (1), 106-121.

Rabar, D. (2017). An overview of data envelopment analysis application in studies on the socio-economic performance of OECD countries. *Economic Research-Ekonomska Istraživanja*, *30* (1), 1770-1784. Doi: 10.1080/1331677X.2017.1383178

Tekman, N. (2023). *Ekonomik büyüme bağlamında finansal istikrar ve ekonomik özgürlükler: gelişmekte olan ülkeler üzerine bir panel veri analizi* [Yayımlanmamış doktora tezi]. Atatürk Üniversitesi.

Tekman, N., & Ordu, M. (2024). Export-import based macroeconomic performance analysis for the countries of the Organization of Turkic States. *3rd International Korkut Ata Scientific Research Conference*, 22-24 November 2024, Osmaniye, Turkey, (pp. 647-652).

Uludağ, A. S., & Ümit, A. Ö. (2020). Türk Dünyası ülkelerinin katma değerli üretim ve makroekonomik performanslarının DEMATEL ve COPRAS yöntemleriyle analizi. *Sosyoekonomi*, *28* (45), 139-164. Doi: 10.17233/sosyoekonomi.2020.03.09

Urfalıoğlu, F., & Genç, T. (2015). Çok kriterli karar verme teknikleri ile Türkiye'nin ekonomik performansının Avrupa Birliği üye ülkeleri ile karşılaştırılması. *Marmara Üniversitesi İktisadi Ve İdari Bilimler Dergisi*, *35* (2), 329-360. Doi: 10.14780/iibdergi.201324469

Yapa, K., Durmus, M., Tayyar, N., & Akbulut, İ. (2020). Comparison of the European Union countries and Turkey's macroeconomic indicators with Best Worst method. *In Handbook of Research on Social and Economic Development in the European Union* (pp. 204-219). IGI Global.

Yılmazer, M. (2010). Doğrudan yabancı yatırımlar, dış ticaret ve ekonomik büyüme ilişkisi: Türkiye üzerine bir

deneme. *Celal Bayar Üniversitesi Sosyal Bilimler Dergisi*, *8* (1), 241-260.

World Bank (2024). *World Bank Open Data 2024*. (Accessed on: https://data.worldbank.org/ at 20/11/2024).

CHAPTER II

A Macroeconomic Performance Assessment Regarding Industry and Employment for the Northeastern Anatolia Development Region

Nazlı TEKMAN[1]

1. Introduction

The efficient use of production factors and their integration into the production process are essential conditions for economic growth in a country. Specifically, the effective utilization of labor, one of the most important production factors involved in the production process, plays a crucial role in economic development through increased employment (Yamak et al., 2012). Changes in macroeconomic indicators related to production and employment contribute to economic efficiency and growth. The volume of production reflects the economic scale of a country or city. Gross domestic product (GDP) serves as a primary indicator of economic growth by measuring the total production level. Countries and cities with high production capacities achieve economic growth and secure a significant position in the global economy. A high labor force

[1] Lec. Dr., Osmaniye Korkut Ata University, Osmaniye Vocational School, Osmaniye/Turkey, Orcid: 0000-0003-0626-4296, nazlitekman@osmaniye.edu.tr

participation rate indicates that more people are actively engaged in work within that city, region, and country, signaling high economic activity. A high employment rate is a sign of economic vitality and social welfare. Growth in employment boosts economic growth by supporting consumption expenditures. The rise in the number of entrepreneurs enhances the production of goods and services, strengthens the economic power of cities and countries, and enables the formulation of growth strategies in these areas. High unemployment rates may trigger economic stagnation and social issues. Policies aimed at increasing employment rates are crucial for maintaining and boosting economic power.

Production and employment indicators are key factors in enhancing the economic power of cities and countries. These indicators foster economic growth, improve social welfare, and promote sustainable development. By developing strategies based on these indicators, cities and countries can gain a competitive edge in the global economy. With the growth of economic power, it is expected that favorable conditions will be created for the development of health, knowledge, and skills, which can be utilized in social, cultural, and political spheres, thus elevating the level of human development (Durgun, 2023).

Development agencies were formed to reduce regional inequalities and ensure a more balanced distribution of prosperity across the country. Their objectives include maximizing the contribution of each region to national development by assessing their potential, enhancing competitiveness, strengthening economic and social integration, and fostering a more balanced settlement pattern (Kalkınma Ajansları, 2024). Turkey is divided into 26 development regions, and the Northeastern Anatolia Development Region is one of these (Ordu, 2023). It is important to analyze macroeconomic indicators to minimize the gaps in development levels both within of the cities of Turkish development regions and between these regions. In this situation, rather than conducting single-parameter analyses (such as GDP or unemployment rate), multi-parameter analyses - those involving multiple macroeconomic

variables - allow for a more robust and reliable comparison. For this purpose, multicriteria decision-making approaches are widely used in various research fields. For instance, Al & Demirel (2022), Doğan (2022), Kuzugüden (2022), Pınar (2023), and Pınar et al. (2023) have applied various multicriteria decision-making approaches, focusing on Turkey's macroeconomic analysis. On the other hand, Çetin (2021) monitored the performance of Level-2 regions between the years 2017 and 2019 based on eight different macroeconomic indicators. Additionally, they determined the criteria weights separately using the Entropy and CRITIC methods and analyzed their impact on performance. These criterion weights were then integrated into the COPRAS method to complete the analysis phase. Furthermore, multicriteria decision-making approaches have been used in studies related to development regions, addressing various themes. For example, Bakırcı et al. (2014), Tarı et al. (2017), Akpınar & Keskin (2018), Şengül & Şengül (2018), Çağlar & Keten (2018), and Ordu (2023) have also conducted studies using multi-criteria decision-making approaches in the context of development regions, focusing on different themes and research areas. This study, unlike others in the literature, focuses on the macroeconomic performance of the cities within the Northeast Anatolia Development Region, specifically in terms of industry and employment.

In this study, the aim is to analyze the economic development levels of three cities within the Northeastern Anatolia Development Region, one of Turkey's development regions, and provide a framework from a macroeconomic perspective to enhance their development levels. To achieve this, five different criteria were weighted using the Entropy method, and the three cities were compared macroeconomically using the COPRAS method. Thus, a comparison was made through a study that considers multiple macroeconomic performance indicators for the cities within the development region.

2. Material and Metot

This study aims to analyze the cities within the Northeastern Anatolia Development Region from a macroeconomic perspective in order to minimize the development gaps between Turkish development regions and prioritize economic development. As shown in Figure 1, a two-stage hybrid multicriteria decision-making approach has been used for this purpose. In the first stage, the CRITIC method, an objective decision-making tool, was employed to weight the criteria, followed by the completion of the macroeconomic performance analysis using the Multi-Attributive Border Approximation Area Comparison (MABAC) method. The data used in this study is from 2023 and was obtained from the Turkish Statistical Institute (TÜİK, 2024). The cities representing alternative cities in the Northeastern Anatolia Development Region are Bayburt, Erzincan, and Erzurum. These cities have been evaluated based on criteria such as GDP per capita, employment participation rate, employment rate, number of enterprises, and unemployment rate (see Figure 2).

