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Comparison of the Macroeconomic Performance of European Union Countries and Hungary with the TOPSIS Method

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ABSTRACT

Macroeconomic data are the key indicators for assessing economic development and effective use of country resources for both local and foreign investors. In this respect, the macroeconomic performance of the countries determines the future of many economic and financial factors. In this study, the macroeconomic performances of the European Union and Hungary are compared using the TOPSIS method over the 1980-2021 data. GDP growth (annual, %), consumer price inflation (annual, %), unemployment rate and current account balance (as a percentage of GDP) data were used as criteria to evaluate macroeconomic performance. The criteria were weighted using the NMD method and four macroeconomic performance indicators. TOPSIS ranking results were calculated separately for the relevant periods in accordance with the weighting values, and the ranking results were converted into integrated ranking results using the Copeland method. The relationships between the ranking results were analyzed with Spearman correlation using SPSS 26 program and the level of relationship between them was tried to be determined. In the study, it has been concluded that Hungary performed in line with EU countries in the context of 2017 and 2021, when the most successful performance was produced, and differed negatively from EU countries on the basis of 1991, when the lowest performance was produced.

Avrupa Birliği Ülkeleri ve Macaristan'ın Makroekonomik Performansının TOPSİS Yöntemi ile Karşılaştırılması

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ÖZ

Bir ülkedeki ekonomik gelişimin ve ülke kaynaklarının etkin kullanımının hem yerel hem de yabancı yatırımcılar açısından değerlendirilmesi için en önemli temel göstergeler, makroekonomik verilerdir. Bu açıdan ülkelerin makroekonomik performansı birçok ekonomik ve finansal faktörün de geleceğini belirlemektedir. Bu çalışmada Avrupa Birliği ve Macaristan'ın makroekonomik performansları 1980-2021 verileri üzerinden TOPSİS yöntemi kullanılarak karşılaştırılmaktadır. Makroekonomik performansın değerlendirilmesinde GSYİH büyümesi (yıllık, %), tüketici fiyat enflasyonu (yıllık, %), işsizlik oranı ve cari işlemler dengesi (GSYİH'ya oran olarak) verileri kriter olarak kullanılmıştır. Kriterler, NMD yöntemi ve dört makroekonomik performans göstergesi kullanılarak ağırlıklandırılmıştır. TOPSİS sıralama sonuçları ağırlıklandırma değerlerine göre ilgili dönemler için ayrı ayrı hesaplanmış ve sıralama sonuçları Copeland yöntemi kullanılarak entegre sıralama sonuçlarına dönüştürülmüştür. Sıralama sonuçları arasındaki ilişkiler SPSS 26 programı kullanılarak Spearman korelasyonu ile analiz edilmiş ve aralarındaki ilişkinin düzeyi belirlenmeye çalışılmıştır. Çalışmada Macaristan'ın en başarılı performansın üretildiği 2017 ve 2021 yılları bağlamında AB ülkeleri ile uyumlu performans gösterdiği, en düşük performansın üretildiği 1991 yılı bazında ise AB ülkelerinden negatif yönde farklılaştığı sonucuna ulaşılmıştır.

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INTRODUCTION

The foundation of the European Union (EU) was established on the steel and coal sector, the most important resources of the time, in order to put an end to the ongoing wars in Europe and to bring countries together in France and Germany, and to make peace permanent. For this purpose, the European Coal and Steel Community was established on April 18, 1951, and Germany, France, Belgium, the Netherlands, Luxembourg, and Italy were the signatories of the agreement. The same countries established the European Atomic Energy Community and the European Economic Community (EEC) on 25 March 1957 with the Treaty of Rome. Although these communities had different organs and budgets in the early days, they were gathered under a single roof in 1967 and became an economic union known as the "European Communities".

Since it was thought that the European Community would not have been able to achieve economic power unless a singular monetary structure had been formed, the monetary union process was started in 1988 and the "Delors Plan", the first step of the transition to monetary union, was accepted at the Madrid Summit held in 1989. As a result, as a result of the effects of the Maastricht Treaty, which entered into force in November 1993, the European Community began to be called the "European Union" (Kiral & Esen, 2013). The three criteria that must be met in order to become a member of the EU are known as political, economic and cohesion criteria.

Currently, the member states of the European Union are Germany, Austria, Belgium, Bulgaria, Czechia, Denmark, Estonia, Finland, France, Greek Cypriot Administration, Croatia, Netherlands, Ireland, Spain, Sweden, Italy, Latvia, Lithuania, Luxembourg, Hungary, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Greece.

Macroeconomic data are the most important basic indicators for the evaluation of the economic development and effective use of the country's resources in terms of both local and foreign investors. In this respect, the macroeconomic performance of countries determines the future of many economic and financial factors.

First of all, country credit ratings (Chee et al., 2015; Yildiz & Günsoy, 2017) and stock market performance (Kyereboah-Coleman & Agyire-Tettey, 2008; Pal & Mittal, 2011) can be affected by macroeconomic indicators. In addition, macroeconomic performances affect investor behavior, capital flows and foreign direct investment inflows (Enu et al., 2013; Sharma & Joshi, 2015). On the other hand, macroeconomic performances affect exchange rates (Akhter & Faruqui, 2015) and private sector performance in terms of corporate profitability (Bekeris, 2012). Therefore, comparing the macroeconomic performances of the countries can shed light on the future macroeconomic performances of the countries and their macroeconomic positions in their regions.

In the economic field, macroeconomic performance is tried to be measured using various variables. Studies conducted to evaluate the macroeconomic performance of countries are carried out within the framework of four factors: "economic growth, inflation rates, unemployment rates and current account deficit", which are defined as the magic diamond and developed by the OECD (Knox Lovell et al., 1995; Eyüboğlu, 2017).There are different and complexly related variables for the measurability of a country's macroeconomic performance, and it is difficult to make a general assessment by using all the relevant variables together in the same study. In this context, in determining the macroeconomic performance by measuring the effect of n different factors together, studies on developing various synthetic macroeconomic performance indicators (Ramanathan, 2006; Karabulut et al., 2010; Demir & Bakirci, 2014; Güran & Tosun, 2015; Pulay & Simon, 2020) have been done.

