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The Effect of Tax Structure on Economic Growth, and Macroeconomic Performance: Analysis with GMM and APLOCO Methods

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ABSTRACT

This study examines the dynamic effects of tax structure on economic growth per capita through its interactions with health expenditures and labor force participation rates. The study evaluates the effects on economic growth of taxes on income, profits and capital gains, other taxes, exports of goods and services, health expenditures, and labor force participation in 16 developing countries using the System Generalized Method of Moments (GMM). According to the GMM results, the increase in health expenditures, income, profits and capital gains, and other taxes has a significant negative effect, whereas a similar trend in labor force participation and exports of goods and services has a positive and significant impact. In the macroeconomic performance analysis conducted using the NMV-based APLOCO method, one of the Multiple Criteria Decision Making (MCDM) methods, Peru was determined as the most successful country, while Saudi Arabia appeared as the country with the lowest level of success.

Keywords: *Economic Growth, Tax Structure, System GMM, APLOCO Method*

Vergi Yapısının Ekonomik Büyümeye Etkisi ve Makroekonomik Performans: GMM ve APLOCO Yöntemleriyle Analiz

ÖZET

Bu çalışma, vergi yapısının kişi başına ekonomik büyüme üzerindeki dinamik etkilerini, sağlık harcamaları ve işgücü katılım oranları ile olan etkileşimleri üzerinden incelemektedir. Araştırma, Sistem Genelleştirilmiş Momentler Yöntemi (GMM) kullanarak, gelişmekte olan 16 ülkede, gelir, kar ve sermaye kazançları üzerinden alınan vergiler, diğer vergiler, mal ve hizmet ihracatı, sağlık harcamaları ve işgücüne katılımın ekonomik büyüme üzerindeki etkilerini değerlendirmektedir. GMM sonuçlarına göre, sağlık harcamaları, gelir, kar ve sermaye kazançları ve diğer vergilerdeki artış negatif ve anlamlı; işgücüne katılım ve mal hizmet ihracatındaki artış ise pozitif ve anlamlı etki yaratmıştır. Çok Kriterli Karar Verme (ÇKKV) yöntemlerinden NMV tabanlı APLOCO yöntemi kullanılarak yapılan makroekonomik performans analizinde en başarılı ülke Peru, en düşük başarı düzeyine sahip ülke Suudi Arabistan olarak belirlenmiştir.

Anahtar Kelimeler: *Ekonomik Büyüme, Vergi Yapısı, Sistem GMM, APLOCO Yöntemi*

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1. INTRODUCTION

In developing countries, taxation, export, health expenditures and labor force participation factors are of great importance due to their significant effects on economic growth, development, and stability (Balasoiu, Chifu, & Oancea, 2023; Cebeci & Ay, 2016; Pettinger, 2022). Considering these factors together is important for the economic development strategies of developing countries. In existing studies, the effects of the related factors are usually examined separately, and their complex interactions are not adequately addressed (Özmen, 2024). In terms of taxation factor, developing countries generally focus on the collection of international trade taxes, unlike the income taxes of developed countries (Easterly & Rebelo, 1993). This focus is due to the limited capacity to implement income tax collection effectively. Low marginal tax rates in developing countries have been associated with higher economic growth, indicating that efficient tax systems can encourage investment and economic activity (Irekponor & Ebieri, 2023; Wasylenko, 1997). In economies in the midst of an economic growth process and with high growth rates, direct taxes have a temporarily devastating effect in light of the potential tax curse theory (Kazak, Çiftçi, Akcan, & Topaloğlu, 2024). It should also be noted that the tax structure may not always increase the economic growth of developing countries (Abd Hakim et al., 2022). The export of goods and services factor is essential for developing countries because it provides the necessary foreign exchange and supports economic growth (Akbas & Sancar, 2021; Kircicek & Ozparlak, 2023; Shaddady, 2023). Trade liberalization and integration into global markets provide important opportunities for developing countries to improve their economic performance (Busse, Dary, & Wüstenfeld, 2024; Ferrari Filho, Terra, Ferrari Filho, & Terra, 2022; Siddiqui, 2015). The external environment, including global trade dynamics, significantly affects the growth rates of developing countries and requires adaptive domestic policies to reduce adverse effects (Kindo, Adams, & Mohammed, 2024). Health expenditures are a critical component of macroeconomic development because they directly affect labor productivity and economic output (Bloom, Canning, & Sevilla, 2004; Raghupathi & Raghupathi, 2020; Ridhwan, Nijkamp, Ismail, & M.Irsyad, 2022). Investment in health can lead to a healthier workforce, which is essential for sustainable economic growth (Agénor & Montiel, 2015; Aykırı & Tokucu, 2017; Sungur, Akdoğan, & Gökten, 2024). Gross domestic product (GDP) plays an important role in determining the level of health expenditures (Hansen & King, 1996), health expenditures contribute positively to economic growth (Dreger & Reimers, 2005; Heshmati, 2001), and some studies have shown a strong relationship between health indicators and GDP (Arısoy, Ünlükaplan, & Ergen, 2010; Cebeci & Ay, 2016; Celik, Omay, & Tengilimoglu, 2023), a weak relationship in some studies (Yumuşak & Yıldırım, 2009), and only a long-term relationship in some studies (Akram, 2009). Labor force participation is an important driver of economic growth in developing countries (Özmen, 2024; Umair et al., 2024), but labor force may not have any effect on economic growth (Çamkaya, 2023). Policies that increase labor market efficiency and participation can lead to significant improvements in economic performance (Davis & Haltiwanger, 2014; Weller, 2001; Yılmaz & Özek, 2022). In the

context of growth, increased health expenditures can lead to greater labor force participation (Rauf et al., 2018)

Developing countries are often at the center of analyses because they have difficulty with developing effective policies to ensure economic growth and stability (Montiel & Servén, 2006; Siddiqui, 2012). These countries face specific challenges such as limited financial resources and institutional constraints (Arayssi, 2020; Falcone, 2023). This situation can be considered providing accurate examples for other countries to understand the broader effects of economic theory and practice of developing countries (Beirne & Fernandez, 2020; Kumar et al., 2023). Kim (2015), extended the previous studies on Asian countries to developed countries by revisiting the growth regression proposed by Barro and Sala-i-Martin (2004) with GMM and showed that, contrary to the slower convergence rate suggested by Barro and Sala-i-Martin (2004), economies can achieve faster growth through transition dynamics and fundamental changes with the adoption of appropriate growth policies. Therefore, the study of developing countries can better understand both their internal dynamics and their effects on the global economy. Consequently, understanding the macroeconomic dynamics of developing countries is important not only for these countries (Bazaluk et al., 2024) but also for global economic stability and prosperity (Ergün, 2022; Kılıç & Gökçeli, 2024; Shaikh, Lund, & Ghumro, 2024).

