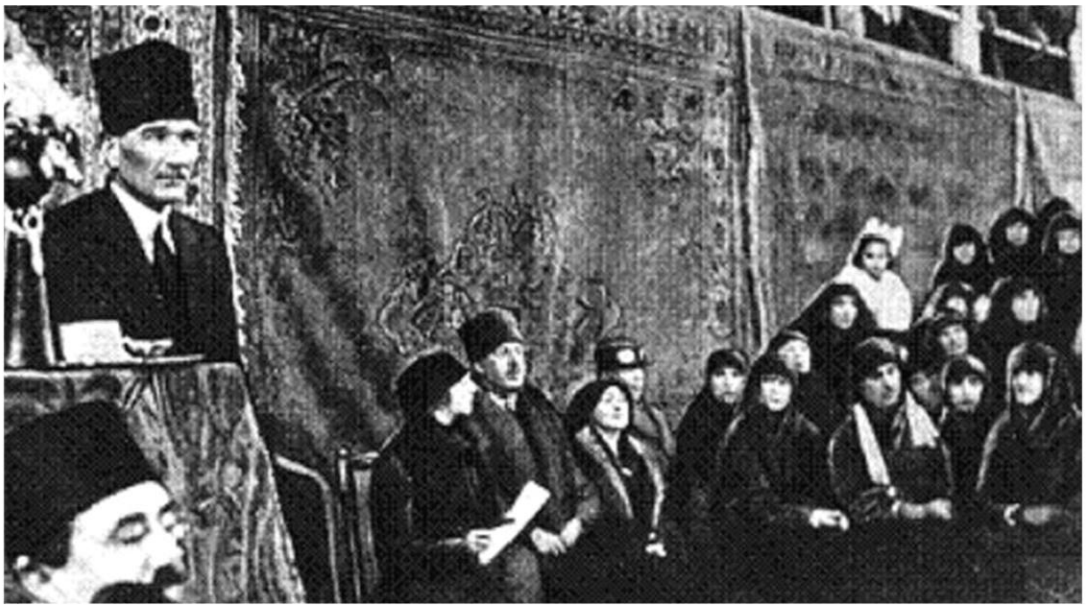
8 INTERNATIONAL İZMİR ECONOMICS & BUSINESS ADMINISTRATION CONGRESS

FEBRUARY 23-25, 2024 / IZMIR, TÜRKIYE



PROCEEDINGS BOOK

EDITOR:

Prof. Dr. Sadettin PAKSOY

ISBN: 978-625-8254-34-1

8th INTERNATIONAL IZMIR ECONOMICS & BUSINESS ADMINISTRATION CONGRESS

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Issued: 05.03.2024
ISBN: 978-625-8254-34-1

CONGRESS ID

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EVALUATION PROCESS

All applications have undergone a double-blind peer review process

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PASS-THROUGH OF AGRICULTURAL SUPPORT TO AGRICULTURAL GROWTH IN TURKEY: AN EMPIRICAL STUDY BASED ON THE TIME VARYING PARAMETER VECTOR AUTOREGRESSION MODEL

PhD Hakan SÖNMEZ

Dokuz Eylül University, Efes Vocational School, Department of Transportation Services, Selçuk /İzmir

ORCID ID: 0000-0001-6126-3275

ABSTRACT

The aim of this study is to examine the transition effect of agricultural support on agricultural growth in Turkey. Agricultural support policies vary over the years in Turkey. It is necessary to utilize models that analyze structural shifts throughout time in order to assess these dynamic changes. The impact of agricultural support shocks on agricultural growth has been evaluated using a time-varying parameter vector autoregressive (TVP-VAR) model in this study. The Tramo/Seat method is applied to seasonally adjust the quarterly data spanning from 2006:Q1 to 2023:Q3. The coefficients for all variables are interpreted as elasticity values, which are computed by taking the natural logarithm. The vector Y_t=[(SUPPORTagricultural), (LOANagricultural), (GDPagricultural)] represents the internal variables utilized in both linear VAR and TVP-VAR models. SUPPORTagricultural represents agricultural support payments allocated from the central government budget to the agricultural sector, LOANagricultural indicates the amount of credit utilized for the agricultural sector, and GDPagricultural denotes the value of agricultural gross domestic product in this vector. Two stages have been followed to determine the transition effect of agricultural support payments on agricultural growth. Firstly, the stationary of the variables has been evaluated using unit root tests. Then, the results of the linear VAR model and TVP-VAR model have been analyzed using all variables that have become stationary after taking first differences. According to the impulse response functions of the linear VAR model, the effect of shocks in agricultural support during the 2008 global financial crisis and the 2019 coronavirus pandemic on agricultural GDP is to a great extent similar. During both economic crisis periods, the responses of agricultural GDP fluctuate above or below the initial equilibrium level until the end of the 6th period, which then stabilizes in subsequent periods in response to a shock in agricultural support variables. On the other hand, 10.000 iterations have been performed to approximate the parameters in the TVP-VAR models. It has been determined that the transition effect from agricultural support to agricultural GDP is positive when examining the impulse response functions of the TVP-VAR model. Also, positive shocks in agricultural support lead to an increase in agricultural GDP. The highest positive response of agricultural GDP to agricultural support shocks has been calculated as 1.4% in the study period. Furthermore, it is found that the transition effect from agricultural support to agricultural GDP gradually decreases from 2014 onwards. Based on the results obtained from the study, it is considered necessary to increase the share of agricultural support in national income compared to other developing countries and to distribute it effectively, to increase support for technology-intensive production aimed at improving agricultural productivity in the short and long term, to focus on support policies for agricultural inputs that will provide cost advantages in strategically important markets, and to plan policies that will enable not only large agricultural enterprises but also numerous small agricultural enterprises in rural areas to benefit more effectively from agricultural support.