Comparison between countries based on macroeconomic indicators is important for the welfare level and development of countries, determining the right investment and financing policies and implementing the relevant political decisions, developing economic cooperation between countries and revealing the competitiveness levels of countries (Aliukov & Buleca, 2022; Cazacu & Bărbută-Mişu, 2023; Didenko & Yefimenko, 2023; Fritz & Koch, 2016; Ritenour, 2023; Tuncay & Dorjnaran, 2023; Yapa et al., 2023). In other words, it is important to compare countries in terms of macro variables in order to present the macroeconomic outlook of countries with different structural characteristics in an

ecosystem with limited resources (Asiloğulları & Ceyhan, 2019) from a holistic perspective and to identify and implement the necessary policy recommendations for a sustainable performance . In this context, evaluations can be carried out with multi-criteria decision-making methods using macro variables in order to understand the current situation of countries, to identify the necessary areas of improvement, to ensure improvements and to contribute to future projections. Differences in the results obtained by differentiating the normalization methods of the preferred Multi-Criteria Decision Making (MCDM) methods in the studies can also be examined (Baydaş et al., 2024).

In the literature, the different dimensions of the macroeconomic performances of the countries and the complexity of the variables used in the evaluations (Uludağ & Ümit, 2020) have increased the usability of MCDM methods in the measurement of macroeconomic performance.

Hungary, a European country with recent targeted financial disciplines implemented, cannot be freed from its risky appearance due to the negative effects it has experienced, especially the global economic crisis in 2008 (DEİK, 2011), and is in the category of developing countries like Turkey, despite being in the Euro Zone where developed countries are located (TCMB, 2022). Hungary's macroeconomic performance is largely affected by its public finance performance, similar to Turkey's (Pulay & Simon, 2020). In this context, it is important to reveal the macroeconomic performance of Hungary in comparison with the EU countries.

Within the scope of similar studies in the literature (Karabulut et al., 2010; Dinçer, 2011; Ashourian, 2012; Genc & Urfalioğlu, 2013; Önder et al., 2015; Eyüboğlu, 2017), the aim of this study is to compare and evaluate the macroeconomic performances of the European Union and Hungary, which became a member of the EU in 2004, using the TOPSIS method, and considering Four macroeconomic data for the period 1980-2021: GDP growth (annual, %), consumer price inflation (annual, %), unemployment rate, and current account balance (as a percentage of GDP).

1. LITERATURE REVIEW

In some studies in the literature, the Topsis method has been used to reveal the macro performance of various country groups or individual countries (I. Al & Demirel, 2022; Azimifard et al., 2018; Hu et al., 2022). Although the studies in the literature generally use TOPSIS as a powerful decision-making method in performance analyses conducted with MCDM methods, the results obtained may differ depending on the data, as can be seen from the studies below.

The studies, some of which are related to the subject of the study and some of which are given below, reveal the macroeconomic situation of countries located in different regions of the world and having different structural characteristics, point out what policies are needed for countries in the context of sustainability and economic development and emphasize the importance of political interventions.

Shih, Shyur and Lee (2007) characterize TOPSIS method as a basic MCDM technique over other related techniques because of its four main advantages, such as the facts that it is based on very robust logic that reflects human choice, is a numerical value that simultaneously considers both the best and worst alternatives, includes a simple computational process that can be easily programmed into a spreadsheet, and that it has the ability to visualize performance measures of all related alternatives regarding attributes on a polyhedron for at least any two dimensions.

Dinçer (2011) analyzed 30 countries consisting of EU countries and EU candidate countries for 2008 using TOPSIS and WSA methods. Five decision criteria were used: GDP per capita, inflation rate, export and import volume as a ratio to GDP, and employment rate. The top three performing countries according to the findings of the TOPSIS method are Luxembourg, Netherlands, and Denmark, while the last three are Macedonia, Latvia, and Bulgaria.

Ashourian (2012) evaluated such data with the TOPSIS method as labor force to population ratio, life expectancy at birth, primary education, per capita GDP, age dependency ratio, adult female literacy rate, and infant mortality rate in 18 countries in the Middle East and North Africa for the years 1997-1999. As a result of the performance ranking, Mauritania and Yemen were in the first and second places, while Lebanon and Iran were in the last places, respectively.

Sevgin and Kundakçı (2017), on the other hand, examined 28 EU countries for 2013 using Moora and TOPSIS and determined six decision criterion which are public debt/GDP ratio, budget deficit/GDP ratio, export/import ratio, inflation rate, GDP/population ratio and unemployment rate. According to the result, Luxembourg, Sweden, and Denmark took the first three places, while Slovenia, Greece and Turkey took the last three places in terms of macroeconomic performance.

Öztürk and Bayramoğlu (2018) ranked the macroeconomic performances of EU countries and Turkey for the period 2006-2016 using the TOPSIS method. They used GDP growth rate, per capita GDP, export rate, import rate, inflation rate and employment rate as decision criteria. They found that Turkey ranked first in terms of macroeconomic performance in years when Turkey's growth rate was higher than other countries.

Ela and Kurt (2019) analyzed the macro performance of eight sub-Saharan African countries using four macro variables (GDP growth rate, inflation rate, unemployment rate and current account balance/GDP) through the TOPSIS method based on 2016 data. Côte d'Ivoire and Tanzania, which have low inflation and unemployment rates and high GDP rates, were found to have the best performance, while South Sudan and Nigeria were found to have the lowest performance. The study emphasized that oil exporters Nigeria and South Sudan should pursue export diversification to combat economic vulnerabilities, while South Sudan, which has a chronic inflation problem, should abandon the practice of monetizing public deficits.

Topçu and Oralhan (2019) analyzed 35 OECD countries for the period 2010-2015 using Electre and TOPSIS methods. In order to compare the macroeconomic performances of the countries, per capita income, export and import volumes, inflation rate, GDP growth rate and employment rate were determined as decision criteria.

Atasaver (2021) analyzed Turkey's macroeconomic performance for the 1980-2020 period through four variables (inflation, unemployment, economic growth and current account balance) using TOPSIS method within the scope of Extended Core, Narrow Core, Boratav Heterodox and Keynesian indices. Different results were obtained for each index in terms of macro performance. According to the TOPSIS method, 2000-2009, 1980-1989 according to the Extended Core and Keynesian indices, 1990-1999 according to the Boratav heterox index and 2010-2020 according to the Narrow Core index were determined as the best macro performance periods. The study evaluates that the results obtained within the scope of index methodologies may differ.