The criteria used in the study are defined as follows. **GDP per capita** means the rate of total population of a country to its GDP (Tekman, 2023). **Employment participation rate** is the percentage of the active population within the non-institutional working-age population (Yenilmez and Kılıç, 2018). **Employment rate** is calculated by dividing the employed population by the non-institutional working-age population and expressing it as a percentage (TÜİK, 2023). **Number of enterprises** refers to the total count of businesses operating in a particular region. **Unemployment rate** is determined by dividing the number of individuals not employed by the total population and presenting it as a percentage (TÜİK, 2023).

Table 1 presents the criteria considered in the study, along with their abbreviations and units. Additionally, while the unemployment rate criterion is expected to have the lowest value for the alternatives, the other criteria aim for the maximum value.

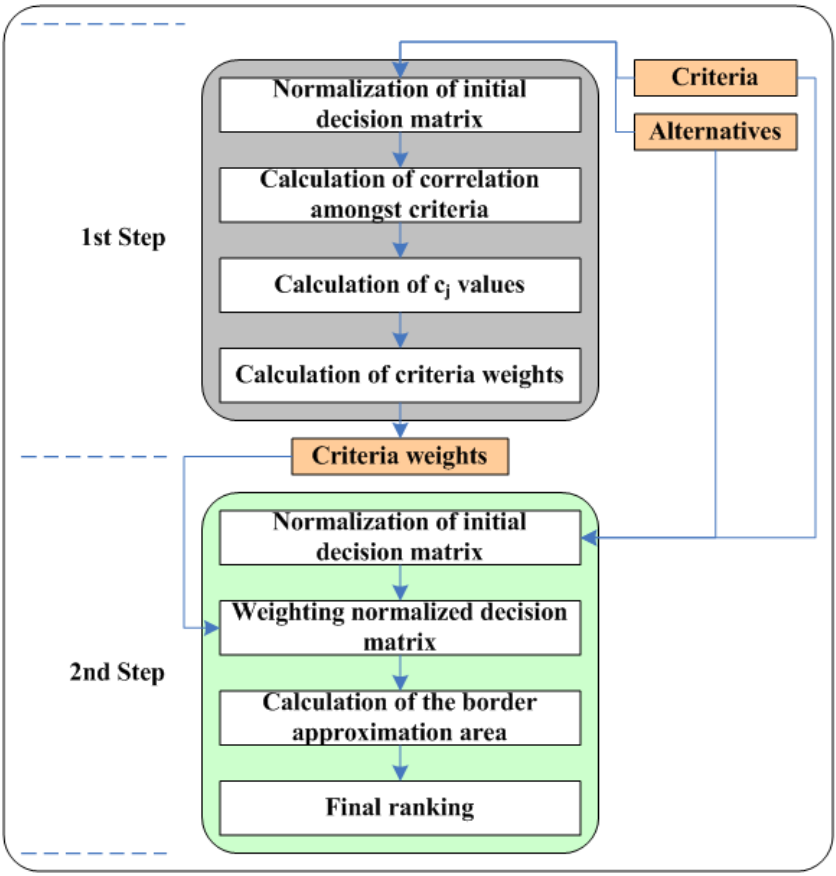

Figure 1: The two-step hybrid multicriteria decision making approach

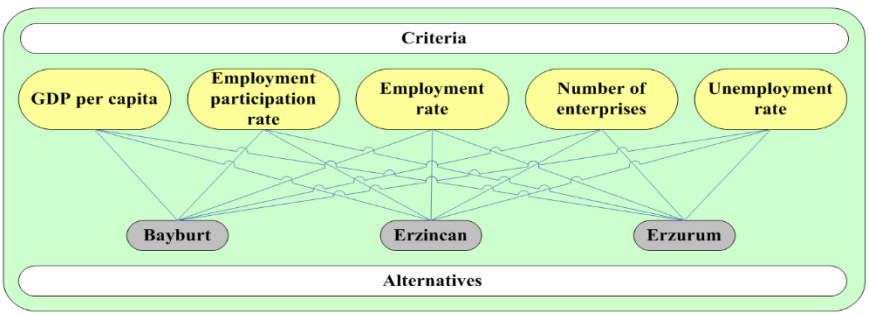

Figure 2: The hierarchy of the decision-making approach

Upon reviewing the data (see Table 2) used in the study, it is found that Bayburt has the highest values for the employment and employment participation rate criteria, while having the lowest value for the number of enterprises. Erzurum, on the other hand, ranks highest only for the number of enterprises, but shows the poorest performance in all criteria except for the employment rate. Erzincan, with the lowest values for GDP per capita and unemployment rate, stands out by having the most favorable value for the employment rate compared to the other cities.

Table 1: Criteria in the study

Criteria	Abbreviations	Unit	Character
GDP per capita	GDPPC	US $	Maximization
Employment participation rate	EPR	%	
Employment rate	ER	%	
Number of enterprises	NoE	-	
Unemployment rate	UR	%	Minimization

Table 2: Descriptive statistics for the development region

Criteria	Mean	Standard deviation	Maximum		Minimum	
			City	Value	City	Value
GDPPC	6742.67	1541.44	Erzincan	8904	Erzurum	5416
EPR	51.13	1.49	Bayburt	53.1	Erzurum	49.5
ER	46.03	1.33	Bayburt	47.9	Erzincan	44.9
NoE	13322.67	9734.03	Erzurum	26525	Bayburt	3345
UR	9.9	1.31	Erzincan	11.6	Erzurum	8.4

Source: TÜİK (2024)

2.1. Criteria importance through intercriteria correlation (CRITIC) method

This method focuses on calculating the correlations among various criteria in a decision-making process, considering both direct and indirect relationships between them (Jahan et al., 2012). It helps assess their relative importance within the decision process. The CRITIC method is especially useful in situations where the criteria are complex and interconnected, allowing for a more comprehensive

and objective assessment of the decision's elements (Işık et al., 2024). The steps involved in the CRITIC method are outlined as follows:

Step 1: The initial decision matrix is normalized by using either Eq. (1) or (2), depending on whether the criteria are beneficial or cost-oriented, respectively.

$$r_{ij} = \frac{x_{ij} - x_j^{min}}{x_j^{max} - x_j^{min}} \quad (1)$$

$$r_{ij} = \frac{x_j^{max} - x_{ij}}{x_j^{max} - x_j^{min}} \quad (2)$$

where x_{ij} means the value of alternative i of the criterion j, r_{ij} denotes the normalized x_{ij}, x_j^{max} gives the maximum value of the criterion , and x_j^{min} is the minimum value of the criterion j.