In cases where there is more than one alternative or a large number of complex variables, it may be difficult for decision makers to find the right solution. In the optimal solution of such complex problems, multi-criteria decision making (MCDM) methods can systematically evaluate criteria, expressed in different measurement units, which have the potential to directly affect the results (Baydaş & Eren, 2021). In some cases, due to the methodological characteristics of MCDM, difficulties may be experienced in terms of accuracy and reliability of the results, depending on the preferred method (Baydaş et al., 2024; Yanık, 2024). However, the development of various MCDM methods and their application as single, hybrid or integrated (more than 30 MCDM methods have been developed) (Chakraborty, Chatterjee, & Das, 2023) facilitates ease of application and conscious and objective decisions within the framework appropriate to real life (Büyüközkan, Güleryüz, & Karpak, 2017; Ersoy & Ersoy, 2024; Macit, 2024). Evaluating the macroeconomic performance of countries in a mathematical framework through MCDM methods brings a more objective and systematic approach to decision-making processes (Karahan, Çetintaş, & Karahan, 2021). The use of various MCDM methods in the analysis of the macroeconomic performance of developing countries supports the achievement of sustainable development goals of the countries, provides solutions for achieving an optimal balance between economic indicators, and enables reliable analyses in economic policy-making processes (Çamlibel, 2024; Karahan et al., 2021; Yapa, Durmus, Tayyar, & Akbulut, 2023).

In this study, the macroeconomic performances of developing countries were examined based on data for the period 2014-2021 were examined through taxation, export, health expenditures, labor force participation factors, and economic growth data. The Normalized

Maximum Values (NMV) method was preferred in criterion weighting because it allows for a more target-oriented analysis by determining the importance levels of the criteria and has ease of application (Bulut, 2018). The Logarithmic Concept Approach (APLOCO) is an easy-to-use method applicable to various sectors for solving multiple MCDM problems, such as ranking, selection, efficiency, and productivity measurements (Fındık & Özkaynak, 2021). The APLOCO method is an approach that helps to make optimal decisions when there are many options and various factors affecting these options. Since this method includes functions for more than one purpose, it facilitates the decision-making process according to the goals and preferences of the users (Fındık & Özkaynak, 2019). The NMV-Based APLOCO method allows for a comprehensive examination of the factors affecting economic growth. However, it is also important to consider the dynamic interactions of these factors, as these interactions can determine the total effects on macroeconomic performance. A review of the existing scholarship reveals that the NMV-based APLOCO approach has yet to be applied to the evaluation of economic performance across different nations or their categories. This research, consequently, aims to address this gap in the literature. In this context, the study examining the dynamic effects of tax structure on economic growth per capita how these dynamics are shaped through interactions with variables such as current health expenditures and labor force participation rate, was analyzed using the System Generalized Method of Moments (GMM). This analysis focuses on the effects of taxes on income, profit, and capital gains; other types of taxes; and exports of goods and services on growth rate per capita. The study details how macroeconomic indicators such as income distribution, health investments, and employment rates interact with taxation policies and the consequences of this interaction on economic growth. The study explains the roles of the factors determining the economic performance of countries, with comprehensive data collected from sixteen developing countries, and offers suggestions for policy makers to develop a balanced strategy between sustainability and social welfare. This study is structured in five parts. After the introduction, the second part provides a review of the relevant literature. This section includes some studies examining the relationship between the factors in question and economic growth per capita and those evaluating the macroeconomic performance of countries with MCDM methods are included. The third part, on the other hand, provides information about the methodology of this study and the data used, while the fourth part includes the findings. Finally, the fifth part brings the findings together and makes a comprehensive assessment.

2. LITERATURE REVİEW

There is a wide range of studies in the literature in which the relationships between economic factors are analyzed using the GMM method in the context of various countries or country categories (Nafngiyana, Setiawan, & Rahayu, 2019). Similarly, studies in which the macroeconomic performances of different country categories are evaluated in line with various criteria using MCDM methods are also widely available in the literature (Çamlıbel, 2024; Karahan et al., 2021; Yiğit, 2019). In this part of the study, some use the GMM and

MCDM methods that examine the relationships between the economic performances of countries and macroeconomic indicators are discussed.

Önder et al. (2015) examined the developments in macroeconomic performance of five developing countries (Brazil, Turkey, India, Indonesia, and South Africa), evaluated as the fragile five, using the ANP-based TOPSIS method with 11 macroeconomic indicators as reference, using data from the period 2001-2013. In the study, the four most important indicators were determined as net domestic product at constant prices, current account balance, inflation, and average consumer prices, with the ANP method, while the state's gross debt stock, import volume of goods and services, export volume of goods and services, and general government expenditures were evaluated as the four least important factors. The study findings indicated that Turkey was the most fragile economy during the great recession period (2008-2009), but it showed relatively high performance afterwards. While it was determined that India, generally found to be in the first two places in the performance rankings during the relevant periods, has a stable economy, it was also evaluated that in 2013, Indonesia was the best performing country, Turkey was in second place, and Brazil and South Africa were in the last two places as the countries with the lowest performance.

Chattopadhyay and Bose (2015) examined the data of 48 countries for the period 2000-2012 using the Entropy-based TOPSIS method on six variables, consisting of real GDP growth rate, real GDP per capita, unemployment rate, fiscal balance, inflation rate, and current account balance indicators. It was stated in the study that the six indicators with different characteristics would facilitate the evaluation of the macroeconomic performance of the relevant countries into a composite indicator, summarizable with a single statistic. The authors stated that, with the index they proposed within the scope of the study, relative performance scores showed a great variability in the post-crisis years, and despite this, a general stability continued in the country rankings based on traditional indicators such as GDP growth or GDP per capita. The proposed index was also found to easily identify countries with consistent performance and especially those that experienced a sharp deterioration in their macroeconomic performance in the post-crisis period.

Nantob (2015) examines the effect of taxes on economic growth for the period 1989-2012 for eight countries that are members of the West African Economic and Monetary Union (WAEMU). It is concluded, using GMM, that there is no non-linear relationship between taxes and economic growth. It is found that low tax rates in the short term and high tax rates in the long term do not have a distorting effect and positively affect economic growth and income increase. It is determined that this effect on economic growth becomes stronger over time as tax revenues increase.

Halıcı-Tülüce et al. (2016) research using the GMM method unveiled a negative correlation between private and public health expenditures and economic growth across low and high-income countries during the 1995–2012 and 1997–2009 periods.

Masca (2017) conducted a macroeconomic performance assessment with the Topsis method using 2015 data from EU member countries on six variables, such as long-term interest rates, inflation, and unemployment rates. It was determined that Sweden had the best performance under the relevant method and period constraints, while Greece had the lowest performance.

Nafngiyana et al. (2019) analyzed the relationship between CO2 emissions, income, and health expenditures using the System GMM method within the scope of eight-year (2008-2015) data of 10 ASEAN countries. The study ignored the possible effects of external factors, while it determined significant and dynamic relationships between health expenditures, average income per capita, and CO2 emissions in ASEAN countries. It was also stated that the increase in per capita income indirectly affects CO2 emissions through health expenditures and that the delayed effects of each variable create a long-term multiplier effect.

The Sultanuzzaman et al. (2019) study employing the GMM model demonstrated that exports and technology significantly and positively influence economic growth in developing Asian countries between 2000 and 2016, validating the Solow economic growth model's predictions.