Keywords: Agricultural Support, Agricultural Growth, Agricultural Credit, TVP-VAR Model, Turkey

1. INTRODUCTION

Agricultural supports provide economic support to farmers and agricultural enterprises, contributing to increased agricultural production. While support policies may vary depending on countries' economic structures and goals, they generally aim to achieve similar objectives. Farmers can continue their production in a balanced and continuous manner under suitable economic conditions thanks to these policies. These policies also promote production, increase productivity, and expand product diversity (Köroğlu, 2003). In this context, these supports provided to farmers are one of the important tools supporting the sustainability of agricultural activities and economic development. Moreover, considering the stable growth of the agricultural industry and its impact on the economy at a national level, the importance of such support policies is expected to increase further. The design and implementation of these policies tailored to the needs of farmers are critical for the sustainable growth of the agricultural sector. Furthermore, it is important that the effectiveness and distribution of agricultural support policies are carried out fairly. Additionally, agricultural supports are also crucial incentives for pricing agricultural

products. Thanks to these supports, producers' incomes increase, costs decrease, and agricultural production is encouraged. When agricultural credits are used in conjunction with agricultural supports, increases in production capacity and productivity can also be achieved. However, ineffective use of agricultural supports and credits can lead to imbalances in agricultural markets. Thus, it is significant to manage the relationship between agricultural supports and credits in a balanced and effective manner.

Table 1. Agricultural GDP, Support and Loan Data in Turkey (2006-2022)

Year	Agricultural Gross Domestic Product (Thousand TRY)	Agricultural Support (Thousand TRY)	Agricultural Loan (Thousand TRY)
2006	64.415.593	4.746.708	17.943.038
2007	66.197.107	5.555.092	22.730.041
2008	74.451.345	5.809.044	28.696.285
2009	81.234.274	4.494.568	34.756.343
2010	104.703.635	5.817.012	49.315.336
2011	114.838.169	6.961.306	76.718.348
2012	121.692.893	7.553.045	81.769.578
2013	121.733.979	8.684.168	80.301.881
2014	134.744.489	9.147.584	93.764.765
2015	161.471.476	9.971.168	128.331.168
2016	161.330.969	11.488.898	176.585.158
2017	189.232.800	12.721.748	210.087.243
2018	217.832.444	14.552.453	244.791.131
2019	276.415.863	16.965.138	275.275.968
2020	336.736.520	21.943.631	318.100.167
2021	401.536.982	24.124.983	405.043.702
2022	972.301.593	39.642.220	671.047.572

(**Source:** The Central Bank of the Republic of Türkiye, 2024)

Agricultural supports play a crucial role in developing countries. Moreover, a considerable number of the population is still employed in the agricultural sector in many developing countries. Additionally, the agricultural sector holds strategic importance in producing raw materials necessary for the production of many goods and services. As is known, the agricultural sector is one of the sectors that are significantly affected by unpredictable risks and uncertainties, especially due to climatic conditions. Furthermore, changes in production quantity exert pressure on agricultural product prices due to agricultural products exhibit low elasticity in both supply and demand. The government intervenes in the agricultural products market through various methods to control the fluctuations in production quantity and prices. Thus, agricultural supports play an important role in preventing any kind of negativity that may arise in ensuring the continuity of agricultural output. In this regard, it is necessary to give the necessary importance to agricultural supports, especially in developed and developing countries (Kazgan, 2003). Table 1 includes data on agricultural gross domestic product(AGDP), agricultural support, and agricultural credit between 2006 and 2022. When Table 1 is evaluated, it is denoted that Turkey has undergone a significant growth and development process in the agricultural sector over its historical development process. The increase in agricultural support and credits is remarkable, especially in the last five years. The increasing support to the agricultural sector in recent years and the increasing trend in agricultural credits reveal the sector's growth potential.