Akandere and Zerenler (2022) analyzed the economic and environmental performance of the countries in the Eastern European bloc using CRITIC-based TOPSIS method. In the study where the criterion with the lowest value in the evaluation criteria was determined as ecosystem vitality and the criterion with the highest value was determined as ecosystem services, it was determined that Romania was the best country in terms of performance and Bosnia and Herzegovina was the lowest country. It is emphasized that the findings of the study differ from the findings of similar studies in the literature in terms of the countries selected and the methodology used.

Al and Demirel (2022) ranked Turkey's macroeconomic performance between 2002 and 2019 by measuring it with the TOPSIS method. Economic growth, inflation, unemployment, and current account balance criteria were chosen as performance criteria, and the best macroeconomic performance was 2002 in terms of Kaldor approach and Heterodox approaches, and 2008 was the worst year.

Valaskova and Nagy (2023), in their study conducted with the TOPSIS method within the scope of determining the inequalities among EU member countries and the negative factors affecting the business environment, suggested that there are inequalities in economic development among member countries. Within the scope of the macroeconomic development of EU countries, it was evaluated that the current economic structure is not suitable for the competitiveness and sustainability of SMEs in some member countries.

When analyzed periodically, it was revealed that the best macroeconomic performance was in the 2002-2005 period, and the worst in the 2008-2009 period.

2. DATA and METHODOLOGY

In this study, the macroeconomic performance of the European Union countries and the EU member Hungary were evaluated with the Normalized Maximum Values (NMD), Narrow core, Broad core, Keynesian and Heteredox based Topsis approach.

Within the scope of the study, the data of EU countries and Hungary were accessed through the World Bank database (World Bank, 2022) and the European Statistical Office database (Eurostat, 2022).

Considering that the results to be obtained by examining the performance of countries or regions with macroeconomic factors will be limited to the selected methods, criteria and periods, importance has been attached to the selection of criteria with a simple and inclusive perspective. Considering that the criteria weighting is the determining factor on the performance results, the weighting of the factors used in the macroeconomic performance measurement was carried out with the NMD method, in addition to the "Narrow core, Broad core, Keynesian and Heteredox" performance indices.

Information on the criteria is given in Table 1.

Table 1. *Criteria*

Criteria	Code	Impact Direction on Macroeconomic Performance
GDP (Annual %)	I1	Positive
Inflation (Annual %)	I2	Negative
Unemployment rate	I3	Negative
Current Account Balance (% of GDP)	I4	Positive

The criteria are equally weighted for the narrow core, unemployment, inflation, and growth rate, which are among the performance measurement methods at the macro level. The expanded core contains equal weights for the four variants.

In the Keynesian index, unemployment and growth are more weighted, while inflation is less weighted. In the heterodox index, growth, unemployment, and current account balances are equally weighted (Benlialper et al., 2016; Atasever, 2021). Except for the NMD method, which is one of the methods used in the study, the macro performance weighting method values were determined by Benlialper et al. (2016) studies.

Instead of methods such as Entropy AHP and Electre methods, which are frequently used in criterion weighting related to MCDM problems in the literature, the NDM method, which calculates the importance and weight of the criteria with simple steps and objective methods, was preferred in this study.The calculated weight values of the criteria are shown in Table 2 below.

Table 2. *Criterion weight values*

Method	I1	I2	I3	I4
Narrow Core	0,33	0,33	0,33	-
Expanded Core	0,25	0,25	0,25	0,25
Keynesian	0,4	0,2	0,4	-
Heterodox	0,33	-	0,33	0,33
NMD	0,21	0,35	0,20	0,24

2.1. NMD Method

The NMD method, which is used to solve different decision-making problems such as ordering, selection and risk estimation where weighting is required, was developed by Bulut (2017), and it can be easily applied compared to other weighting methods in cases where the weight degrees and order of importance of the criteria cannot be determined (Bağcı & Sarıay, 2021). The application processes of the NMD method are as follows:

In the first step of the process, the decision matrix (Xij) is created.

$$X_{ij} = \begin{Bmatrix} X_{1,1} & X_{1,2} & X_{1,3} & X_{1,c} \\ X_{2,1} & X_{2,2} & X_{2,3} & X_{2,c} \\ X_{3,1} & X_{3,2} & X_{3,3} & X_{3,c} \\ X_{r,1} & X_{r,2} & X_{r,3} & X_{r,c} \end{Bmatrix} \quad (1)$$

The ratio matrix is created. Each criterion of the decision matrix is proportional to the sum of its criteria. The total value of each column is calculated. Then, the ratio matrix (R_ij) is obtained by dividing each criterion value by the value of the subtotal set (T_i) of the criterion to which it belongs.

$$T = \sum_{j=1}^{c} X_{ij} \quad t = \{c_1, c_2 \dots c_c\} \; R_{ij} = \begin{Bmatrix} r_{1,1} & r_{1,2} & r_{1,c} \\ r_{2,1} & r_{2,2} & r_{2,c} \\ r_{r,1} & r_{r,2} & r_{r,c} \end{Bmatrix} \quad (2)$$

The normalized value is calculated over the maximum standard value. In this context, the standardized value (N) of each criterion is calculated over the mean (A) and standard deviation (S) of the value of each criterion.

$$\max = \{\max_1, \dots \max_c\} \; A = \frac{\sum_{j=1}^{c} r_{ij}}{r} \; S = \frac{r_{ij} - a_i}{\sqrt{\sum (r_{ij} - a_i)^2}} \; N = \frac{\max_i - a_i}{s_i} \quad (3)$$

Weight coefficients (w) are calculated by proportioning the normalized value of each criterion to the sum of these criterion values.

$$W = \frac{n_i}{\sum_{i=1}^{c} n_i} \quad (4)$$

2.2. TOPSIS Method

There are many Multi-Criteria Decision Making (MCDM) methods to help select and rank multi-criteria conditions. TOPSIS (Ideal Solution-Based Ranking Technique) is a very useful technique in solving MCDM problems and helps the decision maker to organize and solve problems and to perform analysis, comparison and ranking of alternatives.

Although the first TOPSIS studies were made by Hwang and Yoon (1981), the method entered various stages of development in the following years. In the TOPSIS method, which produces easily understandable outputs with a limited number of input parameters, the chosen alternative is expected to be closest to the ideal solution, while it is expected to be the farthest from the non-ideal alternative (Chitsaz & Banihabib, 2015; Eren et al., 2012)

The method is based on the concept of compromise solution to choose the best alternative that is closest to the positive ideal solution and farthest from the negative ideal solution (Tzeng & Huang, 2011; Kizil, 2019; Acer & Kalender, 2020; Elma, 2023). The implementation processes of the TOPSIS method (Acer & Kalender, 2020) are as follows.