Belke (2020) examined the macroeconomic performance of G7 countries, using CRITIC and MAIRCA methods in his study with data from the period 2010-2018. The study used indicators such as average income per capita, annual growth rate of gross domestic product, percentage of active population that wants to work but cannot find a job, general increase rate in price levels, percentage of total investments in country production output, distribution of imported and exported products in total economic volume, current account balance, budget deficit, and share of public debt in GDP. Germany was identified as the country with the best score, and Italy with the lowest score within the scope of the relevant methods for the mentioned periods. The study's results provided a standardized framework for comparing the economic situations of the countries using the macroeconomic indicators employed in the study.

Leveraging the GMM methodology on data from 15 developing countries, Maneerat and Fazal (2020) comprehensively demonstrated that tax revenue, government expenditures, fiscal decentralization, carbon emissions, and exports exert a significant positive impact on economic growth, emphasizing the critical necessity for policymakers to strategically understand and prioritize these multifaceted economic determinants.

Utilizing World Bank data and the GMM method for 21 developing countries from 2000-2018, Zhou et al. (2020) revealed that tax revenue and labor force participation significantly increase health expenditures, while inflation demonstrates a declining trend, exposing tax revenue, labor force participation, and GDP per capita positively influence public health costs.

Arsu and Ayçin (2021) used the CRITIC-based MARCOS method in their study, in which they evaluated the economic, social, and environmental dimensions of OECD countries based on 12 variables. In the study where the performance of countries in two different categories was evaluated, it was stated that Switzerland, Denmark, and Ireland were successful in the first category, while the USA, Canada, and Australia were less successful. In the second category, Slovenia, Spain, and Portugal were successful, while Turkey, Chile, and Colombia were less successful. The weights of the variables used in the evaluation of the macro performances of the countries in the two categories revealed that inflation, unemployment, and growth rates were the most important criteria in the first category. In the second category, the life satisfaction index, ecological footprint, and the share of renewable energy in gross final energy consumption were the three most important criteria.

Koşaroğlu's (2021) research using the Entropy-based Aras method revealed that the current account balance significantly influences macroeconomic performance across E7 countries, with China emerging as the top performer and Brazil scoring the lowest during the 2010-2019 period. The research also demonstrated that investment, unemployment, and import rates have comparatively minimal impact.

Hoang et al. (2021) applied GMM to data from 63 countries between 2003 and 2017 and concluded that most taxes have a positive effect on economic growth in poor countries.

Kete and Karasaç (2022) conducted an economic performance analysis using the Copras method with 2020 data from 27 EU member states and Turkey. The study examined the countries in question based on seven variables such as GDP growth rates, unemployment rates, and budget balance. While Slovenia, Denmark, and Germany were identified as the top three countries with the best performance among countries with low inflation and unemployment rates. Romania, Greece, the Greek Cypriot Administration of Southern Cyprus, and Turkey, especially in terms of unemployment and inflation, were identified as the countries with the lowest performance rankings.

Syofya (2022), in his study, examined the effects of human development index, export change, and public expenditure variables on growth in the period 2000-2019 using the System GMM model. In the study, it was expected that a higher human development index would be positively correlated with economic growth in the Asian context during the relevant period; however, the study findings revealed that the human development index had a negative and significant effect on economic growth, while export change and public expenditure make a positive and significant contribution to growth. The study results indicated that there is a gap in understanding the relationship between human development and economic performance within the scope of sustainable growth in Asia.

Kulu (2023), with findings obtained from System GMM and OLS estimations, confirms that exports were the main driver of economic growth in West African countries between 2008 and 2018. The study recommends reduce taxes on international trade, create a suitable business environment to encourage export-oriented production enterprises, and thus attract foreign investors to the region.

Hokka and Bektaş's (2024) analysis of D8 Group countries using the Entropy-based Aras method revealed that inflation, poverty index, and GDP per capita critically shape macroeconomic performances, with Malaysia, Bangladesh, and Indonesia emerging as top performers, and Turkey ranked 5th in 2021, and 7th in 2022. Egypt, Pakistan, and Iran were generally evaluated as countries with low performance.

Kahreman (2024) analyzed, using Lopcow and CRITIC-based CoCoSo methods, that unemployment rate, GDP growth, and import growth emerged as critical macroeconomic performance determinants for D8 Group countries, with Malaysia, Indonesia, and Turkey demonstrating high performance, while Iran, Egypt, and Nigeria exhibited lower economic performance during the 2011-2020 period.

Tan et al. (2024)'s research, employing multiple MCDM methods, comprehensively evaluated countries' environmental, social, and governance (ESG) performances, highlighting Sweden, Finland, and New Zealand as top performers, and emphasizing the critical importance of per capita GDP, population, and foreign trade percentage in enhancing ESG performance across the 2009-2020 period.

Özmen (2024) examined the macroeconomic factors affecting public health expenditures in Turkey between 2002 and 2022, and the complex interactions among the factors: (Atilgan, Kilic, & Ertugrul, 2017; Esen & Çelik Keçili, 2022; N. Yavuz, Yilanci, & Ozturk, 2013; R. Yavuz & Yılmaztürk, 2023) using principal component analysis.

The study showed that GDP per capita, exchange rates, and tax revenues have significant effects on health expenditures; while increasing labor force participation is associated with decreasing public health expenditures, and economic growth positively stimulates public health investments.

3. DATA AND METHOD

3.1. Study Data

In the study, the annual data of 16 developing countries, (China, Indonesia, Philippines, Bangladesh, Malaysia, South Africa, Brazil, Argentina, Mexico, Colombia, Peru, Saudi Arabia, Turkey, Romania, Bulgaria, and Slovakia) for the period 2014-2021, in Appendix-1, were used in the GMM method data set (World Bank, 2024). These data were also used as the decision matrix for the NMV-based APLOCO method.

In the study first, the macro-level performances of the relevant countries were evaluated with the NMV-based APLOCO method.

The impact of health expenditures, taxes on income, profit and capital gains, other taxes, labor force participation rate, and exports of goods and services on economic growth was analyzed using the System GMM method (Arellano-Bover/Blundell-Bond estimator). This method was chosen because the number of cross-sectional units is larger than the time dimension (T = 8, N = 16), making it appropriate for dynamic panel data analysis (Yıldırım, 2023).

The Arellano and Bond estimator has a weak effect when the ratio of the variance of the unit effect to the variance of the error is remarkably high, or when the number of autoregressive parameters is also high (Engblom & Oikarinen, 2015). However, when T is small or when working with unbalanced panel data, the first difference transformation becomes weak again. For this reason, the forward orthogonal deviations method, which includes orthogonal deviations, is another transformation method recommended instead of the first difference transformation (Yerdelen Tatoğlu, 2020).

Arellano and Bover (1995) recommend the orthogonal deviations method as an effective estimation tool for dynamic panel data models. With this method, the measure of the mean difference in potential future values of a variable is obtained.

The start and end years (2014-2021) were determined according to the accuracy, availability, and currency of the data. Basic information about the variables used in the analyses is given in Table 1.