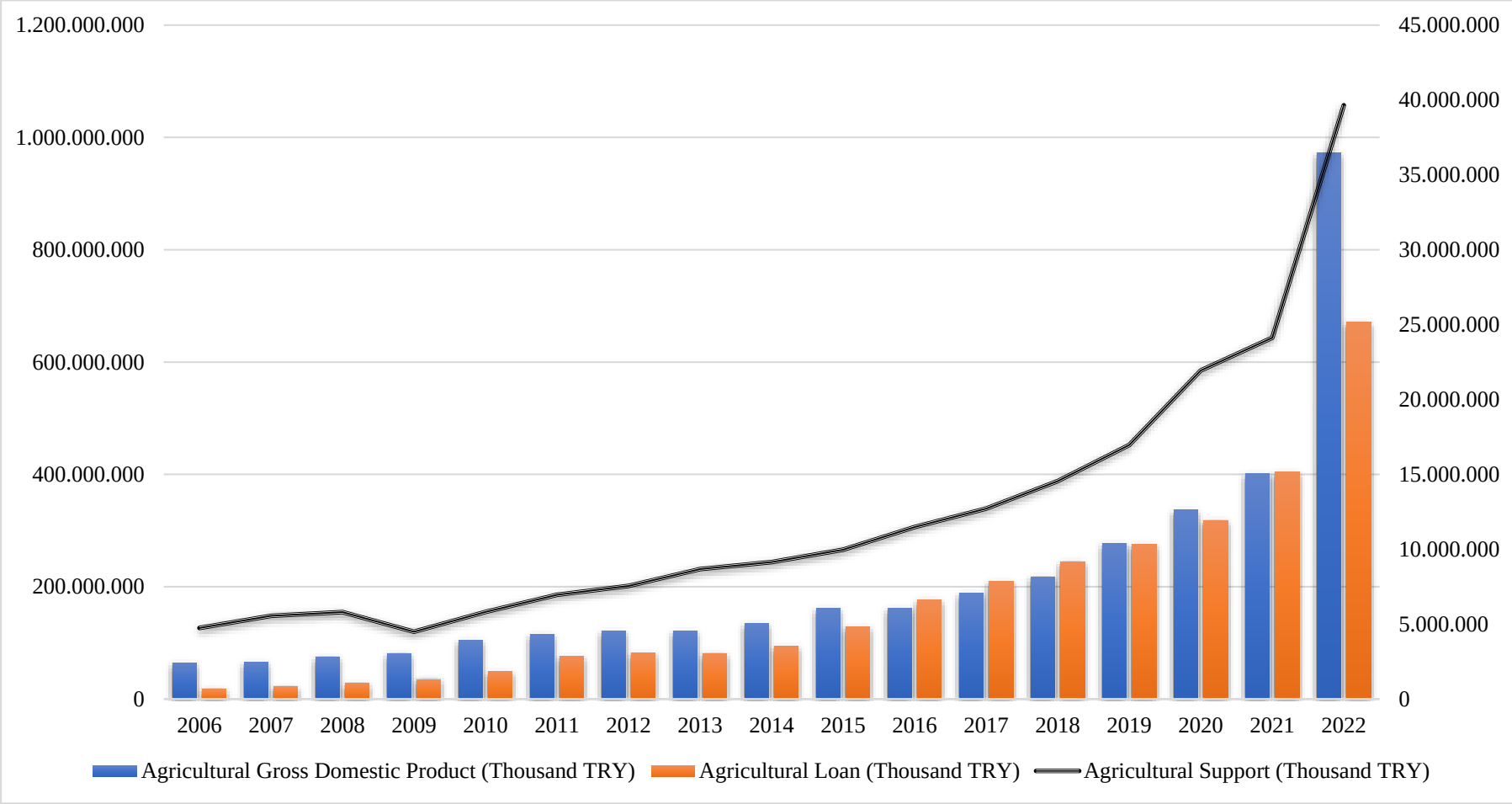


Figure 1: The Historical Development of Agricultural GDP, Agricultural Support, and Agricultural Loan Data in Turkey (2006-2022)

(**Source:** The Central Bank of the Republic of Türkiye, 2024)

When the recent development process of the agricultural sector in the Turkish economy is examined, it is observed that numerous local and global crises have occurred, which have led to significant changes in macroeconomic policy decisions. Analyzing the impact of these changes on the agricultural sector necessitates taking into account the changing structure over time. In this context, the fundemental aim of this study is to investigate the dynamic effect of agricultural supports in connection with agricultural credits on AGDP, considering the changing parameters over time. In research on the impact of agricultural supports on agricultural growth, the time-varying parameter structure is generally overlooked. As far as we know, this study, which uses the time-varying parameter VAR (TVP-VAR) model, is the first to examine the transition effect of agricultural supports from the central government budget in the agricultural sector in Turkey on agricultural growth through agricultural credits. Moreover, the study's evaluation of the impact of these transition effects on growth in the agricultural sector, which considers the global crises in Turkey and the world, is expected to make a significant addition to the literature.

Turkey is a country with significant potential in the agricultural sector. Recently, changes in agricultural production and the support provided to the sector have raised important questions about the impact on Turkey's agricultural potential. Figure 1 shows the development of GDP value in the agricultural sector in Turkey between 2006 and 2022, along with the support payments allocated from the central government budget and agricultural credits. The growth process in Turkey's agricultural sector is remarkable as seen in Figure 1. The AGDP, which has risen from 64,415,593 billion Turkish Liras in 2006 to 972,301,593 billion Turkish Liras in 2022. This means that the AGDP has almost increased 15 times in approximately 16 years. Also it is evident that agricultural support and credit policies have played a significant role in this growth. Agricultural support is one of the leading policies implemented by Turkey to support and develop its agricultural sector. Thus, understanding the changes in the amount of agricultural support over the years is important to grasp the sector's significance in the economy and its impacts of agricultural policies. As seen in Figure 1, the amount of agricultural support has shown a significant increase between 2006 and 2022. The amount of support has risen from 4,746,708 billion Turkish Liras in 2006 to 39,642,220 billion Turkish Liras in 2022 during this period. Also, decrease in agricultural support is observed between 2009 and 2010. Among the reasons for this decrease are economic uncertainties, changes in agricultural policies, and fluctuations in weather conditions. Furthermore, the steady increase in agricultural support amount is noticeable from 2010 onwards. During this period, the support amount has increased annually and reached a record level in 2022.

The increase in agricultural credit amount contributes to strengthening the financing of the agricultural sector and its sustainable growth in Turkey. Moreover, it is possible to manage agricultural policies effectively and fully evaluate the country's agricultural potential through these credits. As seen in Figure 1, the amount of agricultural credit in Turkey has continuously increased between 2006 and 2022. The lowest credit amount has been 17,943,038 billion TRY in 2006, while the highest credit amount has been 671,047,572 billion TRY in 2022. Especially, the rate of increase in agricultural credit amount has been remarkable since 2010. Also the average agricultural credit amount has been calculated as approximately 171,485,748 billion TRY for all years. Furthermore, it is believed that increasing the efficiency in the agricultural sector, educating farmers, and correctly implementing agricultural policies will be crucial for the effectiveness and sustainability of agricultural credit increases.

This study is divided into five different sections. After an introduction to the subject in the first section, the second section presents knowledge on relevant literature. The methodology of the model used to estimate the coefficients of the parameters is elaborated upon in the third section. The study's empirical findings are deliberated upon in the fourth section. Finally, the results are presented along with policy recommendations in the last section.