The normalization process is applied by creating the decision matrix (Aij). In the decision matrix to be created, there are decision points (m) in the rows and factors (n) in the columns. The normalized decision matrix ((Rij) is obtained.

$$A_{ij} = \begin{Bmatrix} a_{1,1} & a_{1,2} & aX_{1,3} & a_{1,n} \\ a_{2,1} & a_{2,2} & a_{2,3} & a_{2,n} \\ a_{3,1} & a_{3,2} & a_{3,3} & a_{3,n} \\ a_{m,1} & a_{m,2} & a_{m,3} & a_{m,n} \end{Bmatrix} \qquad R_{ij} = \begin{Bmatrix} r_{1,1} & r_{1,2} & r_{1,3} & r_{1,n} \\ r_{2,1} & r_{2,2} & r_{2,3} & r_{2,n} \\ r_{3,1} & r_{3,2} & r_{3,3} & r_{3,n} \\ r_{m,1} & r_{m,2} & r_{m,3} & r_{m,n} \end{Bmatrix} \quad (1)$$

$$r_{mn} = \frac{A_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}}, \quad (2)$$

A weighted normalized decision matrix (V) is created.

$$V_{ij} = \begin{Bmatrix} w_1 r_1 \dots \dots & w_n r_{1n} \\ \dots \dots \dots \dots \dots & \\ w_1 r_{m1} \dots \dots & w_n r_{mn} \end{Bmatrix} \quad (3)$$

Positive ideal (A^*) and negative ideal (A^-) solutions are generated.

$$A^*=\left\{\left(\max_i v_{ij}|i\in J'\right),\quad \left(\min_i v_{ij}|i\in J''\right)\right\} \tag{4}$$

$$A^-=\left\{\left(\min_i v_{ij}|i\in J'\right),\quad \left(\max_i v_{ij}|i\in IJ''\right)\right\} \text{ J' benefit, J'' cost.} \tag{5}$$

$$A^*=v_1^*\ldots\ldots v_n^*\ A^-=v_1^-\ldots\ldots v_n^- \tag{6}$$

Positive (S_i^*) and negative ideal discrimination values (S_i^-) are calculated.

$$S_i^*=\sqrt{\sum_{i=1}^n (v_{ij}-v_j{}^*)^2},\ S_i^-=\sqrt{\sum_{i=1}^n (v_{ij}-v_j{}^-)^2} \tag{7}$$

The relative closeness (C_i^*) to the ideal solution is calculated and sorted.

$$C_i^*=\frac{S_i^-}{S_i^*+S_i^-}, \tag{8}$$

3. FINDINGS and RESULTS

Within the scope of the TOPSIS method, the NMD, Narrow and Extended Core weighted values regarding EU countries were calculated on the basis of the relevant years as given in Table 3 below.

Table 3. *TOPSIS method results for eu countries*

Year	NMD-Topsis				Narrow Core-Topsis				Expanded Core-Topsis			
	Si+	Si-	Ci*	Ranking	Si+	Si-	Ci*	Ranking	Si+	Si-	Ci*	Ranking
1980	0,170	0,110	0,393	41	0,153	0,158	0,507	38	0,138	0,130	0,485	37
1981	0,166	0,093	0,359	42	0,158	0,128	0,447	40	0,143	0,108	0,431	42
1982	0,146	0,102	0,410	40	0,136	0,137	0,502	39	0,130	0,114	0,466	39
1983	0,130	0,117	0,473	38	0,121	0,151	0,555	35	0,115	0,128	0,527	35
1984	0,107	0,140	0,567	33	0,101	0,173	0,633	31	0,091	0,152	0,625	21
1985	0,094	0,147	0,611	26	0,084	0,180	0,683	27	0,088	0,152	0,634	18
1986	0,068	0,170	0,714	12	0,068	0,193	0,739	15	0,066	0,170	0,719	10
1987	0,067	0,171	0,717	11	0,071	0,190	0,728	18	0,064	0,171	0,729	9
1988	0,063	0,182	0,744	8	0,056	0,216	0,795	6	0,052	0,190	0,785	6
1989	0,090	0,160	0,642	20	0,073	0,205	0,736	16	0,075	0,173	0,697	11
1990	0,102	0,147	0,590	28	0,077	0,196	0,717	22	0,092	0,158	0,633	19
1991	0,101	0,140	0,582	30	0,091	0,172	0,654	30	0,096	0,143	0,599	28
1992	0,114	0,127	0,527	36	0,107	0,155	0,592	34	0,109	0,129	0,543	33
1993	0,115	0,126	0,524	37	0,129	0,135	0,511	37	0,120	0,118	0,495	36
1994	0,080	0,161	0,669	14	0,079	0,188	0,703	24	0,075	0,164	0,686	13
1995	0,086	0,157	0,646	17	0,076	0,190	0,714	23	0,083	0,158	0,657	16
1996	0,103	0,148	0,590	29	0,083	0,181	0,687	26	0,105	0,143	0,577	30
1997	0,097	0,158	0,618	24	0,068	0,197	0,743	14	0,099	0,154	0,610	25
1998	0,095	0,166	0,635	21	0,058	0,206	0,781	8	0,097	0,161	0,623	22
1999	0,092	0,168	0,647	16	0,057	0,207	0,784	7	0,094	0,162	0,633	20
2000	0,093	0,168	0,643	19	0,049	0,217	0,816	2	0,092	0,169	0,647	17
2001	0,091	0,156	0,630	22	0,074	0,188	0,718	20	0,092	0,152	0,622	23
2002	0,088	0,159	0,644	18	0,089	0,177	0,667	28	0,094	0,147	0,611	24
2003	0,097	0,157	0,618	25	0,091	0,176	0,659	29	0,104	0,142	0,579	29
2004	0,099	0,163	0,621	23	0,063	0,201	0,762	10	0,102	0,156	0,604	26
2005	0,106	0,155	0,594	27	0,074	0,189	0,717	21	0,110	0,146	0,571	32
2006	0,119	0,163	0,579	31	0,049	0,213	0,815	3	0,120	0,161	0,573	31
2007	0,134	0,161	0,546	35	0,051	0,209	0,803	4	0,136	0,157	0,537	34
2008	0,145	0,128	0,468	39	0,102	0,160	0,610	32	0,148	0,120	0,447	41
2009	0,129	0,156	0,547	34	0,189	0,134	0,415	41	0,153	0,124	0,448	40
2010	0,069	0,178	0,720	10	0,066	0,200	0,752	12	0,074	0,168	0,693	12
2011	0,076	0,164	0,683	13	0,079	0,183	0,697	25	0,078	0,159	0,671	15