Table 1. Basic Information on Variables Used in Analysis

Variable (Criteria)	Explanations	Code	Direction	Period	Source
Per Capita Growth Rate	Annual (%)	pcgr	Positive	2014-2021	World Bank
Current Health Expenditures	% GDP	che			
Taxes on Income, Profit and Capital Gains	% Income	tıpcg			
Other Taxes	% Income	ot			
Labor Force Participation Rate	% Total population aged 15-64	lfpr			
Exports of Goods and Services	% GDP	egs			

Note: In the application of the GMM method, logarithmic transformation was applied only to the series that gained significance in level form.

Basic descriptive statistics and correlation values for the data within the scope of the GMM method are reported in Table 2. The studied data were examined on an annual basis.

Table 2. Basic Descriptive Statistics and Correlation Values for the Data Set

	pcgr	che	tıpcg	ot	lfpr	egs
Average	2.026651	6.003948	26.25333	2.273201	66.85472	33.82928

Median	2.547867	5.520000	24.35549	1.560475	67.94300	27.20213
Maximum	11.97436	10.34702	52.85811	9.885912	80.78100	95.83585
Minimum	-12.21669	2.257622	1.338761	-2.15E-05	54.04800	10.44279
Standard Error	4.245665	2.174990	12.68833	2.241495	6.322436	22.10990
Skewness	-0.913565	0.247114	0.187273	1.251584	0.038097	1.358304
Kurtosis	4.509763	2.227341	2.390697	3.808636	2.397967	3.931518
Number of Observations	127	127	127	127	127	127

Correlation						
	lpcgr	**lche**	**ltıpcg**	**lot**	**llfpr**	**legs**
lpcgr	1.0000					
lche	-0.302	1.0000				
ltıpcg	-0.021	-0.245	1.0000			
lot	-0.143	-0.265	0.163	1.0000		
llfpr	-0.037	0.324	0.183	-0.283	1.0000	
legs	0.065	0.194	-0.055	-0.569	0.112	1.0000

When the VIF values of the independent variables in Table 3 are examined, the VIF value for Other Taxes is 1.68, for Exports of Goods and Services is 1.51, for Labor Force Participation Rate is 1.32, for Health Expenditures is 1.28, and for Taxes on Income, Profit and Capital Gains is 1.21. Based on the data in Table 3 (average VIF value = 1.40 < 5), it is concluded that there is no multicollinearity problem. GDP was used as the dependent variable.

The multicollinearity values of the independent variables are given in Table 3.

Table 3. VIF Values of Independent Variables

Variable	**VIF**	**1/VIF**
lot	1.68	0.594

legs	1.51	0.663
llfpr	1.32	0.758
lche	1.28	0.778
ltıpcg	1.21	0.828
Mean VIF	**1.40**	

When the VIF values of the independent variables in Table 3 are examined, other taxes are 1.68, exports of goods and services are 1.51, labor force participation rate is 1.32, health expenditures are 1.28, and taxes on income, profit, and capital gains are 1.21, indicating low multicollinearity among the variables. It is seen from the data in Table 3 (average VIF value is 1.40 < 5) that there is no multicollinearity problem.

In the study where the effect of the tax structure on economic growth is also examined, a model was created using the research in the literature, considering health expenditures and labor force participation rates. While examining the effect of the tax structure on economic growth using the GMM method, the model includes variables such as health expenditures, income, taxes, labor force participation, and foreign trade , and is detailed in equation (1)

$$\boldsymbol{pcgr_{it=}\beta_0 + \beta_1\, ypcgr_{it-1} + \beta_2\, che_{it} + \beta_3\, tıpcg_{it} + \beta_4\, ot_{it} + \beta_5\, lfpr_{it} + \beta_6\, exp_{it} + \varepsilon_{it}} \quad (1)$$

In equation (1), pcgr is the GDP per capita growth rate; i is the country; t is the time; che is the health expenditures; tıpcg is the taxes on income, profit and capital gains; ot is the other taxes; lfpr is the labor force participation rate; egs is the export of goods and services; and ε is the random error term. In addition, to test the relationship between the tax structure and the GDP per capita growth rate, the dependent and independent variables are shown in logarithmic form. The basic model created in this direction is given in equation (2);

$$\boldsymbol{lnkbgdpbuy_{it=}\beta_0 + \beta_1\, lnkbgdpbuy_{it-1} + \beta_2\, lnhealty_{it} + \beta_3\, lngksv_{it} + \beta_4\, lndv_{it} + \beta_5\, lniko_{it} + \beta_6\, lnexp_{it} + \varepsilon_{it}} \quad (2)$$

The data set used in the analysis is evaluated in panel data format because the time dimension is greater than one and it includes more than one country. Dynamic structures are frequently preferred in panel data analysis. In this context, the main difference between dynamic and static panel data models is that dynamic models include lagged variables. Dynamic panel data models can be examined in two main categories: autoregressive panel data models and distributed lags panel data models. Due to the difficulties encountered in dynamic models, autoregressive models are generally preferred. The autoregressive panel data model can be formulated as follows in a lagged case (Yerdelen Tatoğlu, 2020):

$$Y_{it} = \delta Y_{it-1} + \beta X'_{it} + \mu_i + u_{it} \quad (3)$$

A lagged value of the dependent variable is shown as the independent variable in model (3). In another model, a model with no explanatory variable other than the lagged dependent variable is expressed as follows:

$$Y_{it} = \delta Y_{it-1} + \mu_i + u_{it} \quad (4)$$

Although these models can be estimated mathematically with traditional estimation methods, deterioration may occur in the properties of the estimators. The presence of a lagged dependent variable as an independent variable in the model reveals one of the most important problems: the endogeneity problem. Due to past shocks, it is generally stated in dynamic models that $y_{(it-1)}$is correlated with u_it. In addition, in panel data models, $y_{(it-1)}$ is a function of μ_i, and $y_{(it-1)}$is also considered a function of μ_i. Based on model (3), it is concluded that $y_{(it-1)}$ is correlated with the error term that includes μ_i. Therefore, the strict exogeneity assumption is violated and the estimators become inconsistent and biased.

3.2. Study Methods

3.2.1. GMM Method

The method developed by Blundell and Bond is widely applied in econometrics, especially in dynamic panel data settings, to efficiently estimate parameters that address endogeneity and unobserved heterogeneity (Arellano & Bover, 1995; Blundell & Bond, 1998; Engblom & Oikarinen, 2015; Roodman, 2009; Serin & Demir, 2023, p. 234).

Its versatility has led to its wide use in different fields (Trotta, Hansen, & Sommer, 2022; Wang, Zhang, & Li, 2022). With the GMM method, estimation is unbiased, convergent, and efficient (Lai, Zhang, Li, & Zhu, 2024).

Although the GMM method is powerful, it requires careful consideration of model specifications and assumptions, as incorrect applications can lead to biased estimates. This highlights the need for robust validation in empirical research (Yerdelen Tatoğlu, 2020).

3.2.2. NMV Method

Determining the criteria weights in decision-making processes is a difficulty that researchers frequently encounter. Although there are various methods in the literature such as AHP, Entropy, CRITIC, the use of these methods generally requires certain conditions and assumptions.