2. LITERATURE REVIEW

The analysis of agricultural supports together with numerous macroeconomic variables has made this topic a frequently debated issue at the academic level. It is observed that the analysis results vary depending on the differences in the methods used in studies evaluating the effects of agricultural supports, as well as the practices and periods examined in the countries. This situation is an important point to be considered in studies on the effectiveness of agricultural supports. Thus, it is possible to classify the literature on the economic effects of agricultural supports into three main groups. The first group consists of studies focusing on a single country or studies involving groups of countries. When the literature related to the studies in the first group is examined, it is observed that there are numerous studies on the effectiveness of agricultural support policies. Both quantitative and qualitative analysis methods are used in these studies. While quantitative methods attempt to measure the economic effects of policies objectively by using numerical data and various econometric techniques, qualitative methods focus on examining more subjective factors such as the social effects, feasibility, and psychological effects on agricultural communities. Thanks to studies based on these two approaches, a comprehensive evaluation of the overall effectiveness of agricultural support policies has been possible.

The studies that include single countries or groups of countries show that the effects of agricultural supports on various macroeconomic variables differ from one country to another and sector to sector. Agricultural production has an important role in meeting the increasing food demand, which is directly proportional to the population growth rate, especially in developing countries. Thus, a significant part of the studies examines the effects of agricultural supports on agricultural production. For instance, Roe et al. (2002) have investigate the effect of agricultural supports on the value added by agricultural producers in the United States. According to the research results, it has determined that agricultural capital markets differ under perfect competition and imperfect competition conditions. In addition, under the assumption of perfect competition, they have showed that supports do not have a production-increasing effect. However, under the assumption of imperfect competition, they have observed that supports had short-term positive effects on value added but these effects disappeared in the long run. Bezlepkina & Oude (2006) have investigated the impact of debts and supports received by 19,000 large-scale farms in Russia between 1995 and 2000 on production. The result of the study have determined a negative relationship between supports and productivity. McCloud & Kumbhakar (2007) have researched the effect of incentives used by dairy farms in Denmark, Sweden, and Finland between 1997 and 2003 on value added. The study has concluded that supports have increased productivity by providing flexibility in efficiency and inputs used in production. Rizov et al. (2013) have analyzed the effect of supports on value added for 15 European Union countries between 1990 and 2008. The research results have determined that there have been differences between northern and southern European countries in terms of total productivity and agricultural growth. It has also been found that the effect of supports on value added was negative before the reform of direct support payments independent of production, but this effect has changed positively after the reform. Vozarova & Kotilic (2016) have concluded the relationship between agricultural supports and agricultural output in Slovakia between 2009 and 2013. This analysis has emphasized a strong correlation between the agricultural supports provided by the government and agricultural output. Aktaş, et al. (2015) have comparatively analyzed the effect of agricultural supports on agricultural output for selected 12 countries including the European Union and Turkey. Data for the period 1995-2010 have been examined using panel data analysis. The study has concluded that while market support and input support have increased agricultural output in developed countries, they have had a negative impact in developing countries. Koç & İşlek (2020) have identified the causal relationship between agricultural subsidies and agricultural production across BRICS-T countries. Analyzes, which have been conducted using annual data covering the period 2000-2016, have found that there is a bidirectional causality relationship between agricultural supports and agricultural production in Turkey and China; a unidirectional causality relationship from agricultural supports to agricultural production has been found in Brazil and Russia. Also unidirectional causality relationship has been found from agricultural production to agricultural supports in South Africa, and for India, no causal relationship has been detected. Acar & Eser (2021) have compared the financial support given to agriculture in Turkey and the European Union and made suggestions for Turkey. First, the share of the agricultural sector in the economy has been discussed, then the financial support given to agriculture in Turkey and the European Union has been examined in detail, and finally, a comparison has been made between these supports. The conclusion of the research has emphasized that while the EU adopts a producer-based support system, Turkey prefers product-based premium support payments, and it is crucial for Turkey to solve the structural problems in agriculture and transition to producer-based support.

Agricultural support policies are significantly linked to the unique economic composition of individual countries. Therefore, agricultural support policies can vary from country to country depending on their level of development. Ensuring continuity in agricultural production is greatly supported by agricultural supports, especially in developing countries. Many studies have been conducted to evaluate the relationship between agricultural output and agricultural supports in Turkey. It is important to examine these studies in different regions and time frames for interpreting the results. In this context, studies specific to Turkey have been examined in the second group of research. When the literature related to Turkey is examined, it is observed that empirical studies are mostly analyzed using time series methods. Moreover, it is seen that the impact of agricultural support on agricultural output is mostly analyzed using linear models. As an illustration, Erdal & Erdal (2008) has examined the effect of premium payments on six different agricultural products within the scope of agricultural supports. In the analyzes conducted using the Granger causality test for the period 1980-2006, no causality relationship has been found between cultivation regions and premium payments for three products. However, a one-way causality relationship has been found between rapeseed production area and premium payment, and a two-way relationship has been found between corn production area and premium payment. In terms of product prices, a two-way causality relationship has been found between premium payments and product prices for soybean and rapeseed products, while a one-way causality relationship has been found for sunflower products. Uzmay (2009) has conducted the effect of the price difference payment system and support purchase on cotton production for the period 1990-2006. According to the result of the paper of the study, it has been demonstrated that the price difference payment system has been more suitable than support purchases for consumer welfare. Terin et al. (2013) has evaluated the relationship between Real Agricultural GDP and total fixed capital investments for agriculture, the amount of support for the agricultural sector, the share of the agricultural sector in GDP, and the employment rate in the

