Turkish Journal of Agriculture - Food Science and Technology, 13(3): 601-610, 2025
DOI: https://doi.org/10.24925/turjaf.v13i3.601-610.7445

Turkish Journal of Agriculture - Food Science and Technology

Available online, ISSN: 2148-127X | www.agrifoodscience.com | Turkish Science and Technology Publishing (TURSTEP)

The Economic Determinants of Agricultural Value Added: A Panel Data Analysis on E7 Countries

Ahmet Kasap[1,a,*]

[1]*Tokat Gaziosmanpaşa University, Turhal Applied Sciences Faculty, Department of E-Commerce and Management, Tokat, Türkiye.*
[*]*Corresponding author*

A R T I C L E I N F O

Research Article

Received : 28.12.2024
Accepted : 12.02.2025

Keywords:
Agricultural Value Added
Government Expenditures
Panel ARDL Model
E7 Countries
Economic Development

A B S T R A C T

The agricultural sector plays a crucial role in economic growth, employment, and food security. Although E7 countries (Brazil, China, India, Indonesia, Mexico, Russia, and Turkey) hold a significant share in global agricultural production, there is limited literature on the determinants of agricultural value added. This study aims to analyze the key economic factors affecting agricultural value added in E7 countries and assess the effectiveness of agricultural policies. The study covers the period 2001-2022 and employs the Panel ARDL method to examine long-term relationships. The findings indicate that the proportion of agricultural land and agricultural employment positively impact agricultural value added, whereas government expenditures may have a negative effect. Governments intervene in the agricultural sector through both direct and indirect measures. It can be suggested that direct income support policies for farmers may have the potential to increase dependency rather than enhance productivity. Although a detailed distinction regarding the implementation of direct payments during the analyzed period could not be made, the impact of government support is likely to vary depending on the type and implementation of the assistance provided. The results emphasize the need for more effective planning of agricultural support mechanisms. Redirecting public expenditures towards infrastructure investments, agricultural technology adoption, and rural development projects could enhance the sector's long-term sustainability. Additionally, improving the transparency and measurability of support policies may increase their effectiveness and strengthen agricultural productivity. Policymakers should conduct a more detailed analysis of the effects of different support mechanisms to develop appropriate intervention strategies.

[a] *ahmet.kasap@gop.edu.tr* *https://orcid.org/ 0000-0001-7231-2693*

Introduction

The agricultural sector plays a crucial role in economic growth, employment, and food security. Beyond food production, it provides raw materials for industries, contributes to export revenues, and supports rural development (Soyyiğit & Yavuzaslan, 2019). The sector's capacity to generate employment is particularly significant in developing economies, where it enhances social welfare (Kaya, 2020). Additionally, the agricultural sector establishes strong economic linkages with industries such as logistics, trade, and finance, reinforcing overall economic stability (Aydoğan & Vardar, 2020). Due to these factors, agriculture holds great significance in terms of both direct and indirect economic contributions.

E7 countries (Brazil, China, India, Indonesia, Mexico, Russia, and Turkey) occupy a crucial position in global agricultural production and trade. These nations, which comprise approximately 45% of the world's population, account for over 30% of global Gross Domestic Product (GDP) (Doğdu, 2022). However, studies analyzing the determinants of agricultural value added in these economies remain limited. The impact of government expenditures on agriculture, the contribution of agricultural employment to sectoral growth, and the economic implications of agricultural land use have not been sufficiently examined. This study aims to identify the key economic factors affecting agricultural value added and evaluate the effectiveness of agricultural policies.

Accordingly, this study investigates the economic determinants of agricultural value added in E7 countries. Specifically, it examines the effects of the agricultural employment rate, the share of agricultural land in total land, and government expenditures on agriculture. The study covers the period from 2001 to 2022 and employs the Panel ARDL method to analyze long-term relationships. Given the diverse economic structures of E7 countries, the comparative analysis offers significant insights into the effectiveness of agricultural development policies.

Agricultural value added represents the economic contribution derived from agricultural production. The key elements influencing agricultural value added include agricultural employment, land use, and government support (Soyyiğit & Yavuzaslan, 2019). While the extent of agricultural land determines production capacity, employment levels influence labor productivity within the sector. Government expenditures, on the other hand, affect agricultural productivity through infrastructure investments, subsidies, and direct support payments (Aydoğan & Vardar, 2020). However, the impact of public support may vary depending on its implementation, and in some cases, it may foster dependency rather than increase efficiency (Adedoyin et al., 2021).

This study makes a significant contribution to the literature by being one of the first comprehensive panel data analyses on the economic determinants of agricultural value added in E7 countries. While previous research has often focused on individual countries or specific variables, this study adopts a broader approach by jointly analyzing government expenditures, employment, and land use. Furthermore, using the Panel ARDL model, it assesses the long-term relationships between these variables and provides policy recommendations to enhance sustainable agricultural development.

The structure of the study is as follows: The second section presents the theoretical framework on the determinants of agricultural value added. The third section provides a literature review, summarizing relevant studies. The fourth section details the data set, methodology, empirical findings, and discussion. The fifth section concludes with an overview of the study's findings and presents policy recommendations.

The agricultural sector holds critical importance not only for food production and rural development but also for environmental sustainability and energy security. Agricultural activities contribute to the environment by acting as carbon sinks and preserving biodiversity, while simultaneously playing a fundamental role in the development of renewable energy sources (Adedoyin et al., 2021). These characteristics position the agricultural sector as a central actor not only in economic but also in social and environmental policies. Thus, the agricultural sector occupies a strategic position that integrates environmental sustainability, energy policies, and economic development goals.

In E7 countries, the agricultural sector stands out as one of the cornerstones of their economies. In countries such as Brazil and India, the agricultural sector constitutes a significant portion of export revenues, whereas in nations like China and Indonesia, agricultural modernization projects aim to enhance productivity (Aydoğan & Vardar, 2020). For example, Brazil, as a leading global agricultural exporter, plays a pivotal role in food production, while India focuses on balancing workforce dependency in agriculture with local consumption policies. In these countries, the agricultural sector not only meets domestic consumption demand but also provides strategic advantages in international trade.

Labor utilization, as one of the fundamental components of the agricultural sector, is crucial for ensuring social stability in rural areas. Moreover, agricultural productivity is directly related to factors such as technological investments and government support (Kaya, 2020). For instance, investments in irrigation systems, modernization of agricultural machinery, and infrastructure improvements enhance production capacity while also positively contributing to rural economies (Doğdu, 2022). These factors establish a solid foundation not only for economic growth but also for social development in rural regions.