Step 2: Eq. (3) is applied to specify the correlations amongst criteria, where ρ_{jk} is the correlation between the criteria j and k.

$$\rho_{jk} = \frac{\sum_{i=1}^{m}(r_{ij} - \bar{r}_j)(r_{ik} - \bar{r}_k)}{\sqrt{\sum_{i=1}^{m}(r_{ij} - \bar{r}_j)^2 \sum_{i=1}^{m}(r_{ik} - \bar{r}_k)^2}} \quad (3)$$

Step 3: Eq. (4) is used to determine the c_j values, where σ_j presents the standard deviation of the criterion j, and n denotes the number of criteria.

$$c_j = \sigma_j \sum_{k=1}^{n} (1 - \rho_{jk}) \quad (4)$$

Step 4: Eq. (5) is employed to calculate the criteria weights, where w_j is the weight of the criterion j.

$$w_j = \frac{c_j}{\sum_{k=1}^{n} c_k} \quad (5)$$

2.2. Multi-attributive border approximation area comparison (MABAC) method

Pamucar & Cirovic (2015) introduces how the MABAC method is applied step-by-step as follows:

Step 1: First, an initial decision matrix involving m alternatives and n criteria is established. Then, the matrix is normalized using Eq. (6) for maximization-oriented criteria and Eq. (7) for minimization-oriented criteria. These normalization procedures ensure that all criteria are on a comparable scale, allowing for a fair evaluation of the alternatives based on their performance across different criteria.

$$n_{ij} = \frac{x_{ij} - x_i^-}{x_i^+ - x_i^-} \quad (6)$$

$$n_{ij} = \frac{x_{ij} - x_i^+}{x_i^- - x_i^+} \quad (7)$$

where x_{ij} denotes the value of alternative i of the criterion j, n_{ij} presents the normalized version of x_{ij}, x_i^- is the minimum value of x_{ij}, x_i^+ represents the maximum value of x_{ij}.

Step 2: Eq. (8), where v_{ij} is the weighted normalized value of x_{ij}, provides to weight each element of the normalized decision matrix.

$$v_{ij} = w_j(n_{ij} + 1) \tag{8}$$

Step 3: The border approximation area (BAA), denoted by g_i, is then calculated for each criterion based on Eq. (9), which is used to assess the performance of alternatives in relation to the ideal and negative ideal solutions. After that, the distance of the alternative from the BAA is computed by subtracting the value of the BAA from the normalized weighted value. This calculation helps to assess how close or far an alternative is from the ideal solution for each criterion, allowing for a comparison of its performance relative to the best possible outcome.

$$g_i = (\prod_{j=1}^{m} v_{ij})^{1/m} \tag{9}$$

Step 4: Alternatives are ranked depending on the sum of their distances from the BAA. The alternative with the largest value is specified as the best alternative, as it is the farthest from the ideal solution, indicating its superior performance across the criteria.

3. Results and Discussion

This study seeks to assess the cities within the Northeastern Anatolia Development Region from a macroeconomic perspective, aiming to minimize the development gaps between each other, and promote economic growth. As shown in Figure 1, a two-stage hybrid multicriteria decision-making approach was employed for this purpose. In the first stage, the CRITIC method, an objective decision-making tool, was used to determine the weights of the criteria, followed by the macroeconomic performance analysis using the MABAC method.

When determining the criteria weights, after constructing the initial decision matrix (see Table 3), the formulas in Eqs. (1) and (2) were used to normalize the cost or benefit-oriented criteria, as shown in Table 4. Using Eq. (3), the correlations between the criteria were calculated and are provided in Table 5. Finally, the c_j values were computed using Eq. (4), and the criteria weights were determined through Eq. (5) and presented in Table 6.

Table 3: Initial decision matrix

Alternatives	GDPPC	EPR	ER	NoE	UR
Erzurum	5416	49.5	45.3	26525	8.4
Erzincan	8904	50.8	44.9	10098	11.6
Bayburt	5908	53.1	47.9	3345	9.7

Source: TÜİK (2024)

Table 4: Normalized decision matrix

Alternatives	GDPPC	EPR	ER	NoE	UR
Erzurum	0.0000	0.0000	0.1333	1.0000	1.0000
Erzincan	1.0000	0.3611	0.0000	0.2913	0.0000
Bayburt	0.1411	1.0000	1.0000	0.0000	0.5938

Table 5: Correlation values

Alternatives	GDPPC	EPR	ER	NoE	UR
GDPPC	1.0000	-0.0283	-0.4934	-0.3589	-0.9596
EPR	-0.0283	1.0000	0.8834	-0.9228	-0.2539
ER	-0.4934	0.8834	1.0000	-0.6347	0.2289
NoE	-0.3589	-0.9228	-0.6347	1.0000	0.6069
UR	-0.9596	-0.2539	0.2289	0.6069	1.0000

Table 6: Criteria weigths (%)

Alternatives	GDPPC	EPR	ER	NoE	UR
GDPPC	0.0000	1.0283	1.4934	1.3589	1.9596
EPR	1.0283	0.0000	0.1166	1.9228	1.2539
ER	1.4934	0.1166	0.0000	1.6347	0.7711
NoE	1.3589	1.9228	1.6347	0.0000	0.3931
UR	1.9596	1.2539	0.7711	0.3931	0.0000
Total	5.8403	4.3217	4.0158	5.3095	4.3777
Standard deviation	0.5412	0.5064	0.5430	0.5143	0.5029
$\mathbf{C_j}$	3.1611	2.1884	2.1805	2.7307	2.2017
$\mathbf{w_j}$	0.2536	0.1756	0.1750	0.2191	0.1767

In the second phase of the study, the MABAC method was used to evaluate the alternatives based on the macroeconomic performance criteria. In this context, since four criteria are maximization-oriented and one criterion as shown in Table 1 is minimization-oriented, the initial decision matrix was normalized using Eqs. (6) and (7) (see Table 7). The weighted normalized decision matrix (see Table 8) was then calculated using the criteria weights obtained from the CRITIC method and presented in Table 6, by using Eq. (8). Using Eq. (9), the border approximation area for each criterion was determined and provided in Table 9. The performance ranking of the cities is shown in Table 10. According to this ranking results, Bayburt achieved the best macroeconomic performance based on industry and employment, followed by Erzurum in second place, while Erzincan ranked last.

