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The impact of agricultural supports on economic growth in OECD countries: A dynamic panel analysis from the perspective of the national economy model

Emrah Doğan[1], Hatice Akbay[2], Almir Alihodžić[3]*

1. Department of International Trade and Finance; Faculty of Economic, Administrative and Social Sciences; Istanbul Gelisim University; Istanbul; Türkiye.
2. Department of Finance and Accounting, Faculty of Economics, Gaziantep University, Gaziantep, Türkiye.
3. Department of Finance and Accounting, Faculty of Economics, University of Zenica, Zenica, Bosnia and Herzegovina.

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Abstract

This study examines the impact of agricultural supports on economic growth using a dynamic panel data approach and a comprehensive dataset covering OECD countries from 2000 to 2021. Recognizing the lagged effects associated with economic growth, the analysis emphasizes the long-term and sustained influence of agricultural support measures. The findings reveal that agricultural subsidies have a positive and statistically significant effect on economic growth. These results demonstrate that public support for the agricultural sector not only increases sectoral production but also functions as a crucial policy tool for stimulating overall economic activity and growth. The findings are consistent with the National Economic Model (NEM) developed by Baş (2018), which, within a production-oriented growth framework, identifies the agricultural sector as strategic and advocates for the sustainable strengthening of domestic production, income growth, and domestic demand through public support. Thus, the study corroborates the multiplier effect of agricultural supports on national income growth and highlights the importance of active state involvement in the production process to foster economic growth. The empirical evidence suggests that agricultural policies should be incorporated into comprehensive growth strategies.

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* Corresponding author: almir.dr2@gmail.com, https://orcid.org/0009-0007-7082-1487

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1. Introduction

The agricultural sector further enhances its importance in economic development through its contributions to production, national income, poverty reduction in rural areas, ensuring food security, and its significant share in total employment (Yılmaz et al., 2022). Due to its high sensitivity to climatic conditions and market fluctuations, the agricultural sector requires public interventions and government support.

The sector is protected and supported through various policy instruments. Protectionism involves tools such as tariffs and quotas, subsidies, embargoes, prohibitions, voluntary restrictions, and food safety standards, aiming to shield specific economic sectors from external competition. Today, domestic support is also considered to have protective effects. Particularly, support measures that directly influence market prices are evaluated within the scope of protectionism. Therefore, the concepts of agricultural protectionism and agricultural support are intertwined (Arısoy, 2020).

Agricultural support policies aim to enhance productivity, increase output, and improve farmers' income levels. For these reasons, various support mechanisms have been put into place (Üçgöz, 2022). Tools such as input subsidies, direct income support, price interventions, and credit incentives are used. In Turkey, agricultural support was initially introduced in the 1930s as market price support. Until the planned development period, policies were largely supportive, protective, and interventionist in nature (Merdan, 2024). When examining agricultural support in Turkey between 2000 and 2022, despite fluctuations in certain years, an overall increase is observed. The amount of agrarian support rose from 1.669 billion TL in 2000 to 25.853 billion TL in 2022 (ibid).

The main reason for these subsidies is the belief that domestic farmers cannot compete with imported goods without government help. Removing subsidies is seen as likely to boost income inequality between rural and urban areas, possibly forcing local farmers out of the industry. Losing the domestic agricultural sector is viewed as undesirable because it could lead to higher unemployment and the loss of traditional ways of life. Additionally, countries that are not self-sufficient in food become more vulnerable to international market pressures and global food crises (Vozarova & Kotulic, 2016).

Most developing countries have adopted protectionist policies through import restrictions and tariff quotas to increase self-sufficiency in agriculture. However, these policies have caused higher input costs and price volatility in agricultural products (Akça & Altuntaş, 2022). To create an infrastructure that is independent of foreign seed dependency, seed production should be expanded, with a focus on improving quality, standardization, and packaging conditions. Farmers should be supplied with free, high-quality seeds to boost both the

quality and quantity of their crops (Baş, 2018). Agricultural supports can be considered not only as financial aid to producers but also as public expenditures aimed at enhancing social welfare.