Consequently, the components of the agricultural sector extend beyond economic contributions to directly serve social and environmental development goals. In this context, core elements such as the employment rate in agriculture, the efficiency of agricultural land, and public expenditures provide a critical basis for analyzing the dynamics of the agricultural sector in E7 countries. These analyses will facilitate a deeper understanding of the economic, social, and environmental impacts of the agricultural sector

Figure 1 illustrates the changes in the share of agricultural value added in GDP across E7 countries between 2001 and 2022. India stands out as the country with the highest agricultural value added during this period, starting at approximately 21% in 2001.

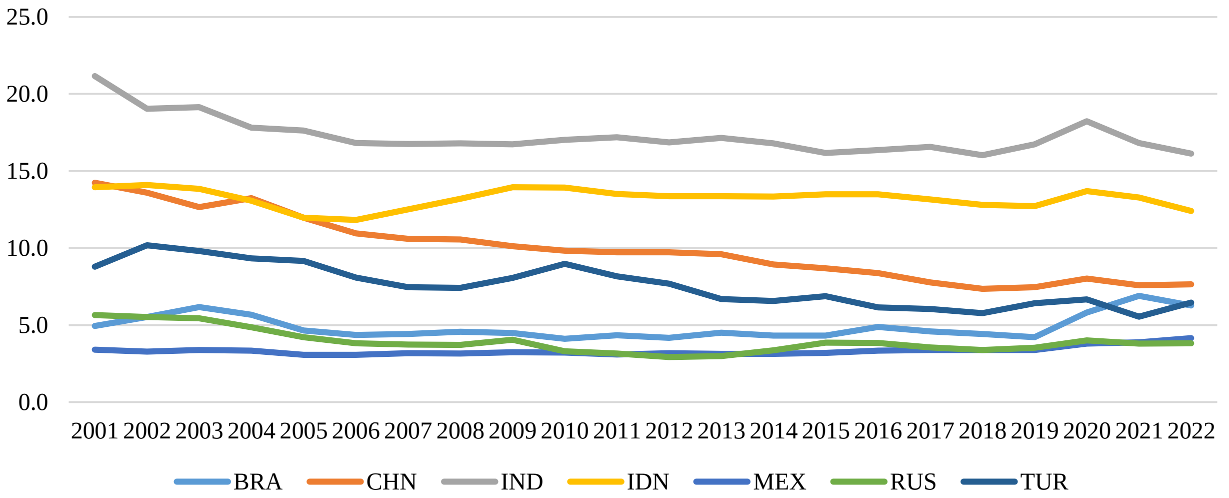

Figure 1. Agricultural Value Added (as % of GDP)
Source: https://databank.worldbank.org/source/world-development-indicators Adapted by the author from

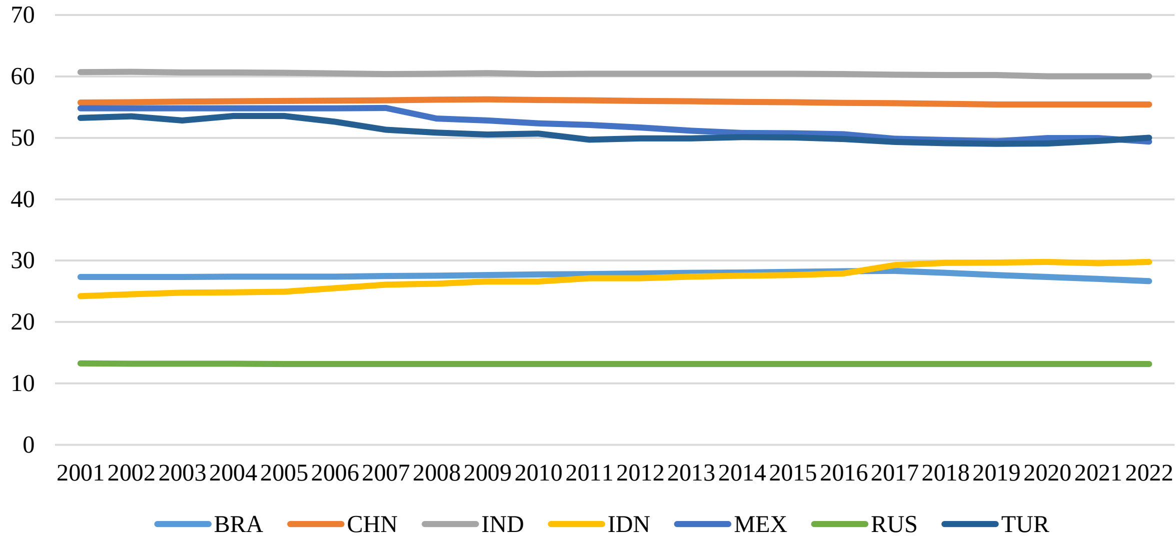

Figure 2. Agricultural Land Proportion (as % of Total Land)
Source: https://databank.worldbank.org/source/world-development-indicators Adapted by the author from

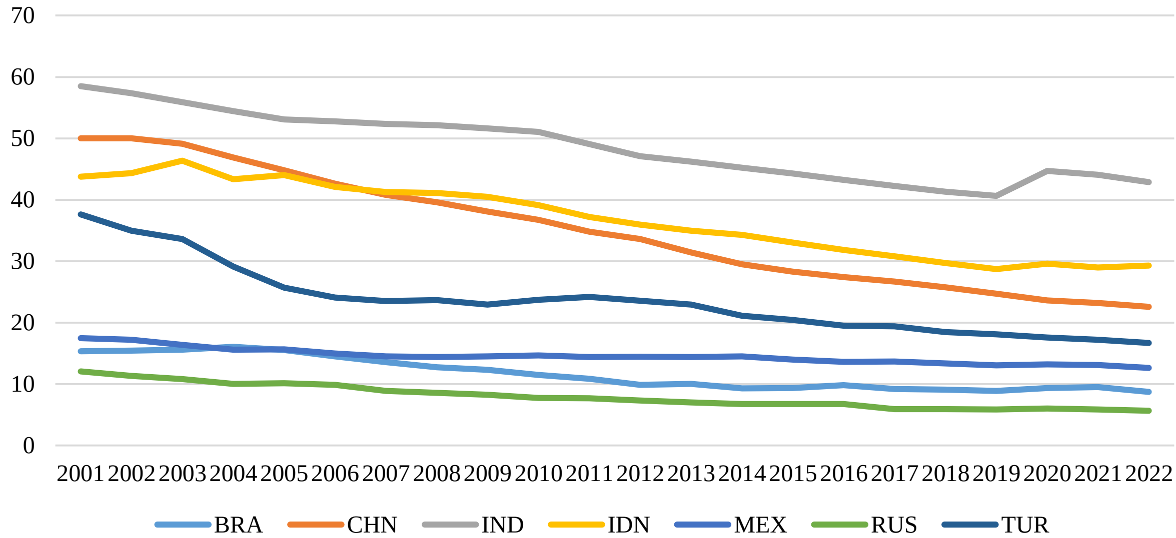

Figure 3. Agricultural Employment (as % of Total Employment)
Source: https://databank.worldbank.org/source/world-development-indicators Adapted by the author from