agricultural sector for the period 1990-2012. According to the parameter estimate results obtained from regression analysis, it has been determined that fixed capital investments for the agricultural sector and agricultural supports have positively affected agricultural growth, but have negatively affected the employment level in the agricultural sector. Özüdoğru & Miran (2015) has asserted the effect of price difference payment supports and other support methods, which are stated to be of strategic importance in cotton production, on cotton supply. They have examined the effect of price difference payment supports and other support methods, which are stated to be of strategic importance in cotton production, on cotton supply. According to the findings of the study, the price difference payment support policy could increase cotton supply by 2.9%. Moreover, it has been determined that for the price difference payment policy to be accepted by farmers, it should include at least 18% price support in cotton compared to conditions without any support. Gül Yavuz et al. (2016) has analyzed the impact of support policies on supply quantity in selected 14 provinces using the survey method. The findings of the study have indicated that agricultural supports have affected rice production but have not affected wheat and maize production. Işık & Bilgin (2016) has studied the effect of different agricultural support programs on agricultural production using cointegration analysis for the period 1986-2015. According to the findings of the study, which indicate that a 1% increase in agricultural supports in the long term has increased agricultural production by 0.68%, the supports have had a positive effect on agricultural output. Yıldız (2017) has emphasized the effects of payments made to the agricultural sector on the agricultural output level. It has been determined that both direct and indirect supports to the agricultural sector have led to an increase in agricultural output in accordance with the analyses conducted for the period 2006:Q1-2016:Q4. Causality test results have shown that there has been a two-way relationship between agricultural supports and the level of agricultural output. Direk et al. (2019) has explored the relationship between support in the agricultural sector and agricultural output for the period 2000-2018. The results obtained from the Gregory-Hansen cointegration test and FMOLS method have shown that agricultural supports have had a positive effect on the level of agricultural output. Sağdıç & Çakmak (2021) has evaluated the correlation between agricultural support payments and agricultural output levels using quarterly data from 2006 to 2014. According to the research findings, there has been a long-term relationship between agricultural support payments and agricultural output levels, and there has been a one-way causality relationship from agricultural support payments and agricultural output levels. Köse & Meral (2021) has identified the relationship between economic growth, agricultural supports, and the food production index using the ARDL boundary test methodology and the Toda-Yamamoto causality examination for the period 1986-2016. The research findings have indicated a two-way positive relationship between food security and economic growth, while no relationship has been found between agricultural supports and economic growth. Kalabak & Aslan (2021) has investigated the effects of subsidies for diesel and fertilizer, as well as soil analysis assistance, on wheat production across Balıkesir districts for the period 2009-2015. The findings obtained from study have shown that the supports have had a positive effect on wheat production, but the effect has been limited. The study has recommended more institutional policies to increase wheat yields and enhance the effectiveness of agricultural subsidies. Oğul (2022) has focused on a study conducted with quarterly data for the Turkish economy for the period 2006:Q1-2021:Q3 to examine the impact of agricultural subsidies on agricultural output. The estimation results obtained from the ARDL boundary testing methodology, it has been concluded that agricultural supports have reduced agricultural production in the short term but have increased it in the long term. There are also non-linear econometric studies. Namely, Gezer & Gezer (2022) have investigated the effect of agricultural supports and agricultural credits on agricultural output. They have examined the effects of positive and negative shocks on agricultural production using the nonlinear autoregressive distributed lag model (NARDL). The estimation results show that agricultural credits and agricultural supports have had a positive impact on agricultural production in the short term. Also, it has been determined that positive credit shocks have increased agricultural production in the long term, while negative credit shocks have decreased agricultural production. Ataş et al. (2023) has empirically tested the effect of price difference payment supports on agricultural production using panel dataset and three different estimators for the period 2002-2020. The study has concluded that the implemented price difference payment supports have yielded a positive effect on agricultural production and the value of agricultural products, and agricultural exports. Additionally, it has been determined that a 1% increase in price difference payment supports in TL has resulted in a 0.74% increase in agricultural production.

The third group of studies is related to the agricultural credit variable, which is included in the vector of internal variables mentioned in my methodology section and used in the analysis of the transition effect from agricultural supports to agricultural GDP. The nature of the relationship among variables, cointegration analysis, and causality relationship are generally interpreted .n these studies. As a case in point, Das et al. (2009) have examined the impact of direct and indirect agricultural loans in agricultural production, as well as regional differences in agriculture, taking into account credit distribution and agricultural production, which are factors that influence agricultural productivity. According to the findings of dynamic panel data analysis, it has been determined that the amount of direct agricultural credit exhibits a positive and statistically significant effect on agricultural production. Also, it has been evaluated that the number of indirect agricultural credit accounts has a positive and significant effect on agricultural output, but it is effective with a one-year delay. Chisasa & Makina (2015) have explored the dynamic correlation between bank lending and agricultural output in South Africa for the period 1970-2011.