Baş's (2018) National Economy Model emphasizes production-oriented development and advocates for an active state role in the economy. In this model, the agricultural sector is regarded as highly significant due to its employment generation and its strategic role in ensuring national independence through self-sufficiency. In land reform, state-owned lands would be leased to farmers for symbolic fees on a long-term basis, with profits belonging to the farmers, thereby increasing employment. Policies such as the expansion of agricultural insurance are also highlighted, as they contribute to protecting farmers against climate risks.

Agricultural supports and subsidies are not seen as an economic burden but as investments that increase production and contribute to national income. According to the National State thesis, the financing required for agriculture would be met through seigniorage revenue generated by increased production, meaning that agricultural support would not impose a burden on national economies. On the contrary, the income growth achieved in agriculture is expected to support fair income distribution, economic growth, and employment (Baş, 2018). Furthermore, the state is envisioned not only as a regulator but also as a guiding and supportive actor.

From the perspective of the National Economy Model, agricultural supports play a crucial role in maintaining the balance between production and consumption. Subsidies reduce production costs, positively influencing farmers' production decisions, thereby contributing to increased agricultural output and productivity. Growth in agricultural production stabilizes food prices, ensures raw material supply for the industrial sector, and raises rural incomes. These supports have both direct and indirect effects on Gross Domestic Product (GDP).

The growth rate of the agricultural sector within GDP is volatile. For instance, the sector's growth rate was 9.7% in 2011 and 22% in 2020. In 2021, it reached 30.9% in the first quarter, 20.9% in the second quarter, and 15.8% in the third quarter (Oğul, 2022). This indicates that production values increase periodically but lack stability. Although the share of agriculture in GDP has declined over time in Turkey, the sector maintains its importance due to its social, employment, and economic impacts. Based on the significance of the sector, this study evaluates the impact of agricultural supports on economic growth within the framework of Baş's (2018) National Economy Model.

The National Economy Model (Baş, 2018) provides an important theoretical framework by emphasizing production-oriented development and prioritizing strategic sectors. Its main advantage lies in promoting domestic production, thereby reducing external dependency and aiming to establish a more balanced income

distribution. In particular, its advocacy for the state to play an active role in strategic sectors such as agriculture offers significant policy implications for rural development and employment. Nevertheless, the model also has certain limitations. It is argued that intensive state intervention in the economy may lead to inefficiencies in resource allocation.

This research empirically investigates the impact of agricultural subsidies on economic growth using data from 2000 to 2021. The sample consists of 14 OECD member countries selected according to data continuity and reliability. This selection offers a heterogeneous and representative context for evaluating the effects of agricultural support policies, encompassing both developed and developing market dynamics. The Han-Philips (2010) dynamic panel data analysis method is employed to assess the influence of agricultural supports on economic growth. A distinguishing feature of this study is the integration of findings with the principles of the National Economic Model (Baş, 2018), thereby facilitating a discussion on the role of models that prioritize domestic production and strategic sectors in growth dynamics.

2. Literature review

The literature includes studies examining the effects of agricultural supports on agricultural production, employment, and economic growth. Some studies have found positive outcomes of agricultural support on economic growth and agricultural production. Guth et al. (2020) found that area-based supports and deficiency payments have a positive impact on agricultural production. Sağdıç and Çakmak (2021) emphasized that subsidy payments to the agricultural sector have long-term positive effects on production. Kopuk and Meçik (2021) argued that investments in the sector would support economic growth.

Conversely, Akça and Altuntaş (2022), in their analysis covering 1991–2019, found no significant effect of agricultural support on agricultural output. Similarly, Uslu and Apaydın (2021) reported that area-based supports negatively affected agricultural production and land use, and when recalculated in terms of dollar value or purchasing power, they had no impact on agricultural productivity. Likewise, Guo et al. (2021), in a study on China, concluded that agricultural support policies have weak and slow effects on agricultural economic growth in the long term. Bulut and Şahan (2020) state that the current structure of government supports is insufficient to increase agricultural production and competitiveness, and therefore support policies should be reconsidered.