Although it has shown a gradual decline over the years, it still remains at a significantly higher level compared to other countries in 2022. Indonesia has maintained a stable trajectory, with agriculture's contribution to GDP fluctuating within the 12-14% range. In contrast, China has exhibited a consistent downward trend in agricultural value added since 2001, though occasional fluctuations have slowed this decline. In Turkey and Brazil, the share of agriculture in GDP declined between 2001 and 2010, followed by fluctuations and a relative increase after 2019. Mexico and Russia have consistently recorded the lowest shares of agricultural value added throughout the analyzed period, with figures remaining below 5%. Overall, Figure 1 highlights the evolving economic significance of the agricultural sector in E7 countries while also revealing differing trends across nations.

Figure 2 illustrates the changes in the proportion of agricultural land as a percentage of total land across E7 countries between 2001 and 2022. India has the highest share of agricultural land, consistently remaining above 60%. Similarly, China also maintains a high proportion, with minimal fluctuations over the years. In Turkey and Brazil, the share of agricultural land has gradually declined since 2001 but has stabilized towards the end of the period. In contrast, Indonesia has experienced a gradual increase in the proportion of agricultural land from 2001 to 2022, approaching Brazil's level after 2017. Russia has the lowest agricultural land proportion among the E7 countries, maintaining a stable level slightly above 10% throughout the period. Mexico falls into the mid-range, showing relatively little variation over time. Figure 2 highlights the trends in agricultural land usage across E7 countries, indicating a decline in some nations while others continue to preserve their agricultural land.

Figure 3 illustrates the changes in the share of agricultural employment as a percentage of total employment in E7 countries between 2001 and 2022. India stands out as the country with the highest agricultural employment rate, which was approximately 60% in 2001 but has steadily declined over the years.

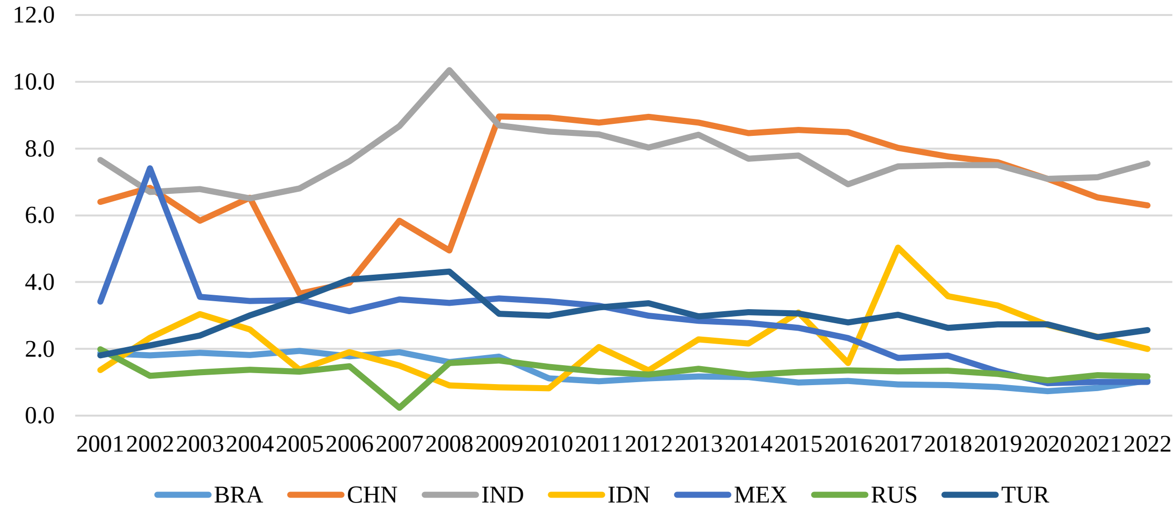

Figure 4. Share of Government Expenditures on Agriculture
Source: https://www.fao.org/faostat/en/#dataAdapted by the author from

A significant decrease in agricultural employment is also observed in China and Indonesia, with China experiencing a more rapid decline. In Brazil and Turkey, the share of agricultural employment has also decreased considerably, albeit at a slower pace compared to other countries. In Mexico and Russia, agricultural employment started at relatively lower levels and exhibited a gradual downward trend throughout the period. Figure 3 highlights the overall decline in the share of agricultural employment across E7 countries, indicating a shrinking role of agriculture in the labor market. However, variations among countries suggest that the rate and extent of this decline differ across economies.

Figure 4 illustrates the changes in the share of government expenditures on agriculture in E7 countries between 2001 and 2022. India and China stand out as the countries with the highest public spending on agriculture throughout the period. In India, a sharp increase was observed between 2006 and 2012, followed by a gradual decline after 2013, although expenditures remained at relatively high levels. In China, the share of government expenditures on agriculture increased after 2005, peaked between 2010 and 2014, and then entered a declining trend. In Turkey and Brazil, public spending on agriculture remained relatively stable, with Brazil experiencing fluctuations in the early years before stabilizing at lower levels. Indonesia saw a notable increase in government expenditures on agriculture between 2015 and 2017, followed by a fluctuating pattern in subsequent years. Mexico and Russia recorded the lowest shares of agricultural public spending throughout the analyzed period. Figure 4 highlights the variability of government support for agriculture in E7 countries, with some nations increasing agricultural subsidies during specific periods.

Literature Review

The agricultural sector plays an important role in economic growth, environmental sustainability, and social development. However, analyses of the agricultural sector in E7 countries (Brazil, Russia, India, China, Indonesia, Mexico, and Turkey) are quite limited. While these countries draw attention with their rising roles in the global economy and the contributions of the agricultural sector to economic performance, the lack of sufficient academic literature on the subject creates a gap. Understanding the economic and social impacts of the agricultural sector in E7 countries can contribute to achieving sustainable development goals in these countries. In this context, the present study aims to shed light on policies for economic growth and development by focusing on the agricultural sector in E7 countries. In addition to the agricultural sector, this study also addresses non-agricultural issues in these countries and agricultural studies in other countries. These analyses are crucial in filling a significant gap in the literature and emphasizing the necessity of new studies in the context of E7 countries.