According to the study findings obtained using the Johansen cointegration test and error correction model, it has been determined that bank credit and agricultural production are cointegrated. Moreover, bank credits have been observed to have a positive effect on agricultural production in the long term. According to the Granger causality test result, it has been emphasized that there is a two-way causality relationship between bank credit and agricultural production increase. Misra et al. (2016) have studied at the level of the most populous 14 states in India within the scope of a panel model. Based on the study's findings, it has been established that the density of credit has a positive effect on total factor productivity in agriculture. Duramaz & Taş (2018) have explored the impact of loans extended to agricultural producers in the Aegean Region of Turkey by public, private, and foreign banks on agricultural production between 2006 and 2015 using panel cointegration analysis. The findings from the research have revealed that agricultural credits have positively and significantly affected agricultural output in the region. Additionally, studies on this issue have shown that agricultural credits have contributed to agricultural growth, especially in certain regions and generally in Turkey. In particular, Doğan et al. (2019) have examined the relationship between agricultural credits and agricultural growth in 81 provinces of Turkey using panel data analysis for the period 2004-2017. A long-term significant relationship between the variables has been noted in light of the study's results. Lawal et al. (2019) have used time series data to examine the impact of bank credit on agricultural productivity using the Toda and Yamamoto Granger causality test in Nigeria. The study has concluded that there is a one-way causality relationship from ACGSF to AGDP. Seven & Tumen (2020) have analyzed the relationship between agricultural credits and agricultural productivity for developed and developing countries for the period 1991-2014. According to the findings of the study obtained using the panel data analysis method, it has been determined that increasing agricultural credits has resulted in a 4-5% increase in agricultural productivity. It has also been emphasized that agricultural credit expansion has contributed to high agricultural growth rates in most countries. Manoharan & Varkey (2021) have examined the correlation between agricultural credit and agricultural productivity in 17 different states in India. Panel data analysis has been used to examine the data from 1990-1991 to 2017-2018. According to the fixed effects model estimation results, doubling direct agricultural credits has had a positive effect on agricultural productivity, while indirect agricultural credits have been shown to have a negative effect on agricultural productivity. Patwary et al. (2023) have examined the correlation between bank loans for agriculture and the agricultural gross domestic product (GDP) in Bangladesh. Econometric analyzes have been conducted using data from 1991 to 2018. Based on the study's findings, it has been established that bank agricultural credits are cointegrated with pesticide consumption and cultivated area use and have a long-term relationship with agricultural output. Mahapatra & Jena (2023) have evaluated the long-term impact of agricultural credits on grain, maize, and rice yields in India using the ARDL model for the period 2000-2020. They have determined that agricultural credits have had a positive effect on total grain and rice yields in their analysis. However, it has been found that there has been no statistically significant impact on maize yield. Özdemir (2023) has analyzed the effect of agricultural credit on agricultural output through encompassing 53 countries between 2000 and 2018. The analysis reveals that a 1% rise in agricultural credit has led to a 0.19% increase in agricultural value-added.

3. MATERIALS AND METHODS

The study utilizes quarterly data spanning from 2006:Q1 to 2023:Q3. All data have been obtained from the electronic data distribution system the Central Bank of the Republic of Turkey's database. Price series categorized by primary sector activities have been employed for agricultural GDP data. Also, agricultural GDP data has been adjusted for inflation using the deflator based on the 2009 base year. Agricultural support payments include payments made from the central government budget expenditures of the Ministry of Treasury and Finance. Agricultural credits include loans disbursed by the banking sector. Moreover, all data have been subjected to logarithmic transformation. Furthermore, agricultural GDP and agricultural support payment data have been seasonally adjusted using the TRAMO/SEAT method. Additionally, data for all series have been added to the models as ratio data by dividing them by the GDP value of the respective year. The model's variable definitions are demonstrated in Table 1.

Table 1. Variables, Abbreviation and Sources

Vairable Name	Short Form of Variable	Source
Agricultural Gross Domestic Product (Thousand TRY)	GDPagricultural	Central Bank of the Republic of Türkiye
Agricultural Support (Thousand TRY)	SUPPORTagricultural	Central Bank of the Republic of Türkiye
Agricultural Loan (Thousand TRY)	LOANagricultural	Central Bank of the Republic of Türkiye

During the analysis of time series, it is important for the series to be stationary. Stationarity of the series prevents spurious regression problems and ensures the reliability of the estimated parameter values. In non-stationary time series, which might lead to a misleading interpretation as though a substantial correlation exists among the

variables in the model, even though there isn't one. This situation can lead to incorrect interpretation of the parameters in the spurious regression equation (Baltagi, 2003). Thus, making the time series stationary is critically important for the reliability of the obtained parameters (Gujarati, 2004). The stationarity of all series has been investigated using the Augmented Dickey-Fuller (ADF) unit root test in this study. The equations for the tests used in the stationarity analysis are expressed in equations (1), (2), and (3). Equation (1) does not include a constant term or trend in the model. Equation (2) contains only a model with a constant term. Equation (3) includes tests for a model that contains both a constant term and a trend. Different criteria exist for determining the appropriate lag lengths for the series. The value that provides the smallest number of lags according to the Akaike Information Criterion (AIC) was considered as the most suitable number of lags.

$$\Delta y_t = \rho y_{t-1} + \sum_{i=1}^{k} \varphi_i \Delta y_{t-i} + \varepsilon_t \quad (1)$$

$$\Delta y_t = \alpha + \rho y_{t-1} + \sum_{i=1}^{k} \varphi_i \Delta y_{t-i} + \varepsilon_t \quad (2)$$

$$\Delta y_t = \alpha + \beta\, t + \rho y_{t-1} + \sum_{i=1}^{k} \varphi_i \Delta y_{t-i} + \varepsilon_t \quad (3)$$

Significant changes have been observed in agricultural supports and agricultural credit usage since 2005 in Turkey. Models analyzing structural changes over time are needed to evaluate these dynamic changes. The parameter coefficients of the Time-Varying Parameter VAR Model with Stochastic Volatility (TVP-VAR), which analyzes changes in agricultural supports on agricultural GDP over time, have been calculated using Bayesian methods in this context (Primiceri, 2005). This model takes into account changes and uncertainties over time, allowing for the analysis of the time-dependent changes in agricultural supports in Turkey. Hence, it became feasible to analyze the effects of changes occurring throughout the study period on the coefficients and to evaluate the decisions taken. Equation 4 has been used to estimate the coefficients using the TVP-VAR model.

$$Y_t = \delta_t + A_{1,t} Y_{t-1} + \cdots + A_{p,t} Y_{t-p} + u_t = X_t' \Theta_t + \varepsilon_t \quad (4)$$

The Y_t is the internal variable vector of size nx1 in equation 4. X_t represents the matrix of explanatory variables, and δ_t represents the time-varying parameters of the explanatory variables. On the other hand u_t, represents shocks whose variance changes over time, dependent on the variance-covariance matrix denoted as Ω_t

$$\Omega_t = \beta_t^{-1} H_t (\beta_t^{-1})' \quad (5)$$

It is possible to decompose the Ω_t variance-covariance matrix into a reduced diagonal form as shown in equation 5.