There are also studies with mixed findings. Merdan (2023) concluded that agricultural supports, fixed capital investments, and agriculture's share in GDP positively affect growth, while agricultural employment negatively influences agricultural growth. Gezer & Gezer (2022) found that although increases in agricultural supports and

agricultural loans boost production in the short term, in the long term, they cause both positive and negative shocks that affect production. They noted that positive shocks in agricultural loans increase production, while negative shocks reduce it. Oğul (2022) similarly found that agricultural supports reduce production in the short term but increase it in the long term.

Köse and Meral (2021) did not find a direct relationship between agricultural supports and economic growth but identified a positive bidirectional relationship between food security and economic growth. Similarly, Şaşmaz and Özel (2019) found that agricultural supports in the sector had no significant long-term effect on agricultural development, while economic growth positively influenced the development of the agricultural sector.

The study analyzes the relationship between agricultural supports and economic growth and aims to evaluate the findings within the framework of the National Economy Model (Baş, 2018), thereby enabling a discussion on the role of approaches that prioritize domestic production and strategic sectors in growth dynamics.

Given that the existing literature presents mixed evidence on the relationship between agricultural supports and economic growth, this study contributes to the literature both methodologically and theoretically. A comparative analysis is conducted using panel data from 14 OECD countries.

3. Data set and Methodology

3.1. Data set

This study investigates the effect of agricultural supports on economic growth using data from 2000 to 2021. The analysis covers the following OECD member countries: Australia, Canada, Chile, Colombia, Costa Rica, Iceland, Japan, Korea, Mexico, New Zealand, Norway, Switzerland, Türkiye, and the United States. The selection of countries was based on data availability. This study aims to determine the relationship between economic growth and agricultural support in OECD countries. Accordingly, the following model was developed.

$$GROWTH = F\,(AS, CAPITAL, INF, LF, TRADE) \quad (1)$$

Equation (1) is rewritten in a panel data form as Equation (2).

$$GROWTH_{it} = \beta_{0i} + \beta_{1i}\, AS_{it} + \beta_{2i}\, CAPITAL_{it} + \beta_{3i}\, INF_t + \beta_{4i}\, logLFit + \beta_{3i}\, TRADE_t + \varepsilon_{it} \quad (2)$$

Panel data from 2000 to 2021 on the variables specified in Equation (2) were used. In Equation (2), i denotes the panel individual (country), t represents the period, and ε_{it} denotes the error term with constant variance and zero mean.

A model was developed to analyze the effects of agricultural subsidies on economic growth. This model draws upon neoclassical growth theory and prior research on the impact of agricultural subsidy policies on macroeconomic performance. The *AS* variable, as defined in Equation (2), measures the effect of agricultural subsidies on sectoral productivity growth and the aggregate income effect of rural income on the broader economy, which is the primary motivation for this research. The *CAPITAL* variable reflects the role of capital formation in increasing the economy's productive capacity. The *INF* variable assesses the potential inhibitory effect of inflation on investment, as inflation indicates macroeconomic stability and can disrupt price mechanisms. The *LF* variable, representing labor, is included as a fundamental input in the production process. The *TRADE* variable measures the degree of economic openness and evaluates the potential influence of global competition on economic growth. Table 1 provides definitions for all variables used in the analysis.

Table 1. Variables used in the model and their explanations

Variables	Explanations (%)	Resource	Expected impact
GROWTH	Economic growth rate	World Bank	Dependent variable
AS	Ratio of agricultural subsidies to GDP	OECD	+
CAPITAL	Gross fixed capital formation (% of GDP)	World Bank	+
INF	Inflation rate (annual %)	World Bank	-
LF	Labor force, total	World Bank	+/-
TRADE	Trade (% of GDP)	World Bank	+/-

Source: by the authors

3.2. Methodology

Panel data enables more effective parameter estimation due to its greater data diversity and increased degrees of freedom compared to cross-sectional or time series data. It also facilitates the analysis of models with complex relationships. Because panel data incorporates both temporal relationships and unit-specific information, it enables more effective control for unobservable variables. For these reasons, panel data is often preferred over cross-sectional and time series data. By combining data from different units and capturing the dynamic structures of economic behavior, panel data provides more consistent estimations (Hsiao, 2007: 2-6).