In studies focusing on the agricultural sector in E7 countries, Tıraşoğlu and Karasaç (2018) analyzed the middle-income trap between 1960 and 2016 and found that macroeconomic stability was effective in overcoming this trap. The study particularly stated that Indonesia, Mexico, and Russia were caught in the middle-income trap. Soyyiğit and Yavuzaslan (2019) examined the relationships between agricultural value added, economic complexity, political stability, and government effectiveness, emphasizing the importance of government effectiveness and political stability in increasing agricultural value added. This study is based on data from the 1996-2017 period. Aydoğan and Vardar (2020) analyzed the relationships between renewable energy consumption, economic growth, agricultural value added, and CO2 emissions, highlighting the importance of the agricultural sector in environmental sustainability. The findings underscore the critical role of agriculture in this context. Ağır et al. (2020) explored the relationships between financial development and income inequality and analyzed the positive effects of agricultural value added on social balance using data from 1988-2016. Özşahin and Güven (2023) assessed the impacts of agricultural subsidies and government stability on agricultural value added. Their findings indicate positive effects of agricultural employment and raw material imports.

In studies focusing on non-agricultural issues in E7 countries, Bozgeyik (2020) examined unemployment hysteresis and stated that unemployment rates in E7 countries generally tend to revert to the mean. This study analyzed unemployment rate data for the 1991-2018 period. Topçuoğlu and Ayyıldız (2020) identified key sectors supporting economic growth and development, highlighting the importance of agriculture and industry for development. This study is based on 2014 data. Han (2022) examined the relationships between renewable energy consumption and economic growth, finding that energy consumption has a significant impact on economic growth. This study used data from 1990-2018. Tekin and Merdivenci (2022) analyzed trade volumes between Turkey and E7 countries, revealing that economic growth and trade are strongly connected. This study focuses on the 2000-2018 period. Gyamfi et al., (2023) analyzed the environmental impacts of economic globalization and emphasized the importance of sustainable environmental policies. This study used data from 1990-2019. Additionally, Doğdu (2022) investigated the causality between renewable energy production and economic growth in G7 and E7 countries, finding that renewable energy investments promote economic growth.

In studies on other countries, Akyol (2018) analyzed the effects of agricultural incentives on agricultural value added in Turkey, South Africa, Mexico, China, and Brazil. The study demonstrated that these incentives positively contribute to economic growth, using data from 2000-2016. Kaya (2020) examined agricultural value added convergence between Turkey, China, the United States, India, Brazil, and Indonesia, emphasizing the importance of technological advancement. The study concluded that Turkey showed convergence with China and the United States but not with Brazil, India, and Indonesia. This study covers the 1960-2018 period. Erdinç and Aydınbaş (2021) examined the determinants of agricultural value added in 20 different countries, evaluating the impacts of economic, social, and legal regulations on the agricultural sector. This study uses data from the 2000-2018 period. Additionally, Adedoyin et al. (2021) analyzed the effects of agricultural development, energy consumption, and economic growth on CO2 emissions in E7 countries. The findings revealed that renewable energy consumption reduces emissions.

Benin et al. (2007) found that agricultural diversity in Ethiopia is shaped by land size, labor, and market access. Oyetade et al. (2014) highlighted the positive impact of fisheries and food production on economic growth in Nigeria. Kakar et al. (2016) found that agricultural land use, fertilizer, and credit utilization improve productivity in Pakistan, while agricultural employment and pesticide use have no significant long-term effects. Onoja et al. (2017) indicated that agricultural growth in Nigeria and Kenya is affected by macroeconomic factors such as capital investments, infrastructure spending, and exchange rates. Muraya et al. (2017) observed that while exchange rate fluctuations and inflation constrain agricultural production in Kenya, infrastructure investments enhance productivity.

Teshome et al. (2018) suggested that Ethiopia's agricultural GDP can be increased through agricultural land expansion and financial support, whereas Mutunga et al. (2018) pointed out the need to reassess agricultural subsidies in Kenya. Mocanu et al. (2018) demonstrated that infrastructure development and incentives for young labor could support agricultural growth in Romania. Overall, market access, financial support, and macroeconomic stability emerge as key determinants of agricultural productivity and large-scale agricultural economies. Czyżewski et al. (2018) stated that agricultural incomes in the EU are related to production scale, subsidies, and economic indicators, while the impact of labor remains limited in new EU member states. Coca et al. (2023) emphasized the critical role of agricultural capital investments in enhancing productivity. Abdi and Mohamed (2025) revealed that exchange rates, foreign investments, and institutional quality influence agricultural exports in Somalia.

The literature on the agricultural sector in E7 countries highlights its significance in economic growth, environmental sustainability, and social development. However, despite the increasing global economic influence of these countries, research on the economic determinants of agricultural value added remains limited. Existing studies have examined various factors, including government effectiveness, political stability, economic complexity, and environmental sustainability, in relation to agricultural sector performance. Additionally, studies focusing on agricultural subsidies, employment, and trade suggest that macroeconomic stability and sector-specific policies play crucial roles in enhancing agricultural productivity. While some research extends beyond E7 countries to assess global agricultural trends, there is a noticeable gap in comparative analyses specific to E7 economies. This study aims to address this gap by providing a comprehensive evaluation of the determinants of agricultural value added in these nations, contributing to a more nuanced understanding of sectoral dynamics and policy implications.

Materials and Methods

This study aims to understand the determinants of agricultural value added in E7 countries for the period between 2001 and 2022. The selected period is significant as it encompasses transformations in agricultural policies and economic turbulence. In this study, the key determinants of the agricultural value-added rate are considered as the agricultural employment rate, the proportion of agricultural land, and the share of government expenditures allocated to the agricultural sector. The E7 countries (Brazil, China, India, Indonesia, Mexico, Russia, and Turkey) hold a significant position in the global economy due to their large populations and substantial economic potential. The agricultural sector plays a critical role in these countries' economic structures, providing a fundamental contribution to economic development and rural prosperity. Therefore, understanding the determinants of agricultural value added is crucial not only for the agricultural development of these countries but also for achieving global goals such as food security and economic sustainability. However, the number of studies in the literature on the comparative analysis of the fundamental economic factors influencing the agricultural value-added rates in these countries is quite limited.