2012	0,086	0,163	0,653	15	0,124	0,150	0,547	36	0,099	0,148	0,600	27
2013	0,068	0,192	0,737	9	0,109	0,170	0,609	33	0,082	0,176	0,681	14
2014	0,048	0,210	0,814	6	0,078	0,199	0,719	19	0,059	0,195	0,769	8
2015	0,039	0,215	0,846	3	0,063	0,212	0,771	9	0,048	0,201	0,808	3
2016	0,043	0,209	0,831	4	0,067	0,206	0,754	11	0,051	0,195	0,792	4
2017	0,035	0,211	0,856	1	0,053	0,210	0,798	5	0,040	0,204	0,837	2
2018	0,045	0,199	0,814	5	0,067	0,197	0,746	13	0,051	0,191	0,789	5
2019	0,048	0,196	0,803	7	0,071	0,195	0,733	17	0,055	0,187	0,774	7
2020	0,136	0,181	0,571	32	0,219	0,136	0,383	42	0,165	0,152	0,480	38
2021	0,037	0,208	0,847	2	0,028	0,247	0,897	1	0,031	0,214	0,872	1

Within the scope of the Topsis method, the Keynesian and Heteredox weighted values for EU countries and the Copeland method ranking results were calculated on the basis of the relevant years, as shown in Table 4 below.

Table 4. *TOPSIS method results and copeland method results for eu countries*

Year	Keynesian-Topsis				Heterodox-Topsis				Copeland			
	Si+	Si-	Ci*	Ranking	Si+	Si-	Ci*	Ranking	GPi	YPi	CPi	Ranking
1980	0,113	0,189	0,626	31	0,120	0,173	0,591	24	19	-22	-3	33
1981	0,136	0,153	0,529	38	0,142	0,144	0,503	37	6	-35	-29	42
1982	0,123	0,160	0,566	36	0,140	0,148	0,514	36	9	-33	-24	39
1983	0,108	0,175	0,619	33	0,121	0,164	0,576	27	17	-25	-8	35
1984	0,085	0,200	0,703	24	0,089	0,195	0,687	13	30	-12	18	25
1985	0,080	0,199	0,714	21	0,101	0,185	0,647	18	29	-13	16	27
1986	0,070	0,208	0,747	12	0,078	0,203	0,721	11	38	-4	34	8
1987	0,072	0,206	0,740	14	0,073	0,208	0,740	9	38	-4	34	8
1988	0,043	0,241	0,850	2	0,049	0,236	0,829	2	40	-2	38	3
1989	0,053	0,235	0,816	5	0,074	0,219	0,748	8	39	-3	36	5
1990	0,062	0,222	0,783	7	0,103	0,198	0,659	14	38	-4	34	8
1991	0,090	0,189	0,677	28	0,113	0,173	0,605	21	24	-18	6	30
1992	0,108	0,171	0,614	34	0,129	0,157	0,549	31	15	-27	-12	36
1993	0,145	0,135	0,482	40	0,151	0,131	0,464	39	7	-35	-28	41
1994	0,079	0,206	0,724	18	0,086	0,20	0,700	12	35	-7	28	19
1995	0,076	0,207	0,730	16	0,099	0,191	0,658	15	35	-7	28	19
1996	0,090	0,191	0,679	27	0,134	0,163	0,548	32	20	-22	-2	32
1997	0,073	0,209	0,740	13	0,127	0,177	0,581	26	35	-7	28	19
1998	0,064	0,218	0,774	9	0,127	0,182	0,590	25	37	-5	32	15
1999	0,064	0,218	0,773	10	0,123	0,183	0,597	23	38	-4	34	8
2000	0,047	0,237	0,835	3	0,118	0,20	0,628	20	40	-2	38	3
2001	0,080	0,199	0,713	22	0,117	0,174	0,598	22	30	-12	18	25
2002	0,103	0,177	0,634	30	0,122	0,161	0,569	28	26	-16	10	29
2003	0,107	0,174	0,619	32	0,136	0,150	0,524	35	19	-23	-4	34
2004	0,071	0,210	0,748	11	0,134	0,173	0,565	29	35	-7	28	19
2005	0,085	0,195	0,697	25	0,144	0,160	0,526	34	24	-18	6	30
2006	0,050	0,229	0,822	4	0,157	0,184	0,540	33	39	-3	36	5
2007	0,055	0,223	0,803	6	0,179	0,177	0,498	38	38	-4	34	8
2008	0,113	0,165	0,594	35	0,193	0,130	0,402	41	10	-32	-22	37
2009	0,226	0,088	0,279	41	0,203	0,103	0,336	42	9	-33	-24	39
2010	0,077	0,204	0,726	17	0,097	0,187	0,658	16	37	-5	32	15
2011	0,088	0,192	0,686	26	0,097	0,185	0,655	17	31	-11	20	24
2012	0,145	0,138	0,488	39	0,128	0,164	0,561	30	27	-15	12	28

2013	0,130	0,156	0,546	37	0,109	0,198	0,646	19	33	-9	24	23
2014	0,093	0,193	0,673	29	0,078	0,221	0,739	10	36	-6	30	17
2015	0,076	0,209	0,735	15	0,064	0,229	0,783	4	39	-3	36	5
2016	0,080	0,202	0,716	20	0,068	0,222	0,764	6	38	-4	34	8
2017	0,061	0,217	0,780	8	0,051	0,243	0,828	3	41	-1	40	1
2018	0,078	0,201	0,721	19	0,065	0,225	0,775	5	38	-4	34	8
2019	0,083	0,197	0,704	23	0,071	0,218	0,755	7	36	-6	30	17
2020	0,263	0,085	0,246	42	0,220	0,153	0,411	40	10	-32	-22	37
2021	0,018	0,272	0,940	1	0,031	0,262	0,894	1	41	-1	40	1

TOPSIS method and Copeland Method ranking results are given comparatively in Table 5.