This study employs the Dynamic Panel Data analysis method developed by Han and Phillips (2010) to assess the effects of agricultural supports on sustainable economic growth. Dynamic panel data analysis is widely used among panel data methodologies. These models measure the impact of the dependent variable from previous periods on its current value. Unlike static panel data models, dynamic models include lagged variables (Küçükkaya et al., 2019: 65; Tatoğlu,

2013: 65). Incorporating the lagged dependent variable addresses the issue of non-stationary residuals present in static panel data models. The traditional dynamic panel data model is represented in Equation (3) and (4).

$$\gamma_{it} = \delta\gamma_{it-1} + X'_{it-1}\beta + \epsilon_{it} \quad (3)$$

$$\epsilon_{it} = \mu_{it} + \upsilon_{it} \quad (4)$$

The i and t indices represent the country and time dimensions, respectively. In addition, μ_i in Equation (4) is i, expresses the unit effect, and since it is constant throughout the whole time. Both/and γ_{it-1} are a function of this unit effect (Baltagi, 2005: 135).

In econometric analysis employing fixed effects dynamic spatial panel models, applying ordinary least squares to first-differenced data leads to efficiency losses in estimating the lagged variable parameter. To address this issue, variable means techniques or the estimator proposed by Arellano and Bond (1991) are commonly used to mitigate such biases. However, Arellano and Bover (1995) and Arellano and Bond (1998) noted that these approaches may yield ineffective results, particularly when the lagged variable parameter approaches unity. To overcome these limitations, a new estimator was developed (Wooldridge, 2003; Green, 2007). Han and Phillips (2010) introduced an estimator that improves dynamic panel predictions. Their method effectively addresses the problem of weak instruments, even when the lagged variable parameter is near 1. Furthermore, this approach is applicable to both stationary and non-stationary data and does not impose restrictions on panel size. The sole requirement for model estimation is that the residuals follow a white noise process.

Given the previously discussed advantages, the Dynamic Panel Data Analysis method developed by Han-Philips (2010) was selected for this study. The corresponding model is presented in Equation (5).

$$Y_{it} = \alpha I + \beta Y_{i0} + \lambda Y_{i(t-1)} + \gamma X + \rho_1 \omega Y_{i0} + \rho_2 \omega X + \epsilon_{it} \quad (5)$$

Y_{it} represents the economic growth rate (*GROWTH*) for region i in year t; Y_{i0} represents the first economic growth rate (*GROWTH*) in different regions. I represent the unit matrix; ω is a spatial weight matrix of order nxn. X represents the impact factors matrix. ρ_1 and ρ_2 represent spatial effects; α, β, λ and γ are parameters to be estimated; and ε is a random error term.

4. Results

This study investigates the relationship between agricultural supports and economic growth. Reviewing the descriptive statistics of the variables prior to model estimation provides a critical foundation for obtaining reliable results. The descriptive statistics are presented in Table 2.

Table 2. Descriptive statistics

Variables	*GROWTH*	*AS*	*CAPITAL*	*INF*	*LF*	*TRADE*
Mean	2.73	1.02	23.57	3.86	28489035	61.09
Maximum	11.81	4.84	34.99	54.91	168920514	133.69
Minimum	-8.35	0.14	13.90	-1.35	167756	19.55
Standard deviation	2.92	0.78	3.63	5.76	40711502	23.80
Number of observations	308	308	308	308	308	308

Source: The authors

Table 2 indicates that *LF* and *TRADE* exhibit the highest standard deviations, whereas *AS* displays the lowest. The mean values are 2.73 for *GROWTH*, 1.02 for *AS*, 23.57 for *CAPITAL*, 3.86 for *INF*, 28,489,035 for *LF*, and 61.09 for *TRADE*. To address scale differences across countries, the *LF* variable was log-transformed. The remaining variables, expressed as percentages, were not adjusted. Consequently, the descriptive statistics do not indicate any concerns for panel data analysis.