The econometric analysis of the study initially examines the stationarity of the series in the panel data set using the Pesaran unit root test. Subsequently, the panel ARDL method is employed to test for long-term relationships. The model selection is determined using the Hausman test, and error correction models are applied to analyze the speed of adjustment to equilibrium. The findings provide a striking perspective on the agricultural policies of E7 countries and the differences in their economic structures.

The model to be used in this study is as follows:

$$AVA_{it} = \beta_1 AL_{it} + \beta_2 AGE_{it} + \beta_3 EA_{it} + \varepsilon_{it}$$

Where, β_1, β_2 and β_3 are the coefficients, ε is the error term, i represents the countries and t represents time.

Stationarity Testing

In panel data analysis, as in time series analysis, the stationarity of variables plays a critical role. If the stationarity of variables is not checked, spurious regression problems may emerge due to incorrect model selection (Karadaş, 2021). Panel unit root tests are divided into two main groups: first-generation tests assume independence between cross-sectional units, while second-generation tests allow for dependence between these units. If an inappropriate test is chosen, incorrect conclusions regarding the stationarity of the series may be reached, leading to erroneous analyses. Initially, cross-sectional dependence tests should be conducted, and the appropriate model should be determined accordingly. Common tests for examining cross-sectional dependence include the Breusch-Pagan LM test, Pesaran scaled LM test, bias-corrected scaled LM test, and Pesaran CD test. These tests should be chosen based on the characteristics of the data set (Arslan & Karadaş, 2021).

The choice of test depends on the dimensions of the panel data set, specifically the size of the cross-section (N) and the time dimension (T). For instance, the Breusch-Pagan LM test provides meaningful results when T>N, while the Pesaran scaled LM test is preferred when both T and N are large. The bias-corrected scaled LM test and Pesaran CD test are generally used in cases where N>T. In all these tests, the null hypothesis posits that there is no cross-sectional dependence between units. Significant results indicate the presence of cross-sectional dependence in the panel data set (Pesaran, 2004).

In the panel data set used in this study, the time dimension (T=22) is greater than the cross-section dimension (N=7). Therefore, the Breusch-Pagan LM test was applied to examine cross-sectional dependence, and the results are presented in the relevant table.

The Breusch-Pagan LM test results clearly demonstrate the presence of cross-sectional dependence for the variables of agricultural value added, agricultural land ratio, government spending on the agricultural sector, and agricultural employment rate. For all variables, the significance level (p-value) of the test statistics is below 0.05, indicating that the null hypothesis of “no cross-sectional dependence among units” should be rejected. Given that all variables exhibit cross-sectional dependence, a second-generation unit root test will be applied. The results of the Pesaran panel unit root test (CIPS) are presented in Table 3.

The results of the panel unit root tests indicate varying stationarity levels for the variables: agricultural value added, agricultural employment rate, agricultural land ratio, and government spending on the agricultural sector. The AVA, EA and AL variables were found to be non-stationary but became their first differences are stationary. This suggests that these there variables are integrated of order one, I(1). The AGE variable, on the other hand, is the only variable found to be stationary at level (p<0.05).

Table 1. Variables

Variable	Definition	Source
AVA	Agricultural value added as a share of GDP	World Bank Databank
AL	Agricultural land (% of land area)	World Bank Databank
AGE	Share of government expenditures on agriculture	FAO Statistics
EA	Employment in agriculture (% of total employment) (ILO modeled estimate)	World Bank Databank

Table 2. Breusch-Pagan LM Cross-sectional Dependence Test

Variable	Statistic	Probability
AVA	111.4977*	0.0000
AL	182.9394*	0.0000
AGE	45.31639*	0.0016
EA	405.1928*	0.0000

Note: * indicates significance at the 1% level.

Table 3. CIPS unit root test results

Variable	Specification without trend		Specification with trend	
	Zt-bar	Probability	Zt-bar (First Differences)	Probability
AVA	-0.030	0.488	-0.302	0.381
d.AVA	-4.075*	0.000	-2.739*	0.003
EA	-0.166	0.434	-0.445	0.328
d.EA	-3.619*	0.000	-2.428*	0.008
AL	-0.541	0.294	0.865	0.807
d.AL	-1.942**	0.026	-2.843*	0.002
AGE	-2.303**	0.011	-3.777*	0.000

Note: * and ** denote significance levels at 1% and 5%, respectively.

Table 4. Cross-Sectional Dependence in the Equation

Test	Statistic	Prob.
Breusch-Pagan LM	20.16060	0.5111

Table 5. Hausman Test (MG vs. PMG)

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	MG	PMG	Difference	S.E.
AL	6.338517	.5462269	5.79229	9.1934
AGE	-0.5173357	-0.09045	-0.4268857	0.3424212
EA	0.2455498	0.1317203	0.1138295	0.2368086

chi-square = 1.74; Prob> chi-square = 0.6279

Table 6. Hausman Test (PMG and DFE)

	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	PMG	DFE	Difference	S.E.
AL	0.5462269	0.3034526	0.2427743	1.316956
AGE	-0.09045	-0.369192	0.278742	1.963458
EA	0.1317203	0.1120318	0.0196886	0.2372065

chi-square = 0.08; Prob> chi-square = 0.9941

These findings provide critical guidance for determining the methods to be used in the panel data model. The presence of variables with different stationarity levels necessitates the use of models such as panel ARDL, which can accommodate both I(0) and I(1) variables. Furthermore, the significant results for all first-difference stationary variables suggest the potential existence of long-term relationships among the series.

Long-Term Relationships

In this study, the long-term relationships between variables are analyzed. The results of the panel unit root tests reveal that the variables exhibit different levels of stationarity. Therefore, the panel ARDL method has been selected to examine these long-term relationships. However, before proceeding with the panel ARDL analysis, it is critical to verify the model's suitability in terms of cross-sectional dependence. The presence of cross-sectional dependence can lead to misleading estimation results and must be considered. Accordingly, similar methods used for testing cross-sectional dependence among variables have also been applied to the equation. Given that the time dimension (T=22) exceeds the cross-sectional dimension (N=7) in the dataset, the Breusch-Pagan LM test was used to evaluate cross-sectional dependence. The test results are presented in table 4.

According to the test results, the Breusch-Pagan LM test statistic is over 0.05 which suggests that the null hypothesis of "no cross-sectional dependence" cannot be rejected, indicating no cross-sectional dependence among the variables in the equation. This outcome demonstrates independence among the cross-sectional units in the analysis. Consequently, standard panel ARDL models can be applied without the need to account for cross-sectional dependence explicitly.