Table 7: Normalized decision matrix

Alternatives	GDPPC	EPR	ER	NoE	UR
Erzurum	0.0000	0.0000	0.1333	1.0000	1.0000
Erzincan	1.0000	0.3611	0.0000	0.2913	0.0000
Bayburt	0.1411	1.0000	1.0000	0.0000	0.5938

Table 8: Weigthed normalized decision matrix

Alternatives	GDPPC	EPR	ER	NoE	UR
Erzurum	0.2536	0.1756	0.1983	0.4382	0.3534
Erzincan	0.5072	0.2390	0.1750	0.2829	0.1767
Bayburt	0.2894	0.3512	0.3500	0.2191	0.2816
$\mathbf{g_i}$	0.3339	0.2452	0.2299	0.3006	0.2600

Table 9: The border approximation area of the alternatives

Alternatives	GDPPC	EPR	ER	NoE	UR
Erzurum	-0.0803	-0.0696	-0.0315	0.1376	0.0934
Erzincan	0.1733	-0.0062	-0.0549	-0.0177	-0.0833
Bayburt	-0.0445	0.1060	0.1201	-0.0815	0.0216
$\mathbf{g_i}$	-0.0803	-0.0696	-0.0315	0.1376	0.0934

Table 10: The ranking of the alternatives

Alternatives	S_i	Rank
Erzurum	0.0495	2
Erzincan	0.0112	3
Bayburt	0.1217	1

Bayburt ranks first due to its high employment participation rate and employment rates, as well as its low unemployment rate. Additionally, with its relatively small population, Bayburt leads in terms of per capita values, as it is one of the smallest provinces in Turkey. Erzurum, ranked second, does not perform well in certain criteria. Therefore, macroeconomic policies should prioritize improving its low GDP per capita (GDPPC), employment participation rate (EPR), and employment rate (ER), while addressing the high unemployment rate (UR). To boost GDPPC,

sectoral diversification should be encouraged, Small and Medium Enterprises (SMEs) should be supported, tourism should be developed, infrastructure investments should be prioritized, and production levels should be increased. This rise in production would contribute to both an increase in the employmen rate and employment participation rate, and a reduction in the unemployment rate.

Erzincan, ranking last, has a very low employment participation rate, with factors such as underdeveloped industrial and service sectors, low value-added production, migration, population loss, an education-employment mismatch, and low female workforce participation contributing to this situation. To address these issues, decision-makers should focus on plans to enhance the city's development by increasing education and job opportunities, preventing migration and population loss, developing the industrial and service sectors, and implementing policies to support women's workforce participation.

Regionally, these provinces are characterized by an economy primarily based on agriculture and livestock. Since the industrial and service sectors are not sufficiently developed, research and development (R&D) efforts should be directed towards sectors that can create employment, and private sector investments that align with the region's potential should be attracted. Special loans, grants, and tax incentives, along with supports such as electricity, transportation, and infrastructure, should be offered to attract investment, and policies should be developed to promote the overall development of the region.

4. Conclusion

Minimizing the development disparities between Turkish regional development areas, bridging the gaps in sectors such as economy, industry, tourism, and healthcare, and ensuring overall national development and economic progress are crucial. In this context, this study analyzes the cities of the Northeastern Anatolia Development Region, which includes the cities of Bayburt,

Erzincan, and Erzurum, from a macroeconomic perspective. This analysis is critical both for the management of this specific development region and for other regions to adapt this study to their own contexts. In this study, five different criteria (i.e., GDP per capita, employment participation rate, employment rate, number of enterprises, and unemployment rate) were identified and weighted using the CRITIC method. In the next stage, the cities were compared based on macroeconomics using the MABAC method.

This study provides an opportunity to periodically measure the development levels of cities within Turkish development regions. In this way, the impact of developed projects, allocated budgets, considered investments, and social development policies on the advancement of these cities will be better understood, allowing for a clearer assessment of how much their development levels have improved. As a result, the new projects to be undertaken and the policies to be developed will be more robust and accurate. This will ensure that managers and decision-makers take more consistent steps, minimizing waste in terms of cost and time.

This study has certain notable limitations. For example, it is based solely on the Northeastern Anatolia development region. Additionally, the study was conducted using the CRITIC-based MABAC approach. For future studies, similar research could be carried out for other Turkish development regions, focusing on both industry and employment or within the framework of a different theme. Likewise, such a study could also be conducted using a different multicriteria decision-making approach.

References

Akpınar, R., & Keskin, R. (2018). Zafer kalkınma ajansının Manisa ekonomisine katkısı. *Sosyal Bilimler Enstitüsü Dergisi*, *40*, 207-226.

Al, İ., & Demirel, S. R. (2022). Türkiye'nin makroekonomik performansının TOPSIS yöntemiyle değerlendirilmesi: 2002-2019 dönemi. *Mehmet Akif Ersoy Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *9* (1), 202-222. Doi: 10.30798/makuiibf.860476

Bakırcı, F., Ekinci, E. D., & Şahinoğlu, T. (2014). Bölgesel kalkınma politikalarının etkınlığı: Türkiye alt bölgeler bazında bir uygulama. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *18* (2), 281-298.

Çağlar, A., & Keten, N. D. (2018). İllerin insani gelişme endeksinin veri zarflama analizi ile ölçülmesi. *Ege Akademik Bakış*, *18* (4), 565-578. Doi: 10.21121/eab.2018442987

Çetin, B. (2021). *Türkiye'de ekonomik göstergeler açısından düzey 2 bölgelerinin COPRAS yöntemi ile sıralanması* [Yayımlanmamış yüksek lisans tezi]. Balıkesir Üniversitesi.

Doğan, H. (2022). Türkiye'nin makroekonomik performansının 2010-2020 yılları için CRITIC temelli ARAS yöntemi ile değerlendirilmesi. *Akademik Sosyal Araştırmalar*, *6* (19), 189-202. Doi: 10.31455/asya.1027906

Durgun, B. (2023). Türkiye'de finansal gelişme, doğrudan yabancı yatırımlar ve ticari açıklığın insani gelişmeye etkisi: Genişletilmiş ARDL yaklaşımı. *İktisadi İdari ve Siyasal Araştırmalar Dergisi*, 8, 1-20. Doi: 10.25204/iktisad.1339218

Işık, C., Türkkan, M., Marbou, S., & Gül, S. (2024). Stock market performance evaluation of listed food and beverage companies in ıstanbul stock exchange with MCDM methods. *Decision Making: Applications in Management and Engineering*, *7* (2), 35–64. Doi: 10.31181/dmame722024692

Jahan, A., Mustapha, F., Sapuan, S.M., Ismail, M.Y., & Bahraminasab, M. (2012). A framework for weighting of criteria in ranking stage of material selection process. *The International Journal of Advanced Manufacturing Technology*, *58*, 411-420. Doi: 10.1007/s00170-011-3366-7

Kalkınma Ajansları (2024). *Bölgesel Kalkınma ve Ülkemizde Bölgesel Kalkınma Politikalarının Gelişim Süreci*. (Accessed on: https://ka.gov.tr/sayfalar/bolgesel-kalkinma-ve-ulkemizde-bolgesel-kalkinma-politikalarinin-gelisim-sureci--22 at 17/12/2024).