After presenting the descriptive statistics in Table 2, the study provides the correlation matrices for the data set. The correlation values in Table 3 are examined to assess multicollinearity among the independent variables. Tabachnick and Fidell (2001) suggest that a correlation coefficient exceeding 0.90 may indicate a multicollinearity issue. In this analysis, the highest observed correlation coefficient is 0.56, indicating that multicollinearity is not a concern.

Table 3. Correlation matrix of variables

Variables	*GROWTH*	*AS*	*CAPITAL*	*INF*	*LF*	*TRADE*
GROWTH	1.000	0.22	0.20	0.14	-0.11	0.03
AS	0.22	1.000	0.22	0.508	-0.08	0.03
CAPITAL	0.20	0.22	1.000	-0.11	-0.06	0.13
INF	0.14	0.50	-0.11	1.000	-0.07	-0.04
LF	-0.11	-0.08	-0.06	-0.07	1.000	-0.56
TRADE	0.03	0.038	0.13	-0.04	-0.56	1.000

Source: The authors

In the next stage of the study, we estimated the model in Equation (1) using the Han and Phillips (2010) method. To choose the right model, we applied the Robust Hausman test, which remains accurate even if some model assumptions are not met. The null hypothesis is based on resistant variances from bootstrap operations in the Robust Hausman test. The results indicate that the fixed effects model is appropriate. Fixed effects estimation results from Han and Phillips (2010) are shown in Table 4.

Table 4. Han and Phillips (2010) estimation results

Dependent variable: *GROWTH*		
Variables	**Coefficient**	**Z statistic**
GROWTH (-1)	-0.22	-1.92*
AS	1.06	1.93*
CAPITAL	0.38	6.32***
INF	-0.10	-3.05***
LF	-5.08	-3.18***
TRADE	0.05	3.31***
Wald –test	72.36***	
F-test	12.06***	
Robust Hausman Test	13.29**	

Note: ***,**, and * signs in the table indicate that the relevant test statistic is statistically significant at the 1%, 5%, and 10% significance levels, respectively.
Source: The authors

The results presented in Table 4 demonstrate that agricultural support exerts a positive and statistically significant effect on economic growth in OECD countries. Allocating resources to the agricultural sector increases the disposable income of the rural population, which in turn stimulates demand for goods and services at both local and national scales. The findings indicate that resource allocation and support for agriculture enhance aggregate demand and productivity through rural development. Consequently, increases in agricultural support are associated with improvements in economic growth. This outcome aligns with Schultz's (1964) assertion that such support promotes growth by raising productivity and rural income. Agricultural support also fosters economic growth by encouraging investment and production. Furthermore, the results suggest that agricultural subsidies, by enhancing agricultural productivity, facilitate the structural transformation required in the industrial and service sectors, thereby serving as a strategic lever for economic growth. These findings are consistent with those reported by Bezemer and Headey (2008), Gollin et al. (2002), McArthur and McCord (2017), and Oyakhilomen and Zibah (2014).

Capital accumulation positively influences economic growth in OECD countries. An increase in capital stock enhances labor productivity, which raises total output and contributes to higher economic growth. The results confirm that expanding capital stock is essential for sustaining growth in these countries. This evidence supports the perspective that capital accumulation is a primary driver of economic growth, consistent with the findings of Mankiw et al. (1992), Bond et al. (2010), and Topcu et al. (2020).

The analysis indicates that higher inflation rates have a negative impact on economic growth. Disruptions to price stability impose direct

costs on economic performance in OECD countries. Rising inflation increases uncertainty, prompting businesses to delay investments and consequently slowing growth. This result is consistent with Ibarra and Tellez's (2020) conclusion that price instability adversely affects economic growth.

The study finds that the labor force has a negative and statistically significant effect on economic growth in OECD countries. This suggests that increases in the labor force may impede growth unless accompanied by improvements in workforce quality. A larger labor force may slow growth, potentially due to declining productivity associated with an aging population. This result aligns with Prettner and Bloom's (2020) finding that increasing the number of workers without enhancing their skills leads to lower output due to diminishing returns and slows economic growth.