In panel ARDL analysis, three estimators—Mean Group (MG), Pooled Mean Group (PMG), and Dynamic Fixed Effects (DFE)—are commonly utilized. The primary differences among these estimators lie in the assumptions regarding homogeneity or heterogeneity in short- and long-term relationships.

The MG estimator assumes heterogeneity in both short- and long-term relationships across cross-sections, making it suitable when relationships between variables differ across countries. On the other hand, the PMG estimator assumes heterogeneity in short-term coefficients but homogeneity in long-term coefficients (Pesaran et al., 1999; Asteriou et al., 2020; Lee and Wang, 2015). This estimator is particularly advantageous when long-term relationships are expected to be similar across countries (Sohag et al., 2015).

The DFE estimator, however, assumes that intercepts may vary across cross-sections while the short- and long-term coefficients remain constant for all cross-sections. In this method, slopes are assumed to be the same for all units (Sohag et al., 2015; Lee and Wang, 2015). In summary, with the MG method, the short- and long-term coefficients are different across panel cross-sections, while with the PMG method, only short-term coefficients vary, and long-term coefficients are constant. The DFE method assumes both short- and long-term coefficients are constant (Pesaran et al., 1999).

The choice among these estimators depends on examining the homogeneity of the series or using the Hausman test. The Hausman test evaluates the performance of different estimators by testing the validity of the null hypothesis (H0) and the alternative hypothesis (Ha). In this context, the first estimator (b) is considered consistent under both H0 and Ha, while the second estimator (B) is efficient under H0 but inconsistent under Ha (Hausman, 1978). The results of the Hausman tests applied in this study are presented in table 5 and 6.

The results of the Hausman test presented in Table 6 compare the performance of the MG and PMG estimators. According to the test results, the chi-square value is 1.74, with a probability of 0.6279. The results of the Hausman test comparing the MG and PMG estimators show that the null hypothesis is not rejected. Consequently, the second estimator, PMG, is found to be more consistent than the first, MG.

Table 7. Panel ARDL Results According to the DFE Estimator

	Coefficient	Standard Error	z	P>|z|	[95% Confidence Interval]	
ECT	-0.3276842*	0.057372	-5.71	0.000	-0.4401313	-0.2152371
Long-term Equation						
AL	0.3034526*	0.1154253	2.63	0.009	0.0772232	0.5296819
AGE	-0.369192**	0.1541683	-2.39	0.017	-0.6713564	-0.0670276
EA	0.1120318*	0.0269273	4.16	0.000	0.0592552	0.1648083

Note: * and ** denote statistical significance at the 1% and 5% levels, respectively.

The results of the Hausman test presented in Table 6 compare the performance of the PMG and DFE estimators. According to the test results, the chi-square value is 0.08, with a probability of 0.9941. These findings indicate that the null hypothesis cannot be rejected. Therefore, the results of the Hausman test comparing the PMG and DFE estimators show that the null hypothesis is not rejected. Consequently, the second estimator, DFE, is found to be more consistent than the first, PMG.

Based on the comparison of the three estimators, the DFE estimator is concluded to be more consistent than the other two estimators. The preference for the DFE estimator implies that policy recommendations for the agricultural sector may be consistent and generally applicable across countries. This result provides a clearer framework regarding the overall dynamics of the agricultural sector in E7 countries. The panel ARDL results obtained using the DFE estimator are presented in the table 7.

The panel ARDL analysis results presented in Table 7 detail the long-term relationships among variables. First, the error correction term (ECT) is calculated as -0.3276842 and found to be statistically significant at the 1% level. This result indicates that the model can correct short-term shocks in the long run and restore approximately 32.76% of the system to equilibrium within a given period. The significance and negative value of the error correction mechanism validate the model’s ability to accurately represent long-term relationships and confirm that short-term imbalances dissipate over time.

Looking at the long-term coefficients, the coefficient for the agricultural land ratio (AL) is 0.3034526, which is statistically significant at the 1% level. This finding suggests that a 1% increase in the agricultural land ratio positively impacts agricultural value-added by 0.30%. This result underscores the importance of policies aimed at improving the efficient use of agricultural land. Expanding agricultural land or enhancing its productivity emerges as a key strategy for economic growth.

The coefficient for government expenditures on agriculture (AGE) is calculated as -0.369192 and is statistically significant at the 5% level. The negative coefficient indicates that government spending on the agricultural sector has not yielded the expected benefits. This may be attributed to inefficient use of public funds, allocation of expenditures to short-term support rather than infrastructure, or prioritization of other sectors. Additionally, it suggests that government policies in the sector may temporarily address structural issues rather than provide sustainable solutions.

The agricultural employment ratio (EA) variable shows a positive relationship with a coefficient of 0.1120318, significant at the 1% level. This result highlights the positive impact of agricultural employment on agricultural value-added and underscores the importance of rural development policies. Increasing employment in the agricultural sector contributes to economic activity in rural areas and supports the sustainable continuation of agricultural production. The role of human labor in the agricultural sector is critical for both social welfare and economic growth.

Overall, the findings from Table 7 reveal that the agricultural land ratio and agricultural employment positively contribute to agricultural value-added, while government expenditures negatively impact it. This highlights the need to reevaluate policies targeting the agricultural sector and emphasizes the importance of adopting efficiency-focused approaches. The findings also underline the necessity for implementing sustainable agricultural policies and allocating resources more effectively.

Based on the analysis results, this study has identified the distinct effects of various factors on agricultural value-added in E7 countries. The findings demonstrate that agricultural employment and the share of agricultural land have a significant and positive influence on agricultural value-added. Conversely, the impact of government expenditures is more complex and varies across countries. While some studies in the literature emphasize the positive effects of government support, this study finds that its influence is contingent upon the type of support mechanisms in place and their implementation effectiveness.

E7 countries exhibit diverse agricultural policies, reflecting their economic structures and policy priorities. Countries with large-scale agricultural economies, such as China and Brazil, allocate substantial investments in infrastructure and direct subsidies to enhance productivity. In contrast, Turkey, Indonesia, and Mexico focus on supporting small-scale farmers through financial aid, cooperative development, and market access initiatives. Meanwhile, Russia and India periodically adjust their agricultural policies, reflecting shifting government intervention strategies. These variations indicate that a uniform agricultural policy approach is not applicable across all E7 countries.