Kuzugüden, D. (2022). Sağlık harcamaları ile makroekonomik göstergelerin TOPSIS yöntemi ile değerlendirilmesi: Türkiye ve seçilmiş ülkeler. *Pearson Journal of Social Sciences & Humanities*, *7* (18), 24-40. Doi: 10.46872/pj.484

Ordu, M. (2023). Evaluating occupational accidents and diseases-based sustainable performances of the Turkish development regions using a hybrid MCDM approach. Mishra, B. K. (Ed.), *Intelligent Engineering Applications and Applied Sciences for Sustainability* (ss. 190-207). IGI Global. Doi: 10.4018/979-8-3693-0044-2.ch011

Pamucar, D., & Cirovic, G. (2015). The selection of transport and handling resources in logistics centers using multi-attributive border approximation area comparison (MABAC). *Expert Systems with Applications*, *42*, 3016-3028. Doi: 10.1016/j.eswa.2014.11.057

Pınar, A. (2023). *Temel göstergeler ile Türkiye ekonomisinin makroekonomik performansının çok kriterli karar verme yöntemleri ile ölçümü (2003 - 2021)* [Yayımlanmamış doktora tezi]. Selçuk Üniversitesi.

Pınar, A., Yıldırım, M., & Erdoğan, S. (2023). COVİD dönemi ve sonrası Türkiye ekonomisinin performansının CRİTİC, TOPSİS ve MABAC yöntemleri ile ölçülmesi. *KMÜ Sosyal ve Ekonomik Araştırmalar Dergisi*, *25* (44), 433-449.

Şengül, Ü., & Şengül, A. B. (2018). Kalkınma ajansları yoluyla yapılan yatırım teşviklerinin 2013-2014 döneminde etkinlik analizi. *Siyaset, Ekonomi ve Yönetim Araştırmaları Dergisi*, *6* (5), 19-30.

Tarı, R., Pehlivanoğlu, F., & Özbilgin, M. (2017). Efficiency measurement of regional development agencies in Turkey by using data envelopment analysis (DEA). *Dokuz Eylül Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *32* (2), 47-78.

Tekman, N. (2023). *Ekonomik büyüme bağlamında finansal istikrar ve ekonomik özgürlükler: gelişmekte olan ülkeler üzerine bir panel veri analizi* [Yayımlanmamış doktora tezi]. Atatürk Üniversitesi.

TÜİK (2023). *İşgücü istatistikleri mikro veri seti*. (Accessed on: https://www.tuik.gov.tr/media/microdata/pdf/isgucu.pdf at 17/12/2024).

TÜİK (2024). *Geographic Statistics Portal 2024*. (Accessed on: https://cip.tuik.gov.tr/ at 20/11/2024).

Yamak, R., Abdioğlu, Z., & Mert, N. (2012). Türkiye'de işgücüne katılımı belirleyen faktörler: Mikro ekonomik analiz. *Anadolu Üniversitesi Sosyal Bilimler Dergisi*, *12* (2), 41-58.

Yenilmez, F., & Kılıç, E. (2018). Türkiye'de işgücüne katılma oranı-işsizlik oranı ilişkisi: Cinsiyet ve eğitim düzeyine dayalı bir analiz. *Eskişehir Osmangazi Üniversitesi İktisadi ve İdari Bilimler Dergisi*, *13* (2), 55-76. Doi: 10.17153/oguiibf.410254

CHAPTER III

A Macroeconomic Investigation of the Organization of Turkic States by a Hybrid Decision-Making Approach

Muhammed ORDU[1]
Nazlı TEKMAN[2]

1. Introduction

Macroeconomic indicators are used to compare the economic conditions and performance of countries as a way to measure changes in national economies. They are also employed to forecast the future state of the economy (Yapa et al., 2020). Indicators such as GDP, GDP per capita, unemployment, inflation, real interest rates, exports, imports, and foreign trade are commonly used (Topçu & Oralhan, 2017; Yapa et al., 2020). Numerous macroeconomic indicators are frequently featured in reports by international organizations and academic research. In general, identifying these indicator groups is a challenge for nations because they cannot be represented in a single unit, the significance of change in each

[1] Assoc. Prof. Dr., Osmaniye Korkut Ata University, Faculty of Engineering and Natural Sciences, Department of Industrial Engineering, Osmaniye/Turkey, Orcid: 0000-0003-4764-9379, muhammedordu@osmaniye.edu.tr
[2] Lec. Dr., Osmaniye Korkut Ata University, Osmaniye Vocational School, Osmaniye/Turkey, Orcid: 0000-0003-0626-4296, nazlitekman@osmaniye.edu.tr

differs, and some indicators are interconnected, sometimes moving in the same direction and sometimes in opposite directions (Arsu, 2022).

The Organization of Turkic States held its first summit in Almaty on October 20-21, 2011, focusing on "Economic and Trade Cooperation". At the third summit in Gabala, Azerbaijan, on August 15-16, 2013, under the theme of "Transport and Connectivity", the "Cooperation Protocol Between the Ministries of Foreign Affairs of Turkic-Speaking Countries" was signed. On November 12, 2021, in Istanbul, the Council of Heads of State of the Turkic States convened under the theme "Green Technologies and Smart Cities in the Digital Age", during which the organization's name was officially changed to the "Organization of Turkic States". The member countries of the Organization collaborate in more than 30 fields, concentrating on areas such as economy, politics, tourism, education, and health. (Türk Devletler Teşkilatı, 2024). Although the Organization of Turkic States is a relatively young union, it is essential for the full and observer member countries to periodically analyze and monitor their macroeconomic performance in order to build the organization on solid economic foundations. To this end, there are a few studies that model and analyze the economic performance of the Organization using multicriteria decision-making approaches. For instance, Uludağ & Ümit (2020) used the DEMATEL-based COPRAS approach to examine the economic performance of Turkic World countries between 2008 and 2016. They divided their analysis into two parts, focusing both on macroeconomic performance and value-added production. The results showed that Turkey and Turkmenistan were successful in the macroeconomic field, while Kazakhstan, Uzbekistan, and Azerbaijan performed better in value-added production. Eyüpoğlu (2017) used the AHP-based TOPSIS approach to analyze the macroeconomic performance of six countries in the Turkic World between 2004 and 2013. The criteria were weighted using the Analytical Hierarchy Process (AHP), a subjective weighting method, and then integrated into the TOPSIS method. The evaluation focused on growth, inflation,

unemployment, and Gross Domestic Product (GDP), with growth identified as the most critical criterion, holding a 51% weight, followed by inflation with a 29% weight. Azerbaijan exhibited the best performance in the analysis. Bektaş & Baykuş (2023) conducted a study that also evaluated Russia, comparing the macroeconomic performance of Turkic World countries. They used the CRITIC-based MAIRCA approach for this analysis. Unlike previous studies, they included the misery index, purchasing power parity, and government revenues as evaluation criteria, conducting the macroeconomic analysis under a total of five different criteria. Ordu & Tekman (2024) conducted a macroeconomic performance analysis using the CRITIC-based EDAS approach to determine the potential economic positioning of the full and observer member countries of the Organization of Turkic States within the G20 under different scenarios. In their analysis, they found that Turkey currently ranks 17th. In the first scenario, where only the full member countries of the Turkic World are considered, the position rises to 12th. In the final scenario, including the observer member countries, the macroeconomic power of the Turkic World places it in 10th position within the G20. In the another study, Tekman & Ordu (2024) conducted a macroeconomic analysis based on foreign trade for the full member countries of the Turkic World using the data envelopment analysis (DEA) method. In this context, they used GDP and total reserves as output parameters. The results identified Kazakhstan and Uzbekistan as the most efficient countries. This study, unlike previous ones in the literature, focuses on a broader macroeconomic analysis that includes both full and observer member countries. In doing so, it contributes to the emerging research field on the Organization of Turkic States, offering new insights into the topic.