$$B_t = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21,t} & 1 & 0 & 0 & 0 \\ a_{31,t} & a_{32,t} & 1 & 0 & 0 \end{vmatrix} \qquad H_t = \begin{vmatrix} h_{1,t} & 0 & 0 & 0 & 0 \\ 0 & h_{2,t} & 0 & 0 & 0 \\ 0 & 0 & h_{3,t} & 0 & 0 \end{vmatrix} \quad (6)$$

The parameters located in the lower triangular part of the Bt matrix are employed for the purpose of determining the dynamic relationship between variables. Neglecting the time-varying structure in the VAR model can lead to upward biases in parameter estimation (Cogley & Sargent, 2005). Thus, the variance-covariance matrix should take into account the interaction between the examined variables and the stochastic volatility arising from changing variances of shocks. It is assumed that the time-varying parameters change within the framework of equations 7, 8, and 9 (Primiceri, 2005).

$$\Theta_t = \Theta_{t-1} + v_t \quad v_t \sim N(0, Q) \quad (7)$$

$$\alpha_t = \alpha_{t-1} + \zeta_t \quad \zeta_t \sim N(0, S) \quad (8)$$

$$\ln h_{i,t} = \ln h_{i,t-1} + \sigma_i \eta_{i,t} \quad \eta_{i,t} \sim N(0,1) \quad (9)$$

The time-varying Θ_t and α_t parameters expressed in equations 7, 8, and 9 involve a random walk process without a constant. It is assumed that the probabilities follow a geometric random walk unlike the time-varying parameters. This assumption enhances the efficiency of the Markov Chain Monte Carlo (MCMC) algorithm. Moreover, this assumption enables more precise and effective predictions. In the econometric model, the vector of endogenous variables to be used in explaining the relationship, especially between agricultural credit, agricultural support, and agricultural growth, is defined in Equation 10.

Y_t=[Δln(LOANagricultural$_t$), Δln(SUPPORTagricultural$_t$),Δln(GDPagricultural$_t$)] (10)

In Equation 10, Δln(LOANagricultural) represents the amount of credit used for the agricultural sector, Δln(SUPPORTagricultural) represents the agricultural support payments allocated from the central government budget to the agricultural sector, and Δln(GDPagricultural) represents the agricultural gross domestic product. A

two-stage process has been followed to determine the transition effect from agricultural support payments to agricultural growth in line with the aim of the study. Firstly, the first differences of all variables have been taken, and then the natural logarithm of all series has been calculated. Thus, the estimated coefficients have been construed as the elasticities of the variables. The ordering of variables in Equation 10 in both the linear VAR and TVP-VAR models, which has been determined from the most exogenous to the most endogenous in the vector, is as follows: agricultural credits, agricultural support payments, and agricultural gross domestic product, respectively. While determining this order, it has been considered that agricultural credits would externally influence agricultural support payments. Furthermore, it has been assumed that the agricultural GDP value has been influenced by both agricultural credits and agricultural support payments, thus being considered the most endogenous variable. For the predictions made with VAR models, 15,000 iterations have been performed for the convergence of 2000 parameters (Primiceri, 2005; Nakajima, 2011). Eviews 12 software has been used for the analysis of unit root tests. The OxMetrics software used by Nakajima (2011) has been preferred to estimate the TVP-VAR model.

4. FINDINGS AND DISCUSSIONS

In the study, an examination has been conducted to determine the stationarity status of the series that form the basis of our analysis. For this purpose, the Augmented Dickey Fuller (ADF) unit root test, which is widely used in the literature, has been employed. The findings regarding the unit root test results have been shown in Table 2. It has been determined that all variables exhibit unit root characteristics at the level value upon examining Table 2. This finding indicates that the variables are not stationary at the level. It is important for the variables that are non-stationary at the level to become stationary when their first differences are taken, in order for the time-varying parameter VAR model in our analysis to generate valid and significant results. Thus, initially, the first differences of all variables have been taken for the analysis in the model. According to the unit root test results of the differenced variables, it has been determined that all variables are stationary at the first difference level.

Table 2. ADF Test for Unit Root

	Intercept			Trend and Intercept		
	ADF Tau (τ) Test Statistics		Decision of Stability	ADF Tau (τ) Test Statistics		Decision of Stability
Variable Name	Level I(0)	First Difference I(1)		Level I(0)	First Difference I(1)	
Ln(GDPagricultural)	-0.958 (0.763)	- 10.007*** (0.000)	I(1)	-2.906 (0.166)	-9.945*** (0.000)	I(1)
Ln(SUPPORTagricultural)	-0.974 (0.995)	-13.557*** (0.000)	I(1)	-1.435 (0.841)	-5.706*** (0.000)	I(1)
Ln(LOANagricultural)	0.339 (0.912)	-3.395** (0.014)	I(1)	-1.765 (0.710)	-3.549* (0.042)	I(1)

(**Notes:** The symbols*,**,and *** respectively indicate that the variables are significant at the significance level of 1%, 5% and 10%. Selection of lags and deterministic terms are based on akaike criterion.)

(**Source:** Author's estimation)

The determination of the lag length in TVP-VAR models based on different information criteria is crucial for the reliability and performance of the model. Thus, various information criteria, including LogL, LR, FPE, AIC, SC, and HQ, have been used to determine the information criteria used in model selection, and they are presented in Table 3.