The findings highlight the significant contribution of agricultural employment to agricultural value-added. However, sustaining this impact requires improving the quality of agricultural employment. The adoption of modern production techniques and advancements in agricultural technology can enhance labor efficiency and ensure the sector’s long-term viability. Additionally, while the availability of agricultural land remains a crucial determinant of production capacity, its efficient and sustainable utilization is equally important for maximizing productivity and ensuring food security.

The findings of this study largely align with existing literature on E7 countries, while diverging in certain aspects. For instance, the positive effect of the agricultural land ratio on agricultural value-added is consistent with the findings of Tıraşoğlu and Karasaç (2018) and Soyyiğit and Yavuzaslan (2019). These studies emphasize the importance of efficient land use in boosting agricultural production and contributing to economic growth. Similarly, this study confirms that agricultural land positively contributes to agricultural value-added.

The positive impact of agricultural employment aligns with the studies of Ağır et al. (2020) and Kaya (2020). Ağır et al. (2020) highlight the positive social equilibrium effects of agriculture, while Kaya (2020) underscores the role of agricultural employment in supporting economic growth. This study also finds that agricultural employment increases agricultural value-added and further suggests that modernization and technological support can amplify this effect.

However, the negative impact of government expenditures contrasts with much of the existing literature. Notably, studies by Soyyiğit and Yavuzaslan (2019) and Özşahin and Güven (2023) emphasize the positive contributions of government support to agricultural value-added. The negative findings in this study could be attributed to shortcomings in the planning and implementation of support mechanisms, insufficient monitoring systems, or the misallocation of resources for purposes other than intended. These issues suggest that operational problems may hinder agricultural support from achieving its expected impact.

In conclusion, this study is largely consistent with the existing literature but highlights significant practical challenges concerning the effectiveness of government spending. These findings suggest that agricultural support policies in E7 countries need to be revisited and improved to ensure that these mechanisms effectively contribute to agricultural productivity and sustainability.

Conclusion and Policy Recommendations

This study analyzed the determinants of agricultural value-added in E7 countries, evaluating the impacts of agricultural employment, agricultural land, and government expenditures on the sector. The findings indicate that agricultural employment and agricultural land have a significant and positive effect on agricultural value-added. However, the impact of government expenditures varies across countries and, in some cases, fails to provide the expected contribution. This highlights the importance of implementation differences in the effectiveness of agricultural support policies.

The research reveals that agricultural policies in E7 countries are not homogeneous and that there are significant differences in agricultural support mechanisms across countries. While agricultural employment is a critical component for sustaining agricultural production, the quality of labor and access to modern agricultural techniques are also determining factors for its sustainability. The extent of agricultural land is a key determinant of production capacity; however, its efficient use and sustainability policies should also be taken into account. The impact of government expenditures varies depending on the form of support and monitoring mechanisms, indicating the need for a review of agricultural policies.

Based on the findings, country-specific policy recommendations for E7 countries are proposed:

- China and Brazil: Increasing investments in agricultural infrastructure and strengthening logistical support can enhance production efficiency. Additionally, expanding incentives for sustainable agricultural practices will contribute to long-term growth.
- Turkey, Indonesia and Mexico: Supporting small-scale farmers and promoting cooperatives will enhance the sustainability of agricultural production. Facilitating farmers' access to financial instruments and expanding agricultural insurance can strengthen risk management.
- Russia, India: Strengthening monitoring and evaluation mechanisms is essential to assess the effectiveness of agricultural support. Additionally, promoting digitization, smart farming applications, and improved water management systems can enhance productivity and resilience against climate variability.

In addition, several fundamental strategies are suggested to enhance the efficiency of general agricultural policies in E7 countries. Encouraging the conservation and sustainable use of agricultural land will ensure the efficient utilization of natural resources. Instead of relying solely on financial incentives, support programs should incorporate long-term, high-impact policies such as technical assistance, education, and innovative solutions. Moreover, increasing agricultural knowledge-sharing and regional cooperation among E7 countries can help disseminate innovative solutions within the agricultural sector.

In conclusion, this study provides a detailed analysis of the factors affecting agricultural value-added in E7 countries and presents policy recommendations based on the findings. To sustain agricultural growth, policymakers must develop long-term and targeted strategies that address the specific needs of each country.

Declarations

Ethical Approval Certificate

This study does not require approval from an ethics committee.

Author Contribution Statement

Please indicate how each author contributed to this work and at what stage. For example:

Author 1: Data collection (100%), investigation (100%), formal analysis(100%), and writing the original draft (100%), Project administration(100%), supervision(100%), conceptualization (100%), methodology(100%), review and editing (100%),

Fund Statement

This study was not funded by any organization

Conflict of Interest

"The authors declare no conflict of interest."

References

Abdi, A. H., & Mohamed, A. M. (2025). Determinants of agricultural exports in Somalia: The impacts of exchange rates, foreign direct investment, and institutional quality. *Cogent Economics & Finance, 13*(1), 2445755. https://doi.org/10.1080/23322039.2024.2445755

Adedoyin, F. F., Bein, M. A., Gyamfi, B. A., & Bekun, F. V. (2021). Does agricultural development induce environmental pollution in E7? A myth or reality. *Environmental Science and Pollution Research, 28*(41869–41880). https://doi.org/10.1007/s11356-021-13586-2

Ağır, H., Türkmen, S., & Özbek, S. (2020). Finansal Kuznets Eğrisi Yaklaşımı Çerçevesinde Finansallaşma ve Gelir Eşitsizliği İlişkisi: E7 Ülkeleri Üzerine Ekonometrik Bir Tahmin. *Bilgi Ekonomisi ve Yönetimi Dergisi, 15*(2), 71-84.

Akyol, M. (2018). Tarımsal teşviklerle tarımsal katma değer arasındaki ilişkinin incelenmesi: Yeni endüstrileşen ülkeler için panel eşanlı denklemler sistemi analizi. *The Journal of International Scientific Researches, 3*(3), 226-236. https://doi.org/10.23834/isrjournal.456791

Arslan, N., & Karadaş, H. A. (2021). İşsizlik, eğitim yatırımları, gelir dağılımı ve büyümenin suça etkisi: Seçili Avrupa ülkeleri üzerine bir analiz. In A. Umut (Ed.), *Ekonomi, finans ve işletme yönetimi alanında güncel gelişmeler – II* (1st ed., pp. 197-213). Nobel Bilimsel Eserler.

Asteriou, D., Pilbeam, K., and Pratiwi, C. E. (2020). Public debt and economic growth: panel data evidence for Asian countries. *Journal of Economics and Finance,* 1-18.