This study refers to a study that explores the macroeconomic dynamics within the Organization of Turkic States (OTS) using a hybrid decision-making methodology. This hybrid approach combines multiple decision-making techniques to analyze economic relationships, policies, and cooperative strategies between the

member states of the organization. The research aims to provide insights into how these states, which share historical, cultural, and economic ties, can collaborate and improve their macroeconomic performance using structured decision-making processes. In this study, seven member countries were evaluated based on six key macroeconomic criteria using the Entropy-based COPRAS method. The weights for each criterion were calculated using the objective Entropy approach, while the countries' rankings were determined through the COPRAS (Complex Proportional Assessment) technique. The study's findings include recommendations designed to help the countries improve their macroeconomic performance. These suggestions offer guidance on addressing weaknesses in their economic structures and further strengthening their advantages.

2. Material and Method

This study aims to carry out an analysis of the macroeconomic parameters the Organization of Turkic States (OTS) from a macroeconomic perspective, employing a hybrid decision-making methodology. In this context, a two-stage approach has been used for the macroeconomic performance analysis, as shown in Figure 1. In the first stage, the criteria identified using the Entropy method are weighted. Then, in the second stage, the alternative countries are ranked based on the evaluation criteria using the COPRAS method. For this analysis, the data from the World Bank for the year 2022 has been utilized (World Bank, 2024). As shown in Figure 2, Gross domestic product (GDP), GDP per capita, export, import, labor force, and population are considered as the evaluation criteria. In this framework, the full and observer member countries of the Organization of Turkic States are compared. Since data for the Turkish Republic of Northern Cyprus could not be obtained from the World Bank, it has been excluded from the investigation.

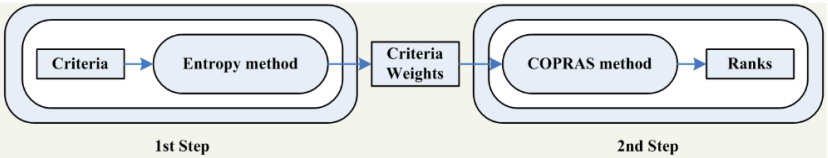

Figure 1: The hybrid decision making approach used in the study

The criteria used in the study are defined as follows. **Export** refers to the sale of goods and services produced within a country to other nations in return for foreign currency (Koşar, 2018). **Import** refers to the purchase of goods and services produced in foreign countries by buyers in a different country (Koşar, 2018). **GDP** is the calculation of the market value of all goods and services produced in a country at a certain period of time (Tekman, 2023). **GDP per capita** is the ratio of total population to GDP (Tekman, 2023). **Labor force** refers to the working-age population that provides labor for the production of economic goods and services during a certain period of time. The labor force is the sum of both employed and unemployed individuals (TÜİK, 2023). **Population** means the total number of people residing in a specific region over a defined period (Aksu, 2011).

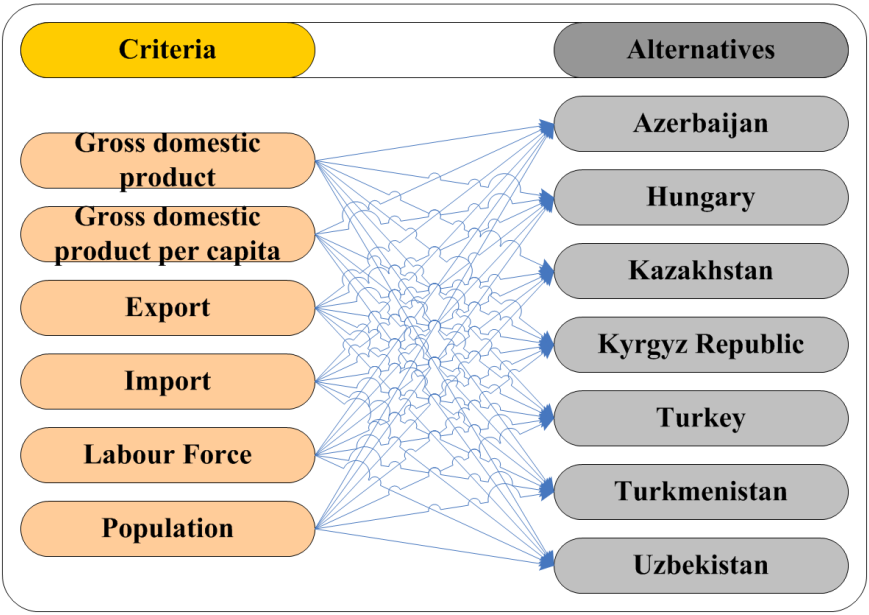

Figure 2: The hierarchy of the decision-making approach

Table 1: Criteria in the study

Criteria	Abbreviations	Unit	Character
Gross domestic product	GDP	US $	Maximization
GDP per capita	GDPPC		
Export	EXP		
Import	IMP		Minimization
Labour Force	LF	-	Maximization
Population	P	-	

Source: World Bank (2024)

Table 1 presents the criteria used in the study, along with their units, abbreviations and whether they are oriented toward maximization or minimization. Thus, all criteria, except for import, are maximization-oriented. The descriptive statistics are presented in Table 2. As shown, the maximum and minimum values for each criterion are held by different alternative countries. Hungary has the highest GDP per capita, whereas Turkey ranks the highest in the

other criteria. The Kyrgyz Republic has the lowest GDP, GDP per capita, and export values, whereas Turkmenistan performs the worst the lowest in the remaining criteria.

Table 2: Descriptive statistics for the Organization of the Turkic States. SD: Standard deviation

Criteria	Mean	SD	Maximum		Minimum	
			Country	Value	Country	Value
GDP	219.8	288.6	Turkey	907	Kyrgyz Republic	12.1
GDPPC	8728	5284.3	Hungary	18356		1739.8
EXP	98.8	114.4	Turkey	350		3.6
IMP	98.4	128.2	Turkey	386	Turkmenistan	7.4
LF	10518	10541.8		34630		2117.4
P	24779	26364.9		84980		6430.8

Source: World Bank (2024)

2.1. Entropy method

The entropy weight method is an objective approach to determining criterion weights. It works by first calculating the entropy weight for each criterion using information entropy, and then adjusting the weights based on the variation of each criterion. Additionally, the entropy method is useful for highlighting differences between sets of information. Criterion that have identical values across different alternatives should be excluded (Li et al., 2020). The steps to calculate the objective weight are as follows:

Step 1: Calculation of normalized decision matrix by Eq. (1) after establishing the initial desicion matrix.

$$v_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \quad (1)$$

where x_{ij} is the value of alternative i of the criteiron j. v_{ij} denotes the normalized value of x_{ij}.