Processes such as determining the order of importance, conducting research on the criteria, and obtaining expert opinions can impose additional burdens on researchers. In this context, the NMV method developed by Bulut (2017, 2018, 2022), unlike other weighting methods, does not require these processes and offers an easier-to-use and more time-efficient solution

(Bağcı & Sarıay, 2021; Ergun & Kılıçarslan, 2023; Yücel, Bolukçu, Bulut & Yücel, 2024). The stages of the NMV method are as follows:

Table 4. Stages of the NMV Method

Stage	Equation
(1) Preparation of the Decision Matrix	$X_{ij} = \begin{Bmatrix} X_{1,1} & X_{1,2} & X_{1,3} & X_{1,c} \\ X_{2,1} & X_{2,2} & X_{2,3} & X_{2,c} \\ X_{3,1} & X_{3,2} & X_{3,3} & X_{3,c} \\ X_{r,1} & X_{r,2} & X_{r,3} & X_{r,c} \end{Bmatrix}$
(2) Creating the ratio matrix	$T = \sum_{j=1}^{c} X_{ij}$ $t = \{c_1, c_2 \dots c_c\}$ $R_{ij} = \begin{Bmatrix} r_{1,1} & r_{1,2} & r_{1,c} \\ r_{2,1} & r_{2,2} & r_{2,c} \\ r_{r,1} & r_{r,2} & r_{r,c} \end{Bmatrix}$
(3) Normalized Values Calculation	$max = \{max_1, \dots max_c\}$ A= $\frac{\sum_{j=1}^{c} r_{ij}}{r}$ $S = \frac{r_{ij} - a_i}{\sqrt{\sum (r_{ij} - a_i)^2}}$ N= $\frac{max_i - a_i}{s_i}$
(4) Weighted Values of Criteria Determination	W= $\frac{n_i}{\sum_{i=1}^{c} n_i}$

Note: Xij: decision matrix, T: criterion subtotal cluster value, Rij: ratio matrix, A: mean of criterion values, S: standard deviation, N: standardized value of each criterion, w: criterion weight value

3.2.3. APLOCO Method

The APLOCO method developed by Bulut (2018) contributes to the optimal solution of decision problems in three different contexts: layer 1, where all criteria of the alternatives are evaluated, layer 2, which is created in the context of criteria groups according to the results of layer 1, and layer 3, which includes only criteria-based sub-results.

While it provides the decision maker with the opportunity to produce static and dynamic outputs in 3 layers in the solution of decision-making problems such as ranking, selection, effectiveness and efficiency measurements, performance evaluation, risk estimation, and optimal solutions, which include open-ended and one-way inequalities, it also has a dynamic quality. This quality can be used regardless of the sector (Bulut, 2018).

The stages of the APLOCO method within the scope of layer 1, as used in the study, are as follows:

Table 5. Stages of the APLOCO Method

Stage	Equation
(1) Preparation of the decision matrix	$X_{ij} = \begin{Bmatrix} X_{1,1} & X_{1,2} & \dots & X_{1,r} \\ X_{2,1} & X_{2,2} & \dots & X_{2,r} \\ \vdots & \vdots & \ddots & \vdots \\ X_{c,1} & X_{c,2} & \dots & X_{c,r} \end{Bmatrix}$
(2) Calculation of baseline criterion values	$P_{ij} = \begin{cases} max_i(x_{ij}) - x_{ij}; & P_{ij}\ maksimum\ başlangıç\ noktası\ değeriyse \\ x_{ij} - min_i(x_{ij}); & P_{ij}\ minimum\ başlangıç\ noktası\ değeriyse \end{cases}$
	$P_{ij} = \begin{Bmatrix} P_{1,1} & P_{1,2} & \dots & P_{1,r} \\ P_{2,1} & P_{2,2} & \dots & P_{2,r} \\ \vdots & \vdots & \ddots & \vdots \\ P_{c,1} & S_{c,2} & \dots & P_{c,r} \end{Bmatrix}$
	$P_{ij} = \begin{Bmatrix} max_i(x_{ij}) + x_{1,1} & max_i(x_{ij}) + x_{1,2} & \dots max_i(x_{ij}) + & x_{1,r} \\ max_i(x_{ij}) + x_{2,1} & max_i(x_{ij}) + x_{2,2} & \dots max_i(x_{ij}) + & x_{2,r} \\ \vdots & \vdots & \ddots & \vdots \\ max_i(x_{ij}) + x_{c,1} & max_i(x_{ij}) + x_{c,2} \dots & max_i(x_{ij}) + & x_{c,r} \end{Bmatrix}$
(3) Construction of the logarithmic transformation matrix	$P_{ij} = \begin{Bmatrix} x_{1,1} - min_i(x_{ij}) & x_{1,2} - min_i(x_{ij}) & \dots & x_{1,r} - min_i(x_{ij}) \\ x_{2,1} - min_i(x_{ij}) & x_{2,2} - min_i(x_{ij}) & \dots & x_{2,r} - min_i(x_{ij}) \\ \vdots & \vdots & \ddots & \vdots \\ x_{c,1} - min_i(x_{ij}) & x_{c,2} - min_i(x_{ij}) & \dots & x_{c,r} - min_i(x_{ij}) \end{Bmatrix}$
	$\begin{cases} \ln x = log_e \\ L_{ij} = \dfrac{1}{\ln(P_{ij} + 2)} \end{cases} P_{ij}, i = 1,2,3 \dots c\ ve\ j = 1,2,3 \dots, r$
	$L_{ij} = \begin{Bmatrix} \dfrac{1}{\ln(P_{1,1} + 2)} & \dfrac{1}{\ln(P_{1,2} + 2)} & \cdots & \dfrac{1}{\ln(P_{1,r} + 2)} \\ \dfrac{1}{\ln(P_{2,1} + 2)} & \dfrac{1}{\ln(P_{2,2} + 2)} & \cdots & \dfrac{1}{\ln(P_{2,r} + 2)} \\ \vdots & \vdots & \ddots & \vdots \\ \dfrac{1}{\ln(P_{c,1} + 2)} & \dfrac{1}{\ln(P_{c,2} + 2)} & \cdots & \dfrac{1}{\ln(P_{c,r} + 2)} \end{Bmatrix}$
	$L_{i,j} = \begin{Bmatrix} l_{1,1} & l_{1,2} & \dots & l_{1,r} \\ l_{2,1} & l_{2,2} & \dots & l_{2,r} \\ \vdots & \vdots & \ddots & \vdots \\ l_{c,1} & l_{c,2} & \dots & l_{c,r} \end{Bmatrix}$

(4) Determination of criteria weights and calculation of weighted logarithmic transformation matrix	$W=\{w_1, w_2, \ldots . w_n\} \quad w_i \in R \ \sum_{i=1}^{n} \quad w_i = 1$ $T_{ij} = \begin{Bmatrix} w_1 xl_{1,1} & w_1 xl_{1,2} & \ldots & w_1 xl_{1,r} \\ w_2 xl_{2,1} & w_2 xl_{2,2} & \ldots & w_2 xl_{2,r} \\ \vdots & \vdots & \ddots & \vdots \\ w_n xl_{c,1} & w_n xl_{c,2} & \ldots & w_n xl_{c,r} \end{Bmatrix}$ $T_{ij} = \begin{Bmatrix} t_{1,1} & t_{1,2} & \ldots & t_{1,r} \\ t_{2,1} & t_{2,2} & \ldots & t_{2,r} \\ \vdots & \vdots & \ddots & \vdots \\ t_{c,1} & t_{c,2} & \ldots & t_{c,r} \end{Bmatrix}$
(5) Identification of the best alternative	$\beta_j = max_i(t_{ij}) \ \ \beta_j = \{t_1, t_2, \ldots . t_n\} \quad \beta_{sj} = \sum_{j=1}^{n} \{l_1, l_2, \ldots . l_n\}$ $\alpha_{si} = \sum_{j=1}^{n} \{t_1, t_2, \ldots . t_n\}$ $\left\{ 0 \le \theta_i \le 1 \quad j = 1,2,3 \ldots r, \quad \theta_i = \frac{\alpha_{si}}{\beta_{sj}} \right\}$