Table 5. *Comparative ranking results for eu countries*

Year	NMD-Topsis	Narrow Core-Topsis	Expanded Core-Topsis	Keynesian-Topsis	Heterodox-Topsis	Copeland
1980	41	38	37	31	24	33
1981	42	40	42	38	37	42
1982	40	39	39	36	36	39
1983	38	35	35	33	27	35
1984	33	31	21	24	13	25
1985	26	27	18	21	18	27
1986	12	15	10	12	11	8
1987	11	18	9	14	9	8
1988	8	6	6	2	2	3
1989	20	16	11	5	8	5
1990	28	22	19	7	14	8
1991	30	30	28	28	21	30
1992	36	34	33	34	31	36
1993	37	37	36	40	39	41
1994	14	24	13	18	12	19
1995	17	23	16	16	15	19
1996	29	26	30	27	32	32
1997	24	14	25	13	26	19
1998	21	8	22	9	25	15
1999	16	7	20	10	23	8
2000	19	2	17	3	20	3
2001	22	20	23	22	22	25
2002	18	28	24	30	28	29
2003	25	29	29	32	35	34
2004	23	10	26	11	29	19
2005	27	21	32	25	34	30
2006	31	3	31	4	33	5
2007	35	4	34	6	38	8
2008	39	32	41	35	41	37
2009	34	41	40	41	42	39
2010	10	12	12	17	16	15
2011	13	25	15	26	17	24
2012	15	36	27	39	30	28
2013	9	33	14	37	19	23

2014	6	19	8	29	10	17
2015	3	9	3	15	4	5
2016	4	11	4	20	6	8
2017	1	5	2	8	3	1
2018	5	13	5	19	5	8
2019	7	17	7	23	7	17
2020	32	42	38	42	40	37
2021	2	1	1	1	1	1

Within the scope of the TOPSIS method, NMD, Narrow and Extended Core weighted values for Hungary were calculated on the basis of the relevant years as given in Table 6 below.

Table 6. *TOPSIS method results for Hungary*

Year	NMD-Topsis				Narrow Core-Topsis				Expanded Core-Topsis			
	Si+	Si-	Ci*		Si+	Si-	Ci*		Si+	Si-	Ci*	
1980	0,100	0,159	0,615	25	0,100	0,207	0,674	24	0,102	0,165	0,617	27
1981	0,091	0,183	0,668	17	0,060	0,245	0,804	7	0,089	0,190	0,681	14
1982	0,070	0,186	0,727	11	0,064	0,240	0,790	12	0,069	0,195	0,738	10
1983	0,071	0,184	0,722	13	0,089	0,219	0,710	21	0,078	0,185	0,703	12
1984	0,062	0,191	0,756	9	0,069	0,235	0,772	15	0,061	0,199	0,765	8
1985	0,083	0,174	0,676	16	0,103	0,208	0,670	27	0,091	0,173	0,655	19
1986	0,094	0,175	0,651	19	0,078	0,229	0,747	19	0,095	0,179	0,654	20
1987	0,072	0,187	0,723	12	0,054	0,250	0,822	5	0,066	0,201	0,753	9
1988	0,102	0,152	0,600	28	0,115	0,193	0,626	33	0,099	0,164	0,623	25
1989	0,102	0,154	0,601	27	0,110	0,200	0,646	29	0,095	0,168	0,639	23
1990	0,151	0,131	0,464	38	0,184	0,134	0,421	39	0,141	0,140	0,498	38
1991	0,219	0,070	0,242	42	0,296	0,022	0,069	42	0,230	0,066	0,223	42
1992	0,142	0,117	0,452	39	0,179	0,127	0,415	40	0,143	0,122	0,460	40
1993	0,182	0,100	0,355	41	0,162	0,158	0,494	38	0,174	0,119	0,406	41
1994	0,163	0,131	0,445	40	0,122	0,207	0,629	32	0,152	0,156	0,506	37
1995	0,148	0,133	0,473	36	0,151	0,194	0,562	34	0,128	0,159	0,554	33
1996	0,139	0,122	0,468	37	0,153	0,166	0,519	36	0,131	0,139	0,515	36
1997	0,115	0,149	0,564	34	0,113	0,211	0,652	28	0,106	0,170	0,615	28
1998	0,119	0,154	0,565	33	0,093	0,227	0,709	22	0,111	0,175	0,611	29
1999	0,117	0,159	0,576	31	0,086	0,224	0,722	20	0,113	0,171	0,603	31

2000	0,118	0,167	0,585	30	0,072	0,242	0,770	17	0,111	0,184	0,623	26
2001	0,098	0,171	0,636	21	0,070	0,239	0,772	16	0,093	0,186	0,665	16
2002	0,095	0,184	0,659	18	0,059	0,254	0,812	6	0,092	0,195	0,679	15
2003	0,108	0,180	0,625	23	0,064	0,247	0,796	9	0,105	0,188	0,643	22
2004	0,113	0,177	0,609	26	0,062	0,252	0,801	8	0,108	0,191	0,639	24
2005	0,102	0,185	0,644	20	0,066	0,250	0,791	11	0,100	0,191	0,656	18
2006	0,105	0,182	0,634	22	0,070	0,247	0,779	14	0,104	0,188	0,645	21
2007	0,118	0,151	0,561	35	0,111	0,196	0,638	31	0,122	0,151	0,554	34
2008	0,113	0,161	0,587	29	0,102	0,208	0,671	26	0,116	0,161	0,580	32
2009	0,122	0,162	0,570	32	0,199	0,139	0,412	41	0,155	0,135	0,466	39
2010	0,077	0,188	0,710	14	0,117	0,210	0,643	30	0,093	0,182	0,662	17
2011	0,071	0,195	0,734	10	0,108	0,221	0,672	25	0,086	0,191	0,688	13
2012	0,086	0,183	0,679	15	0,141	0,181	0,561	35	0,108	0,170	0,611	30
2013	0,059	0,215	0,783	8	0,103	0,225	0,686	23	0,078	0,205	0,726	11
2014	0,047	0,220	0,824	5	0,069	0,257	0,789	13	0,057	0,217	0,791	7
2015	0,042	0,223	0,843	2	0,067	0,253	0,791	10	0,053	0,219	0,806	4
2016	0,043	0,226	0,842	3	0,075	0,238	0,761	18	0,056	0,218	0,795	6
2017	0,036	0,218	0,858	1	0,050	0,256	0,837	4	0,042	0,220	0,840	1
2018	0,042	0,215	0,835	4	0,038	0,269	0,876	2	0,043	0,222	0,837	2
2019	0,051	0,207	0,803	6	0,045	0,259	0,853	3	0,051	0,212	0,806	5
2020	0,105	0,169	0,616	24	0,161	0,166	0,508	37	0,129	0,148	0,534	35
2021	0,052	0,213	0,803	7	0,038	0,284	0,883	1	0,049	0,229	0,823	3

Within the scope of the TOPSIS method, the Keynesian and Heteredox weighted values for Hungary and the Copeland method ranking results were calculated on the basis of the relevant years, as shown in Table 7.