Step 2: Calculation of the entropy value of each criterion by using Eq. (2).

$$z_j = -\frac{1}{\ln(m)} \sum_{i=1}^{m} v_{ij} \ln(v_{ij}) \quad (2)$$

where z_j represents the entropy value of the criterion j. m is the number of alternatives.

Step 3: Calculation of the weight of each criterion by using Eq. (3).

$$w_j = \frac{1 - z_j}{\sum_{j=1}^{n} (1 - z_j)} \quad (3)$$

where w_j is the weight of the criterion j.

2.2. Complex proportional assessment (COPRAS) method

The steps of the COPRAS method outlined by Alinezhad & Khalili (2019), starting with the develoment of the decision matrix. This step entails identifying the criteria to evaluate the alternatives. The criteria must be measurable, pertinent to the decision problem, and independent of one another. The COPRAS method offers a systematic approach to solve the decision making problems, ensuring that decisions are based on a thorough analysis of all relevant parameters. It is commonly applied in a number of disciplines such as economics and engineering (Der et al., 2024).

Step 1: Calculation of the normalized decision matrix. After the initial decision matrix has been established, the next step is to calculate the normalized decision matrix by using Eq. (4). This involves adjusting the values of each criterion to a widely used scale, typically ranging from 0 to 1, to ensure comparability across different criteria.

$$v_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \tag{4}$$

where x_{ij} is the value of alternative i of the criterion j. v_{ij} denotes the normalized value of x_{ij}.

Step 2: Determining the maximum and minimum indices: In this step, g and n-g denote the numbers of benefit-oriented criteria and cost-oriented criteria, respectively. Si refers to the maximum and minimum indices for each alternative by using Eqs. (5) and (6).

$$S_{+i} = \sum_{j=1}^{g} v_{ij} \tag{5}$$

$$S_{-i} = \sum_{j=g+1}^{n} v_{ij} \tag{6}$$

Step 3: Calculation of the relative importance value of each alternative (Q_i) by using Eq. (7).

$$Q_i = S_{+i} + \frac{\min_i S_{-i} \sum_{i=1}^{m} S_{-i}}{S_{-i} \sum_{i=1}^{m} \frac{\min_i S_{-i}}{S_{-i}}} \quad (7)$$

Step 4: Ranking of alternatives: This is carried out by organizing the obtained scores in descending order, from highest to lowest.

3. Results and Discussion

This study seeks to assess the member and observer countries of the Organization of Turkic States based on macroeconomic criteria. A two-stage multi-criteria analysis approach was utilized to achieve this. In the first stage, the Entropy method was used to assign weights to the criteria, while in the second stage, the COPRAS method was applied to rank and compare performance. After normalizing the initial decision matrix using Eq. (1) (see Table 3), the entropy values of the criteria were calculated using Eq. (2). Subsequently, the criteria weights were determined through Eq. (3), and these are presented in Table 4.

Table 3: Normalized initial decision matrix

Alternatives	GDP	GDPPC	EXP	IMP	L	P
Azerbaijan	0.0512	0.1272	0.0683	0.0309	0.0738	0.0585
Hungary	0.1151	0.3005	0.2314	0.2439	0.0677	0.0556
Kazakhstan	0.1466	0.1880	0.1362	0.0862	0.1289	0.1132
Kyrgyz Republic	0.0079	0.0285	0.0053	0.0154	0.0408	0.0402
Turkey	0.5897	0.1747	0.5060	0.5611	0.4704	0.4899
Turkmenistan	0.0368	0.1439	0.0212	0.0107	0.0288	0.0371
Uzbekistan	0.0527	0.0373	0.0317	0.0517	0.1898	0.2055

Table 4: Entropy and weigths values

	GDP	GDPPC	EXP	IMP	L	P
Ej	0.6726	0.8970	0.6973	0.6440	0.7921	0.7705
1-Ej	0.3274	0.1030	0.3027	0.3560	0.2079	0.2295
wj	0.2145	0.0675	0.1983	0.2332	0.1362	0.1503

In this study, which analyzes the macroeconomic performance of the full and observer countries of the Organization of Turkic States, the COPRAS method was used. The initial decision matrix, established using Eq. (4), was normalized, and the normalized values (see Table 5) were multiplied by the criterion weight values obtained from the Entropy method to produce the weighted normalized decision matrix, which is presented in Table 6. To determine the maximum and minimum indices, cost or benefit-oriented criteria were applied using Eqs. (5) and (6). The relative importance values of the alternatives were determined using Eq. (7). In the final step, the performance ranking of the alternative countries was obtained and presented in Table 7.

Table 5: Normalized initial decision matrix for COPRAS method

Alternatives	GDP	GDPPC	EXP	IMP	L	P
Azerbaijan	0.0512	0.1272	0.0683	0.0309	0.0738	0.1377
Hungary	0.1151	0.3005	0.2314	0.2439	0.0677	0.1310
Kazakhstan	0.1466	0.1880	0.1362	0.0862	0.1289	0.2667
Kyrgyz Republic	0.0079	0.0285	0.0053	0.0154	0.0408	0.0947
Turkey	0.5897	0.1747	0.5060	0.5611	0.4704	1.1542
Turkmenistan	0.0368	0.1439	0.0212	0.0107	0.0288	0.0873
Uzbekistan	0.0527	0.0373	0.0317	0.0517	0.1898	0.4842

Table 6: Weigthed normalized decision matrix for COPRAS method

Alternatives	GDP	GDPPC	EXP	IMP	L	P
Azerbaijan	0.0110	0.0086	0.0136	0.0072	0.0101	0.0188
Hungary	0.0247	0.0203	0.0459	0.0569	0.0092	0.0178
Kazakhstan	0.0314	0.0127	0.0270	0.0201	0.0176	0.0363
Kyrgyz Republic	0.0017	0.0019	0.0010	0.0036	0.0056	0.0129
Turkey	0.1265	0.0118	0.1003	0.1309	0.0641	0.1572
Turkmenistan	0.0079	0.0097	0.0042	0.0025	0.0039	0.0119
Uzbekistan	0.0113	0.0025	0.0063	0.0121	0.0258	0.0659

Table 7: Parameter and weigths values for COPRAS method

Alternatives	P_i	R_i	$1/R_i$	Q_i	N_i	Rank
Azerbaijan	0.062	0.007	138.768	0.095	0.206	6
Hungary	0.118	0.057	17.583	0.122	0.265	5
Kazakhstan	0.125	0.020	49.718	0.137	0.297	2
Kyrgyz Republic	0.023	0.004	278.197	0.090	0.194	7
Turkey	0.460	0.131	7.642	0.461	1.000	1
Turkmenistan	0.038	0.003	400.984	0.133	0.289	3
Uzbekistan	0.112	0.012	82.878	0.132	0.285	4

The results of the study clearly show that Turkey demonstrates the best macroeconomic performance based on the criteria used in the analysis. Following Turkey, Kazakhstan ranks 2nd, while Turkmenistan and Uzbekistan occupy the 3rd and 4th positions with closely related scores. The lowest performance was observed in the Kyrgyz Republic.