Note: Xij: decision matrix, Pij: starting point criterion value, Li,j: logarithmic transformation (in order to avoid extreme values and negative values within the scope of logarithmic transformation and to ensure that the values are positive, the number 2 is added to the natural logarithm number value), tij: criterion weighted value:, β_{sj}:ideal score, θ_i: alternative final score, α: sum of criterion values of alternatives, β_j: optimal solution (maximum value of criteria) values, L: layer, m: number of criteria, n: number of alternatives c: total number of clusters consisting of criteria with similar properties.

The validity of instrumental variables is determined by Sargan and Hansen tests. Over-identification restrictions are tested with the Sargan test. For the Sargan and Hansen tests, the probability value is required to be greater than 0.05 (H0: accepted, H1: rejected).

4. FINDINGS

4.1. Empirical Findings of GMM Method

For the Sargan and Hansen tests, the null hypothesis (H_0) states that the instrumental variables are valid, while the alternative hypothesis (H_1) states that they are not. A probability value greater than 0.05 indicates that H_0 cannot be rejected.

H0: Instrumental variables are valid.

H1: Instrumental variables are not valid.

Since the data set is in short panel format, (T<N), the application of the First Difference GMM estimator may lead to a decrease in the number of observations. This creates an unsuitable situation for unbalanced panels and data sets where T is small and N is large. In this context, the GMM estimator proposed by Arellano and Bover/Blundell and Bond was accepted as a more suitable method for the data set.

The results obtained by this estimator using forward orthogonal deviations instead of first differences are presented below (Yerdelen Tatoğlu, 2020).

Table 6. GMM Estimation Results

	Coefficient	**P>z**
GDP per capita growth rate-1	-0.959	0.000*
Health expenditures (log)	-2.612	0.084***
Taxes on income, profits and capital gains (log)	-0.695	0.055***
Labor Force Participation Rate (log)	1.790	0.647
Other taxes (log)	-0.102	0.019**
Exports of Goods and Services (log)	0.245	0.570
System GMM Estimation Results		
Number of observations	63	
Number of groups	15	
Number of vehicle variables	12	
Arellano-Bond test for AR(2) Process at First Differences	0.02 [0.981]	
Sargan Test for Overdetermination Constraints	10.78 [0.095]	

Note: *, ** and *** symbols indicate statistical significance at 10%, 5% and 1% levels, respectively. Values in square brackets describe probabilities. Robust standard errors for system GMM estimation are reported. The Stata package program and the xtabond2 command were used for estimation.

Table 6 presents the GMM estimation results. In the model, the dependent variable is the GDP per capita growth rate, and its one-period lagged value is included as an explanatory variable in the estimation for the panel data. The one-period lagged value of the GDP growth rate per capita has a p-value less than the 0.05 significance level, resulting in a statistically significant finding. However, the coefficient of the health expenditures variable (che) is significant and negative; the coefficient of the taxes on income, profit and capital gains variable (tıpcg) is significant and negative; the coefficient of the other taxes variable (ot) is significant and negative; the coefficient of the labor force participation rate variable

(lfpr) is significant and positive; while the coefficient of the exports of goods and services variable is insignificant.

When the GMM result is evaluated , the number of instrumental variables (12) is below the number of groups (15). When the GMM estimation results are examined, the p-value (0.981) of the 2nd order autocorrelation test results is greater than 0.05, and it is concluded that there is no autocorrelation. According to the Sargan test results, the probability value (0.095) is greater than 0.05, indicating that the over-identification restrictions are valid. To evaluate the validity of the instrumental variables used in the GMM estimation, one- and two-stage estimators of GMM developed by Arellano and Bover and Blundell and Bond were used. The Sargan test statistics results indicate that the probability value is greater than 0.05, confirming that the over-identification restrictions are valid. In the model, the dependent variable is the GDP per capita growth rate, and its one-period lagged value is included as an explanatory variable. The coefficient of the lagged GDP per capita growth rate has a p-value less than the 0.05 significance level, indicating a statistically significant effect.

4.2. Empirical Findings of NMV Method

The weight values of the criteria were calculated as given in Table 7, following the order in Table 4, as part of the NMV method application stages.

Table 7. Criterion Weight Results

Citeria	K1	K2	K3	K4	K5	K6
2014	0,1244	0,1594	0,1665	0,1791	0,1687	0,2019
2015	0,1088	0,1769	0,1407	0,1803	0,1689	0,2245
2016	0,1168	0,1508	0,1322	0,2273	0,1587	0,2140
2017	0,1337	0,1620	0,1405	0,1788	0,1720	0,2129
2018	0,1190	0,1598	0,1492	0,1940	0,1671	0,2109
2019	0,1505	0,1481	0,1349	0,1945	0,1629	0,2091
2020	0,1355	0,1474	0,1472	0,2112	0,1226	0,2361
2021	0,1751	0,1305	0,1565	0,1986	0,1219	0,2174

As can be seen from the data in Table 7, when the annual per capita growth rate is examined, the growth rate, which started with 12.44% in 2014, reached its highest level at 17.51% in 2021. In general, the growth rate has increased over time, although a fluctuation

is observed in 2019 and 2020. It decreased to 13.55% in 2020. While the rate of current health expenditures was 15.94% in 2014, it decreased to 13.05% in 2021. It is seen that health expenditures have followed a fluctuating trend over the years and decreased in 2021. Current health expenditures are important for increasing the quality and accessibility of health services.

When the data in the table are examined in terms of taxes on income, profit, and capital gains, it shows a general decreasing trend throughout the period, starting with 16.65% in 2014 and decreasing to 15.65% in 2021. This situation can be understood in terms of how the tax policy on income may change over time or reflect changes in economic conditions. Taxes on income, profit, and capital gains should be kept at reasonable levels to increase government revenues, with any necessary increases being made cautiously. Reducing the tax burden may have an increasing effect on investment and consumption, whereas increasing the tax burden it may cause the market to shrink. While other taxes were 17.91% in 2014, they reached their highest level at 22.73% as of 2016. Then, they exhibited fluctuations over the years and decreased to 19.86% in 2021. Other taxes can have significant effects on the economic tax burden and the government's tax policies. Therefore, other taxes can be considered by evaluating benefit and cost. They can be increased reasonably in order to support public services in the context of developing countries, but it should be noted that high tax rates may negatively affect economic activities. The labor force participation rate, which was initially 16.87%, decreased to 12.26% in 2020, reaching its lowest level since records began. However, it increased again to 12.19% in 2021. A general increase in the rate of exports of goods and services is observed . It was 20.19% in 2014, and it increased to 23.61% in 2020. However, it then experienced a slight decrease, falling to 21.74% in 2021.