Table 7. *TOPSIS method results and copeland method results for Hungary*

Year	Keynesian-Topsis				Heterodox-Topsis				Copeland			
	Si+	Si-	Ci*	Ranking	Si+	Si-	Ci*	Ranking	*GPi*	*YPi*	*CPi*	Ranking
1980	0,113	0,225	0,666	25	0,130	0,195	0,600	30	23	-19	4	30
1981	0,069	0,267	0,794	8	0,117	0,223	0,656	16	36	-6	30	11
1982	0,071	0,265	0,789	9	0,088	0,236	0,729	10	37	-5	32	9
1983	0,104	0,236	0,695	22	0,100	0,220	0,686	12	31	-11	20	19
1984	0,075	0,262	0,778	13	0,073	0,245	0,770	7	37	-5	32	9

1985	0,119	0,223	0,651	28	0,118	0,204	0,633	21	29	-13	16	23
1986	0,090	0,248	0,733	20	0,124	0,209	0,627	23	29	-13	16	23
1987	0,054	0,281	0,840	4	0,081	0,248	0,755	9	38	-4	34	7
1988	0,121	0,218	0,643	31	0,115	0,205	0,640	19	24	-18	6	29
1989	0,110	0,229	0,675	24	0,107	0,213	0,667	13	30	-12	18	21
1990	0,185	0,159	0,463	38	0,147	0,185	0,557	33	9	-33	-24	39
1991	0,325	0,026	0,075	42	0,274	0,088	0,244	42	0	-42	-42	42
1992	0,192	0,145	0,430	40	0,166	0,156	0,484	38	5	-37	-32	40
1993	0,170	0,183	0,519	37	0,213	0,151	0,415	40	5	-37	-32	40
1994	0,123	0,241	0,662	26	0,188	0,198	0,513	37	16	-26	-10	35
1995	0,137	0,232	0,629	32	0,127	0,211	0,625	24	19	-23	-4	33
1996	0,155	0,194	0,555	35	0,146	0,180	0,552	34	10	-32	-22	37
1997	0,111	0,245	0,687	23	0,120	0,217	0,643	18	27	-15	12	26
1998	0,095	0,259	0,733	19	0,136	0,218	0,615	27	25	-17	8	28
1999	0,094	0,250	0,726	21	0,145	0,207	0,588	31	22	-20	2	31
2000	0,076	0,272	0,781	11	0,143	0,224	0,611	29	31	-11	20	19
2001	0,075	0,268	0,781	12	0,119	0,226	0,656	17	33	-9	24	17
2002	0,067	0,280	0,807	6	0,121	0,233	0,658	15	36	-6	30	11
2003	0,074	0,270	0,786	10	0,138	0,221	0,615	28	34	-8	26	14
2004	0,069	0,280	0,802	7	0,141	0,229	0,619	25	35	-7	28	13
2005	0,078	0,272	0,777	14	0,133	0,223	0,627	22	34	-8	26	14
2006	0,082	0,268	0,766	17	0,137	0,220	0,616	26	30	-12	18	21
2007	0,129	0,208	0,617	33	0,159	0,172	0,520	36	12	-30	-18	36
2008	0,120	0,221	0,649	29	0,153	0,182	0,543	35	20	-22	-2	32
2009	0,239	0,111	0,318	41	0,205	0,133	0,393	41	10	-32	-22	37
2010	0,138	0,220	0,614	34	0,123	0,213	0,634	20	28	-14	14	25
2011	0,128	0,233	0,645	30	0,114	0,223	0,662	14	32	-10	22	18
2012	0,168	0,182	0,520	36	0,143	0,196	0,578	32	27	-15	12	26
2013	0,123	0,234	0,655	27	0,103	0,241	0,700	11	34	-8	26	14
2014	0,083	0,273	0,767	16	0,076	0,254	0,769	8	38	-4	34	7
2015	0,080	0,268	0,769	15	0,070	0,257	0,785	5	40	-2	38	4
2016	0,090	0,248	0,735	18	0,075	0,256	0,775	6	39	-3	36	6
2017	0,059	0,278	0,825	5	0,055	0,263	0,828	1	41	-1	40	1
2018	0,044	0,295	0,871	2	0,056	0,267	0,826	2	41	-1	40	1
2019	0,052	0,283	0,846	3	0,067	0,255	0,792	4	40	-2	38	4
2020	0,193	0,152	0,442	39	0,171	0,153	0,471	39	18	-24	-6	34
2021	0,039	0,319	0,891	1	0,062	0,282	0,819	3	41	-1	40	1

The ranking results of Hungary's TOPSIS method and Copeland Method are given in Table 8 comparatively.

Table 8. *Comparative ranking results for Hungary*

Year	NMD-Topsis	Narrow Core-Topsis	Expanded Core-Topsis	Keynesian-Topsis	Heterodox-Topsis	Copeland
1980	25	24	27	25	30	30
1981	17	7	14	8	16	11
1982	11	12	10	9	10	9
1983	13	21	12	22	12	19
1984	9	15	8	13	7	9
1985	16	27	19	28	21	23
1986	19	19	20	20	23	23

1987	12	5	9	4	9	7
1988	28	33	25	31	19	29
1989	27	29	23	24	13	21
1990	38	39	38	38	33	39
1991	42	42	42	42	42	42
1992	39	40	40	40	38	40
1993	41	38	41	37	40	40
1994	40	32	37	26	37	35
1995	36	34	33	32	24	33
1996	37	36	36	35	34	37
1997	34	28	28	23	18	26
1998	33	22	29	19	27	28
1999	31	20	31	21	31	31
2000	30	17	26	11	29	19
2001	21	16	16	12	17	17
2002	18	6	15	6	15	11
2003	23	9	22	10	28	14
2004	26	8	24	7	25	13
2005	20	11	18	14	22	14
2006	22	14	21	17	26	21
2007	35	31	34	33	36	36
2008	29	26	32	29	35	32
2009	32	41	39	41	41	37
2010	14	30	17	34	20	25
2011	10	25	13	30	14	18
2012	15	35	30	36	32	26
2013	8	23	11	27	11	14
2014	5	13	7	16	8	7
2015	2	10	4	15	5	4
2016	3	18	6	18	6	6
2017	1	4	1	5	1	1
2018	4	2	2	2	2	1
2019	6	3	5	3	4	4
2020	24	37	35	39	39	34
2021	7	1	3	1	3	1

The findings of the ranking results obtained within the scope of the related methods regarding the Spearman rank correlation calculated with the SPSS 26 package program are as shown in Table 9.