Aydoğan, B., & Vardar, G. (2020). Evaluating the role of renewable energy, economic growth and agriculture on CO2 emission in E7 countries. *International Journal of Sustainable Energy, 39*(4), 335–348. https://doi.org/10.1080/14786451.2019.1686380

Benin, S., vd. (2007). The economic determinants of cereal crop diversity on farms in the Ethiopian highlands. *Agricultural Economics, 31*(2), 197-208. https://doi.org/10.1016/j.agecon.2004.09.007

Coca, O., vd. (2023). Analysis of the determinants of agriculture performance at the European Union level. *Agriculture, 13*(616). https://doi.org/10.3390/agriculture13030616

Czyżewski, A., Grzelak, A., & Kryszak, Ł. (2018). Determinants of income of agricultural holdings in EU countries. *Proceedings of the 2018 VII International Scientific Conference Determinants of Regional Development, No 1, Pila 12-13 April 2018,* 65-75. https://doi.org/10.14595/CP/01/005

Doğdu, A. (2022). G7 ve E7 Ülkelerinde GSYİH ve Yenilenebilir Enerji Üretimi İlişkisi: Toda-Yamamoto Panel Nedensellik Analizi. *Toplum, Ekonomi ve Yönetim Dergisi, 3*(2), 57-79.

Erdinç, Z., & Aydınbaş, G. (2021). Tarımsal katma değer belirleyicilerinin panel veri analizi. *Anadolu Üniversitesi Sosyal Bilimler Dergisi, 21*(1), 213-232.

Gyamfi, B. A., Onifade, S. T., Erdoğan, S., & Ali, E. B. (2023). Colligating ecological footprint and economic globalization after COP21: Insights from agricultural value-added and natural resources rents in the E7 economies. *International Journal of Sustainable Development & World Ecology, 30*(5), 500-514. https://doi.org/10.1080/13504509.2023.2166141

Han, A. (2022). E7 ülkelerinde yenilenebilir enerji tüketimi ve ekonomik büyümeye etkisi. *Uluslararası Yönetim, İktisat ve İşletme Dergisi, 18*(3), 797-814. https://doi.org/10.17130/ijmeb.1015102

Hausman, J. A. (1978). Specification Tests in Econometrics. *Econometrica,* 46(6), 1251–1271. https://doi.org/10.2307/1913827

Kakar, M., vd. (2016). Determinants of agricultural productivity: Empirical evidence from Pakistan's economy. *Global Economics Review, 1*(1), 1-12. http://dx.doi.org/10.31703/ger.2016(I-I).01

Karadaş, H. A. (2021). Çevre kalitesi ve ekonomik büyümenin sağlık harcamalarına etkisi: Kırılgan beşli ülkeleri üzerine bir analiz. In A. Umut (Ed.), *Ekonomi, finans ve işletme yönetimi alanında güncel gelişmeler – II* (1st ed., pp. 177-194). Nobel Bilimsel Eserler.

Kaya, L. (2020). Türkiye ile seçilmiş ülkeler arasında tarımsal katma değer yakınsaması: Doğrusal ve doğrusal olmayan birim kök testleri. *Bingöl Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 4*(2), 41-60. https://doi.org/10.33399/biibfad.736598

Lee, Y. M., & Wang, K. M. (2015). Dynamic heterogeneous panel analysis of the correlation between stock prices and exchange rates. *Economic research-ekonomska istraživanja*, 28(1), 749-772.

Mocanu, I., vd. (2018). Regional disparities related to socio-economic determinants of agriculture in the Romanian Plain. *Journal of Urban and Regional Analysis, X*(1), 79-99.

Muraya, B. W., vd. (2017). Determinants of agricultural productivity in Kenya. *Master's Thesis, University of Nairobi.*

Mutunga, P. M., vd. (2018). An analysis of determinants of agricultural growth in Kenya. *Noble International Journal of Business and Management Research, 2*(5), 32-46. http://napublisher.org/?ic=journals&id=2

Oyetade P. Oluwatoyese, Dr. Shri Dewi A/P Applanaidu, Effect of Agricultural Sector Determinants on Economic Growth. Aust. J. Basic & Appl. Sci., 8(8): 68-72, 2014

Onoja, A. O., vd. (2017). Econometric analysis of short-run and long-run determinants of agricultural value addition in Africa. *Agrosearch, 17*(1), 26-43. https://dx.doi.org/10.4314/agrosh.v17i1.3

Özşahin, Ş., & Güven, C. (2023). Tarım destekleri ve hükümet istikrarının tarımsal katma değer üzerine etkisi: Gelişmekte olan ülkeler için panel veri analizi. *Türk Tarım ve Doğa Bilimleri Dergisi, 10*(4), 791–805. https://doi.org/10.30910/turkjans.1272944

Pesaran, M.H., Shin, Y. ve Smith, R.P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association*, Vol. 94, No. 446, pp.621–634.

Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. Cambridge Working Papers. *Economics, 1240*(1), 1.

Sohag, K., Nabilah, A. B., & Begum, R. A. (2015). Dynamic impact of financial development on economic growth: heterogeneous panel data analysis of island economies. *International Journal of Economic Policy in Emerging Economies,* 8(1), 77-95.

Soyyiğit, S., & Yavuzaslan, K. (2019). Tarımsal katma değeri etkileyen faktörler üzerine bir inceleme: E7 ülkeleri örneği. *Kafkas Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 10*(19), 403-429. https://doi.org/10.9775/kauiibfd.2019.017

Tekin, M., & Merdivenci, F. (2022). E7 Ülkeleri ile Türkiye arasındaki dış ticaretin panel veri analizi: Çekim modeli yaklaşımı. *Sosyoekonomi, 30*(51), 407-426. https://doi.org/10.17233/sosyoekonomi.2022.01.20

Teshome, A., vd. (2018). Determinants of agricultural gross domestic product in Ethiopia. *International Journal of Research Studies in Agricultural Sciences, 4*(2), 12-20. http://dx.doi.org/10.20431/2454-6224.0402002

Tıraşoğlu, M., & Karasaç, F. (2018). Orta Gelir Tuzağı: Yapısal Kırılmalar Altında E7 Ülkeleri İçin Ampirik Bir İnceleme. *Akademik İncelemeler Dergisi, 13*(2), 337-361. https://doi.org/10.17550/akademikincelemeler.430713

Topçuoğlu, A., & Ayyıldız, F. V. (2020). E7 ülkelerinde kilit sektör analizi. *Manas Sosyal Araştırmalar Dergisi, 9*(2), 822-833.

https://www.fao.org/faostat/en/#data

https://databank.worldbank.org/source/world-development-indicators