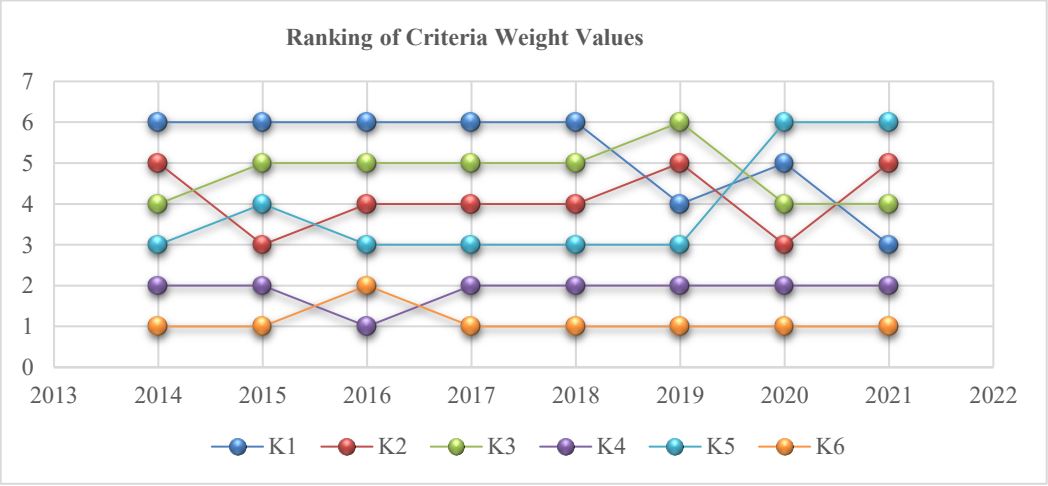

Figure 1. Ranking of Criteria Weight Values

Figure 1 shows the ranking of the criteria in the context of the relevant years. While it is seen that other taxes and exports of goods and services, are the two most important criteria in terms of the relevant periods, it can be said that per capita growth rate and taxes on income, profit, and capital gains are the least important criteria for the relevant countries.

4.3. APLOCO Method Empirical Findings

Following the APLOCO application stages in Table 5, the performance rankings of the relevant alternatives were calculated as in Table 8.

Table 8. Alternative Ranking Results

2014 Year				**2015 Year**			
Alternative	**βsj**	**θ Score**	**Rank**	**Alternative**	**βsj**	**θ Score**	**Rank**
China	1,44	0,367	6	China	1,44	0,366	7
Indonesia	1,44	0,29	12	Indonesia	1,44	0,304	11
Philippines	1,44	0,335	7	Philippines	1,44	0,346	8
Bangladesh	1,44	0,293	11	Bangladesh	1,44	0,314	9
Malaysia	1,44	0,443	3	Malaysia	1,44	0,413	3
South Africa	1,44	0,313	8	South Africa	1,44	0,388	6
Brazil	1,44	0,305	9	Brazil	1,44	0,307	10
Argentina	1,44	0,382	4	Argentina	1,44	0,412	4
Mexico	1,44	0,276	15	Mexico	1,44	0,284	14
Colombia	1,44	0,369	5	Colombia	1,44	0,39	5
Peru	1,44	0,52	1	Peru	1,44	0,523	1
Saudi Arabia	1,44	0,273	16	Saudi Arabia	1,44	0,284	15
Turkey	1,44	0,277	14	Turkey	1,44	0,294	13
Romania	1,44	0,279	13	Romania	1,44	0,275	16
Bulgaria	1,44	0,296	10	Bulgaria	1,44	0,301	12
Slovakia	1,44	0,454	2	Slovakia	1,44	0,489	2

2016 Year				2017 Year			
Alternative	**βsj**	**θ Score**	**Rank**	**Alternative**	**βsj**	**θ Score**	**Rank**
China	1,44	0,345	6	China	1,44	0,317	9
Indonesia	1,44	0,298	10	Indonesia	1,44	0,288	14
Philippines	1,44	0,365	5	Philippines	1,44	0,333	7
Bangladesh	1,44	0,329	8	Bangladesh	1,44	0,29	13
Malaysia	1,44	0,34	7	Malaysia	1,44	0,37	5
South Africa	1,44	0,388	4	South Africa	1,44	0,396	4
Brazil	1,44	0,312	9	Brazil	1,44	0,325	8
Argentina	1,44	0,512	1	Argentina	1,44	0,49	2
Mexico	1,44	0,273	13	Mexico	1,44	0,276	15
Colombia	1,44	0,297	11	Colombia	1,44	0,304	11
Peru	1,44	0,424	3	Peru	1,44	0,51	1
Saudi Arabia	1,44	0,269	14	Saudi Arabia	1,44	0,266	16
Turkey	1,44	0,261	16	Turkey	1,44	0,31	10
Romania	1,44	0,268	15	Romania	1,44	0,357	6
Bulgaria	1,44	0,293	12	Bulgaria	1,44	0,296	12
Slovakia	1,44	0,463	2	Slovakia	1,44	0,462	3
2018 Year				**2019 Year**			
Alternative	**βsj**	**θ Score**	**Rank**	**Alternative**	**βsj**	**θ Score**	**Rank**
China	1,44	0,326	7	China	1,44	0,308	9
Indonesia	1,44	0,29	13	Indonesia	1,44	0,296	12
Philippines	1,44	0,348	5	Philippines	1,44	0,338	7

Bangladesh	1,44	0,339	6	Bangladesh	1,44	0,362	5
Malaysia	1,44	0,411	3	Malaysia	1,44	0,352	6
South Africa	1,44	0,322	9	South Africa	1,44	0,394	3
Brazil	1,44	0,322	8	Brazil	1,44	0,336	8
Argentina	1,44	0,391	4	Argentina	1,44	0,382	4
Mexico	1,44	0,276	14	Mexico	1,44	0,274	14
Colombia	1,44	0,292	12	Colombia	1,44	0,298	11
Peru	1,44	0,533	1	Peru	1,44	0,527	1
Saudi Arabia	1,44	0,269	15	Saudi Arabia	1,44	0,274	15
Turkey	1,44	0,264	16	Turkey	1,44	0,261	16
Romania	1,44	0,295	10	Romania	1,44	0,279	13
Bulgaria	1,44	0,293	11	Bulgaria	1,44	0,304	10
Slovakia	1,44	0,464	2	Slovakia	1,44	0,461	2
2020 Year				**2021 Year**			
Alternative	**βsj**	**θ Score**	**Rank**	**Alternative**	**βsj**	**θ Score**	**Rank**
China	1,44	0,391	4	China	1,44	0,358	5
Indonesia	1,44	0,287	13	Indonesia	1,44	0,264	15
Philippines	1,44	0,289	12	Philippines	1,44	0,298	10
Bangladesh	1,44	0,351	6	Bangladesh	1,44	0,256	16
Malaysia	1,44	0,344	8	Malaysia	1,44	0,404	4
South Africa	1,44	0,4	3	South Africa	1,44	0,329	8
Brazil	1,44	0,353	5	Brazil	1,44	0,351	6
Argentina	1,44	0,493	2	Argentina	1,44	0,408	3