Table 9. *TOPSIS and aras methods spearman rank correlation results*

EU Countries	**NMD-Topsis**	**Narrow Core-Topsis**	**Expanded Core-Topsis**	**Keynesian -Topsis**	**Heterodox -Topsis**	**Copeland**
NMD-Topsis	1,000	0,611	0,936	0,461	0,812	0,726
Narrow Core-Topsis	0,611	1,000	0,649	0,915	0,546	0,909
Expanded Core -Topsis	0,936	0,649	1,000	0,595	0,948	0,806
Keynesian-Topsis	0,461	0,915	0,595	1,000	0,573	0,901
Heterodox-Topsis	0,812	0,546	0,948	0,573	1,000	0,749
Copeland	0,726	0,909	0,806	0,901	0,749	1,000

Hungary	NMD-Topsis	Narrow Core-Topsis	Expanded Core-Topsis	Keynesian -Topsis	Heterodox -Topsis	Copeland
NMD-Topsis	1,000	0,712	0,946	0,617	0,866	0,892
Narrow Core-Topsis	0,712	1,000	0,835	0,975	0,754	0,914
Expanded Core -Topsis	0,946	0,835	1,000	0,779	0,958	0,959
Keynesian-Topsis	0,617	0,975	0,779	1,000	0,732	0,881
Heterodox-Topsis	0,866	0,754	0,958	0,732	1,000	0,911
Copeland	0,892	0,914	0,959	0,881	0,911	1,000

The findings of the ranking results obtained for EU countries and Hungary between Spearman rank correlations are as shown in Table 10.

Table 10. *EU countries and Hungary spearman rank correlation*

		Hungary					
		Copeland	NMD-Topsis	Narrow Core-Topsis	Expanded Core -Topsis	Keynesian-Topsis	Heterodox-Topsis
EU Countries	Copeland	0,341					
	NMD-Topsis		0,526				
	Narrow Core-Topsis			0,365			
	Expanded Core -Topsis				0,557		
	Keynesian-Topsis					0,285	
	Heterodox-Topsis						0,654

DISCUSSION and CONCLUSION

In this study, the economic performance of EU countries and Hungary between 1980-2021 is evaluated and compared using the TOPSIS method. GDP growth (annual, %), consumer price inflation (annual, %), unemployment rate and current account balance (as a percentage of GDP) data were used to evaluate economic performance. The criteria were weighted using the NMD method and four macroeconomic performance indicators. TOPSIS ranking results were calculated separately for the relevant periods in accordance with the weighting values, and the ranking results were converted into integrated ranking results using the Copeland method. The relationships between the ranking results were analyzed with Spearman correlation using SPSS 26 program and the level of relationship between them was tried to be determined.

In the TOPSIS ranking results of EU countries, the year in which the most successful performance was produced is 2017 for NMD, while it is 2021 for other methods. According to Copeland ranking results, 2021 is the year in which the most successful performance was produced for EU countries. The lowest performance, on the other hand, was produced in 1981 for NMD and Extended core, 2020 for Narrow core and Keynesian, and 2009 for Heteredox. According to the Copeland ranking results, 1981 is the year with the lowest performance.

In Hungary's TOPSIS ranking results, the year in which the most successful performance was produced is 2017 for NMD, Extended core and Heteredox, while 2021 for other methods. According to the Copeland ranking results, the most successful performance for Hungary is 2017-2018 and 2021. The year with the lowest performance was determined as 1991 for the different weighted TOPSIS methods and the Copeland method. It is seen that in 1991, when Hungary produced the lowest macroeconomic performance with the 42nd place, it ranked 30th according to the integrated ranking results of the EU countries. In the context of 2017 and 2021, when the most successful performance was produced, it can be evaluated that Hungary has the same performance as the EU countries, and in terms of low performance, it produces a worse macroeconomic performance than the EU countries.

In the correlation relations between the TOPSIS ranking results and Copeland ranking results calculated according to NMD, Narrow core, Broad core, Heteredox and Keynesian weighting methods for EU countries, there were moderately significant relationships in the Keynesian method, while high-level significant relationships were found in terms of other methods. High-level significant relationships were found in the correlation relations between the TOPSIS ranking results calculated according to NMD, Narrow core, Broad core, Heteredox and Keynesian weighting methods and Copeland ranking results for Hungary. When comparing the correlation relations between the TOPSIS ranking results calculated according to NMD, Narrow core, Broad core, Heteredox and Keynesian weighting methods and Copeland ranking results for EU countries and Hungary, it is seen that a highly significant relationship is found among the Heteredox method ranking results. There is moderate correlation between NMD and Extended core results. It was determined that there was a weak positive relationship between the narrow core and Keynesian results, and a weak positive relationship between the Copeland method results.

As a result, it can be said that in the context of the year in which the successful performance was produced, Hungary performed in the same direction as the EU countries, and on the basis of the year in which the low performance was produced, it differed from the EU countries in a negative way.

Based on the correlation relationship between the application results of NMD-based TOPSIS and Extended kernel-based TOPSIS methods, it is evaluated that MCDM methods can be used by researchers in addition to macroeconomic performance measures in measuring the macroeconomic performance of countries.

The study is limited to the data of the relevant variables and the methods used in the 1980-2021 periods of EU countries and Hungary. Macro reasons for Hungary's differentiation from EU countries in terms of performance can be addressed in a further study. In future research, comparative analyzes can be made by choosing different weighting and ranking methods.

Etik Kurul Onayı
Etik onay gerektiren bir çalışma değildir.
Yazar Katkıları
Yazarlar tüm konularda eşit katkıda bulunmuşlardır
Finansman
Herhangi bir finansman desteği alınmamıştır.
Çıkar Çatışması
Çıkar çatışması sözkonusu değildir.

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