The analysis finds that a higher openness ratio positively influences economic growth. In OECD countries, greater openness increases trade volumes and total factor productivity through cross-border technology spillovers. Higher openness allows domestic firms to benefit from global economies of scale, while international competition promotes the allocation of resources to more efficient sectors. Consequently, increased openness leads to greater specialization and contributes to sustainable growth by generating higher added value. Therefore, increasing openness facilitates technology transfer and the realization of economies of scale in OECD countries.

5. Conclusion and Policy implications

Economic growth depends not just on more production factors, but also on the policies that shape how productive these factors are. Agriculture plays a key role in driving economic growth by providing food, connecting with other sectors, and supporting productivity. Because agriculture adds value to the wider economy, supporting this sector is important. Such support boosts production and creates a multiplier effect by encouraging growth in industry and services.

Given the importance of agricultural support in the production process, this study examines the relationship between agricultural support and economic growth. The analysis utilizes data from OECD countries spanning 2000 to 2021 and employs the Han-Philips (2010) dynamic panel data method. The results indicate that agricultural support exerts a positive and statistically significant effect on economic growth. This finding suggests that the agricultural sector functions not only as a primary sector but also as a strategic driver of demand for the industrial and service sectors. Capital accumulation and openness are also found to positively influence economic growth. Conversely, the study finds that inflation and labor force variables have a negative and statistically significant impact on economic growth. Price instability due to inflation and demographic changes in OECD countries are

identified as key factors that hinder growth. These results imply that macroeconomic vulnerabilities and demographic barriers significantly suppress economic growth performance in OECD countries.

In light of these findings, agricultural support in OECD countries should transition from a social-welfare-oriented model to one that emphasizes strategic growth instruments. The findings further suggest that agricultural support is essential for stimulating aggregate demand through rural income growth. Our results supportted National Economic Model by Baş (2018). Additionally, productivity gains from agricultural support enhance economic growth and help mitigate inflationary pressures by ensuring food supply security. Based on these findings, several policy recommendations are proposed:

- Agricultural support should prioritize enhancing productivity and advancing technology. Given the significant impact on economic growth, such support should target quality improvements rather than merely increasing output. In OECD economies, agricultural subsidies are more effectively allocated to precision agriculture, digital farming applications, and biotechnology research and development, rather than direct payments. This strategic transformation is expected to reduce unit costs and amplify the multiplier effect of agriculture on economic growth.
- Agricultural support should encourage more young people to get involved in farming. The implementation of technology grants and low-interest start-up loans for young entrepreneurs in the agricultural sector is recommended. The anticipated emergence of digitally proficient agricultural workers is likely to increase the sector's marginal productivity and support sustained economic growth.
- Agricultural support should help manage supply-side inflation. By lowering costs for things like energy and fertilizers, support can help keep food prices stable. This will support overall economic stability and help prevent inflation from slowing down growth.
- Agricultural support programs should help local producers adapt to global value chains and international standards like the "Green Deal." This can speed up economic growth by increasing high-value agricultural exports.

In summary, this study uses a broad dataset from OECD countries between 2000 and 2021. The results show that agricultural subsidies play a key role in driving economic growth in these countries. These findings offer useful guidance for policymakers who want to support growth. Future research may advance the literature by disaggregating agricultural support into sub-categories, including direct income support, market price support, and infrastructure services, and by

evaluating which type of support produces a greater multiplier effect on economic growth. Furthermore, in addition to institutional quality and governance variables that affect the effectiveness of agricultural funds, the impact of pro-consumption incentives proposed by NEM on the demand for agricultural products and subsequent sectoral investments could be assessed using Computational General Equilibrium (CGE) models.

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

All authors contributed to the original idea, study design.

Ethical considerations

The authors have completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc. This article was not authored by artificial intelligence.

Data availability

The dataset generated and analyzed during the current study is available from the corresponding author on reasonable request.

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