Mexico	1,44	0,28	14	Mexico	1,44	0,278	12
Colombia	1,44	0,299	10	Colombia	1,44	0,336	7
Peru	1,44	0,347	7	Peru	1,44	0,587	1
Saudi Arabia	1,44	0,279	15	Saudi Arabia	1,44	0,267	14
Turkey	1,44	0,291	11	Turkey	1,44	0,293	11
Romania	1,44	0,277	16	Romania	1,44	0,267	13
Bulgaria	1,44	0,325	9	Bulgaria	1,44	0,318	9
Slovakia	1,44	0,502	1	Slovakia	1,44	0,504	2

Table 8 shows the performance rankings of the relevant countries by year within the scope of the APLOCO method. According to the performance results of the APLOCO method, significant changes are observed in the performance of the countries. When the performance rankings of the relevant countries by year are examined, Peru is observed to be the country with the best performance for the relevant years except for 2016 and 2020. Slovakia and Argentina are generally among the countries with the best performance after Peru. Argentina is among the countries with the best performance in 2016, 2017, and 2020. Slovakia is observed to have the best performance as the country that is most frequently ranked 2nd, except for 2017. Malaysia, the Philippines, and South Africa have also shown successful performance in certain years. Countries such as Saudi Arabia, Romania, and Mexico have generally been in the lower ranks. In 2021, while the successful performances of Peru and Slovakia continued, it is seen that Saudi Arabia, Bangladesh, and Indonesia are the countries with the lowest performance in the last three places.

When considering the changes in the rankings of countries, the performance of some countries has increased or decreased compared to others in certain periods. For example, China is usually among the top ten countries, but in 2021, it decreased in performance and dropped to 5th place. When looking at the table in terms of the countries with the lowest performance, it can be said that Turkey showed the lowest performance in 2016, 2018 and 2019, and Indonesia in 2017 and 2021.

5. CONCLUSION AND SUGESSTIONS

In this study, the macroeconomic performance of developing countries was examined based on the data for the period 2014-2021. The dynamic effects of the tax structure on per capita economic growth were analyzed using the GMM method through interactions with health expenditures and labor force participation rates. In the literature, the study's

macroeconomic factors are generally evaluated separately, indicating that the complex interactions between the relevant factors are not adequately addressed. a more holistic perspective will be needed to understand important macroeconomic results and make optimal decisions.

The study aimed to analyze the economic performance of developing countries within a framework where the NMV method was used to determine the criteria weights and the APLOCO method was used to rank the alternatives. In this context, the study examined the impact of factors on economic performance in developing countries per capita economic growth from a holistic perspective and presented suggestions for policy makers to create a strategy that balances sustainability and social welfare. In the study, a data set of 16 developing countries was created, covering the years 2014-2021, primarily by using the World Bank databases. GMM analysis was applied to examine the effects of factors affecting economic performance in developing countries on economic growth per capita from a holistic perspective.

According to the analysis results, the tax structure has a positive effect on economic growth. In addition, it was determined that health expenditures have a positive effect on economic growth, while labor force participation rates do not have a significant effect. Some limitations regarding the findings and method of the study were also taken into account. For example, restrictions related to data availability and sample size may limit the generalizability of the results. In addition, by including a larger data set and different control variables, more comprehensive analyses can be conducted, allowing for a deeper evaluation of the results. In this context, the evaluation suggested that the effects of tax structure on economic growth can be examined more comprehensively in future studies using different methodological approaches and data sets.

When the analysis results are examined, the fact that there is a negative and statistically significant relationship between tax structure and economic growth indicates that higher tax rates reduce economic growth, while a decrease in these tax rates can have a favorable (beneficial) impact on economic growth in developing country groups. Therefore, the findings of the study show that a 1% decrease in tax rates may have an encouraging effect on economic growth. In this context, it is suggested that the rates of taxes that have a negative impact on growth, especially taxes on income, profits, and capital gains, should be reduced. Such a tax reduction can accelerate economic growth by creating positive effects on investment and consumption.

A tax policy should be developed that will maintain the balance between public investments and services by reducing tax rates. The economic growth to be achieved through tax reductions should be planned carefully so that it does not increase the deficits in the public budget. These suggestions can contribute towards reducing the negative effects of tax policies on economic growth and achieving sustainable development goals. Based on the findings of the study, if conclusions are to be drawn for Turkey, it is recommended that the tax structure be reviewed and reforms be made to encourage investment and production in

order to increase the sustainable growth potential of the Turkish economy, that policies to increase labor force participation be strengthened, and that the export structure be transformed towards high value-added products.

According to the NMV method results, while exports of goods and services stand out as the criterion with the highest importance in the 2014-2021 period, the per capita growth rate and taxes on income, profit, and capital gains have been determined to have the lowest weight value.

It has been determined that, in the performance rankings of the alternatives with the APLOCO method, Peru has the best performance in the relevant years except for 2016 and 2020. Peru's negative growth -10.93% in per capita growth in 2020 has relegated it to 7th place.

The country with the highest growth value in the 2014-2020 period is Peru, which recorded a growth rate of 13.36% in 2021. Slovakia, Malaysia, Argentina, South Africa, the Philippines, and China have mostly been in the top 10 places. Saudi Arabia, Indonesia, Romania, Turkey, and Mexico are in the bottom 6 rankings in terms of performance. Brazil and Bulgaria are among the countries whose rankings have remained stable in the relevant periods. Saudi Arabia is the country with the lowest performance in the 2014-2020 period and usually finds itself in one of the bottom three places. Saudi Arabia has lower rates than other countries in income, profit, and capital gains taxes; and per capita growth rate ratios, which are determined as the criteria with the lowest importance weight in the NMV method results. This situation is the basis for Saudi Arabia to rank at the bottom. The APLOCO method results show that the performance rankings of the 16 developing countries may differ annually.

Since the nature of the MCDM methods is to present results that provide optimal consensus rather than definitive solutions to decision problems, sensitivity analyses were not performed in this study. Specifically, analyses on how the differentiation of the criteria affects the ranking of alternatives (Demir & Arslan, 2022; Ersoy & Ersoy, 2024), the correlation levels between different MCDM methods and the APLOCO method regarding robustness and reliability of the study results (Özcan & Çelik, 2021; Taşcı, 2024), and applications on the effect of varying normalization methods within the APLOCO method (Baydaş et al., 2024) were not conducted.

In the study, it is thought that the using GMM and NMV-based APLOCO methods derived from panel data methods together may offer a different perspective for decision makers. The evaluation suggests that by considering the limitations and potential contributions of this approach in terms of time, method, and sample, researchers in future studies will significantly enhance the comprehensiveness and rationality of their results.

Research and Publication Ethics Statement

In all processes of the article, the principles of research and publication ethics of the Journal of Manisa Celal Bayar University Graduate School of Social Sciences were followed.

Authors' Contribution Rates

The authors contributed equally to the study.

Conflict of Interest Statement

The authors have no conflict of interest with any person or organization.

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