Turkey, a top-performing country, leads others in GDP, labor force, export, and population. Kazakhstan ranks second in GDP per capita and population, while Turkmenistan holds the third spot in GDP per capita. These macroeconomic indicators highlight the strengths of these nations, with Uzbekistan following in fourth place due to its labor force. These advantages help these countries secure high rankings. In contrast, Hungary, Azerbaijan, and the Kyrgyz

Republic rank at the bottom. As low-performing countries, they need to improve their macroeconomic performance based on the current criteria. Specifically, Azerbaijan and the Kyrgyz Republic, which are at the lowest positions, should boost their GDP by fostering strong economic performance, supported by domestic demand and export growth. Hungary, on the other hand, should implement macroeconomic policies aimed at increasing the labor force, boosting exports, and reducing imports to support the production process.

4. Conclusion

The Organization of Turkic States, a young alliance formed by Turkic states united around important components such as history, culture, and language, faces the significant issue of addressing the differences between its member countries from an economic perspective. It is crucial for countries united around an economic partnership to develop together, as the strength and stability of the union depend on its economic progress. From this viewpoint, conducting a macroeconomic performance analysis of the member countries is essential both for ensuring that the countries provide a prosperous life to their citizens and for strengthening the union's overall economic health. This study aims to evaluate the member and observer countries of the Turkic States Organization within the framework of macroeconomic criteria. To achieve this, a two-stage multi-criteria analysis approach has been adopted. In the first stage, the criteria were weighted using the Entropy method, and in the second stage, performance ranking and comparison were carried out using the COPRAS method.

This study can be used as a measurement tool for the sustainable development and growth of such economic unions. Periodic, that is annual assessments, could allow countries to anticipate which parameters to focus on in specific situations. In this way, it can help decision-makers take more accurate steps and avoid wasteful actions. These comparisons can be easily applied not only in the economic field but also in areas such as education, tourism and

healthcare, allowing for the careful and disciplined monitoring of the multifaceted development of the union's member countries.

This study has a number of limitations. For example, the focus is on the Organization of Turkic States, a union that shares many common characteristics. In future studies, applying this approach to unions that are primarily based on material expectations and have many differences could provide valuable insights. Additionally, the study is based on data from 2022, and future research could focus on measuring development over different years. While the Entropy-based COPRAS method was used in this study, other multicriteria decision-making approaches could also be developed.

References

Aksu, L. (2011). Dünya'da ve Türkiye'de nüfus analizleri. *Istanbul Journal of Sociological Studies*, *25*, 219-311.

Arsu, T. (2022). Assessment of macroeconomic performances and human development levels of BRICS and MINT countries using CRITIC and COPRAS methods. *Pacific Business Review (International)*, *14* (10), 1-19.

Bektaş, S., & Baykuş, O. (2023). CRITIC ve MAIRCA yöntemleriyle Türk Dünyası ülkeleri, Türkiye ve Rusya'nın 2010-2020 dönemi için makro ekonomik performanslarının analizi. *Uluslararası İktisadi ve İdari İncelemeler Dergisi*, *39*, 107-122. Doi: 10.18092/ulikidince.1173274

Der, O., Ordu, M. & Basar, G. (2024). Optimization of cutting parameters in manufacturing of polymeric materials for flexible two-phase thermal management systems. *Materials Testing*, *66* (10), 1700-1719. Doi: 10.1515/mt-2024-0127

Eyüpoğlu, K. (2017). Türk Dünyasında yer alan ülkelerin makro performanslarının karşılaştırılması. *Bilig*, *83*, 331-350.

Koşar, A. (2018). Türkiye'nin son 10 yılda en çok ihracat ve ithalat yaptığı ülkelerin hiyerarşik kümeleme analizi ile gruplandırılması ve değerlendirilmesi. *Bucak İşletme Fakültesi Dergisi*, *1* (1), 17-28.

Li, H., Wang, W., Fan, L., Li, Q., & Chen, X. (2020). A novel hybrid MCDM model for machine tool selection using fuzzy DEMATEL, entropy weighting and later defuzzification VIKOR. *Applied Soft Computing*, *91*, 106207. Doi: 10.1016/j.asoc.2020.106207

Ordu, M., & Tekman, N. & (2024). Unity or separation? Macroeconomic power of the Organization of Turkic States. *3rd International Korkut Ata Scientific Research Conference*, 22-24 November 2024, Osmaniye, Turkey, pp. 632-646.

Tekman, N. (2023). Ekonomik büyüme bağlamında finansal istikrar ve ekonomik özgürlükler: gelişmekte olan ülkeler üzerine bir panel veri analizi [Yayımlanmamış doktora tezi]. Atatürk Üniversitesi.

Tekman, N., & Ordu, M. (2024). Export-import based macroeconomic performance analysis for the countries of the Organization of Turkic States. *3rd International Korkut Ata Scientific Research Conference*, 22-24 November 2024, Osmaniye, Turkey, (pp. 647-652).

Topçu, B. A., & Oralhan, B. (2017). Türkiye ve OECD ülkelerinin temel makroekonomik göstergeler açısından çok kriterli karar verme yöntemleri ile karşılaştırılması. *International Journal of Academic Value Studies*, *3* (14), 260-277. Doi: 10.23929/javs.304

TÜİK, (2023). *İşgücü istatistikleri mikro veri seti*. (Accessed on: https://www.tuik.gov.tr/media/microdata/pdf/isgucu.pdf at 16/12/2024)

Türk Devletler Teşkilatı (2024). *Teşkilatın Tarihçesi*. (Accessed on: https://www.turkicstates.org/tr/organizasyon-tarihcesi at 17/12/2024)

Uludağ, A. S., & Ümit, A. Ö. (2020). Türk Dünyası ülkelerinin katma değerli üretim ve makroekonomik performanslarının DEMATEL ve COPRAS yöntemleriyle analizi. *Sosyoekonomi*, *28* (45), 139-164. Doi: 10.17233/sosyoekonomi.2020.03.09

Yapa, K., Durmus, M., Tayyar, N., & Akbulut, İ. (2020). Comparison of the European Union countries and Turkey's macroeconomic indicators with Best Worst ethod. *In Handbook of Research on Social and Economic Development in the European Union* (pp. 204-219). IGI Global.

World Bank (2024). World Bank Open Data 2024. (Accessed on: https://data.worldbank.org/ at 20/11/2024).


BRIDGE