Table 3. Criteria for Selecting Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-7.795.630	NA	0.000283	0.342718	0.444772	0.382857
1	1.809.962	353.6101*	9.39e-07*	-5.364959*	-4.956743*	-5.204406*
2	1.873.447	1.128.621	1.02e-06	-5.280.784	-4.566.406	-4.999.816
3	1.916.854	7.303.397	1.19e-06	-5.132.870	-4.112.330	-4.731.486
4	1.951.856	5.555.903	1.44e-06	-4.958.274	-3.631.571	-4.436.475
5	1.994.093	6.301.959	1.70e-06	-4.806.644	-3.173.779	-4.164.430
6	2.028.440	4.797.742	2.08e-06	-4.629.969	-2.690.942	-3.867.340
7	2.143.958	1.503.570	1.98e-06	-4.710.979	-2.465.790	-3.827.935
8	2.244.685	1.215.112	2.00e-06	-4.745.031	-2.193.680	-3.741.572

(**Note:** * denotes a significance level of 5%.) (**Source:** Author's estimation)

As seen in Table 3, the appropriate lag length has been suggested as 1 according to 5 different information criteria (LR, FPE, AIC, SC, HQ). Therefore, the appropriate lag length has been determined as 1 in the estimation stage.

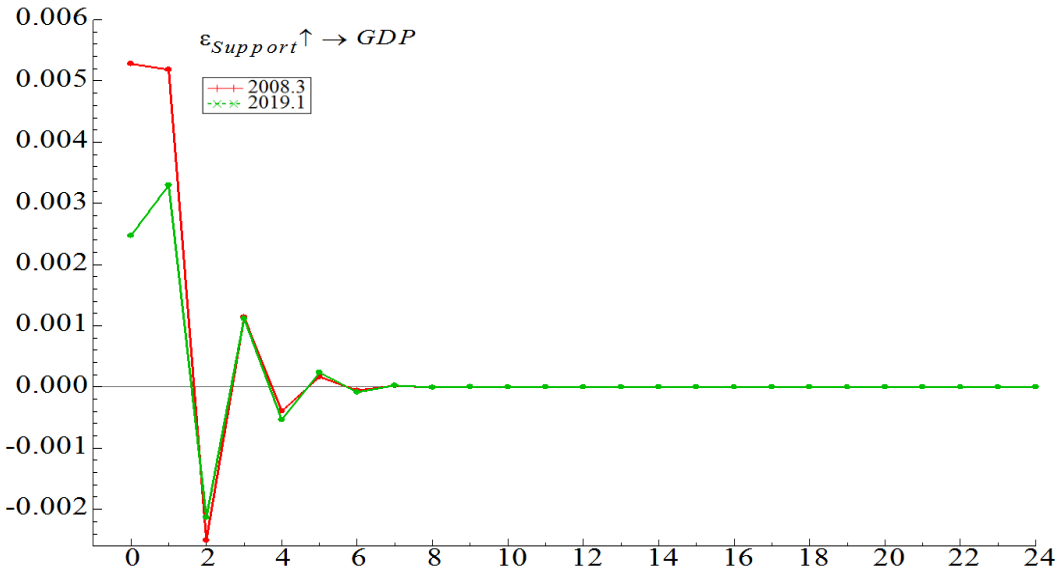


Figure 1. Constant VAR Model (Impulse Responses)

(**Source:** Author's estimation)

The average response of agricultural GDP to a standard deviation positive shock in agricultural support is estimated using the fixed VAR model and presented in Figure 2 after estimating the parameters in the study. The red and green lines respectively indicate the 2008 global financial crisis period and the 2019 coronavirus pandemic period. As seen in Figure 2, the impact of positive shocks in agricultural support on agricultural GDP is quite similar both during the 2008 global crisis period and the 2019 pandemic period. In both crisis periods, it is observed that in response to a shock in the agricultural support variable, agricultural GDP decreases until the end of the 2nd period. However, it is observed that it increases towards the initial equilibrium level with the 3rd period. In this way, it is seen that the responses fluctuate below and above the starting level, continuing until the end of the 6th period. The impact of a positive shock in agricultural support on agricultural GDP stabilizes after the 6th period. Additionally, it has been determined that the reaction is more significant during the 2008 global crisis period compared to the 2019 coronavirus pandemic period.

Table 4. Estimation of selected parameters in TVPVAR Model

Parameter	Mean	Standart Deviation	95%L	95%U	Geweke (Convergence Diagnostics)	Inefficiency
S_{b1}	0.0119	0.0009	0.0102	0.0139	0.001	4.13
S_{b2}	0.0116	0.0009	0.0099	0.0135	0.772	1.34
S_{a1}	0.0754	0.0269	0.0384	0.1375	0.087	7.40
S_{a2}	0.0799	0.0273	0.0430	0.1439	0.088	33.14
S_{h1}	0.6342	0.1493	0.3696	0.9588	0.687	10.97
S_{h2}	0.2466	0.1214	0.0813	0.5426	0.181	15.42

(**Note: T**he means, standard deviations, 95% credible intervals (upper and lower bounds) in the estimation results of the selected parameters in the TVP-VAR model, convergence diagnostics, and the number of inefficient samples are included as part of the diagonal elements of the covariance matrices. $S_{b1}= (\sum\beta)_1$, $S_{b2}= (\sum\beta)_2$, $S_{a1}= (\sum\alpha)_1$, $S_{a2}= (\sum\alpha)_2$, $S_{h1}= (\sum h)_1$, $S_{h2}= (\sum h)_2$) (**Source:** Author's estimation)

Following the estimation results of the fixed VAR model, Table 4 presents the Geweke (1992) Convergence Diagnostics convergence test statistics and inefficiency factor findings for the TVP-VAR model, which includes the parameter results. it can be seen that all inefficiency factor values are less than 100, indicating that the selected sample is effective in parameter estimation (Nakajima, 2011) upon examining the parameter estimation results in Table 4. Moreover, the average values of the parameters fall within the 5% confidence intervals. This result implies that the coefficient estimation values of the parameters are reliable within the 5% confidence interval.

Consequently, the TVP-VAR model has been effectively adapted to the sample dataset, and the obtained parameter estimations are based on a reliable foundation. This supports the reliability and significance of the impulse response function results and the overall findings of the analysis.

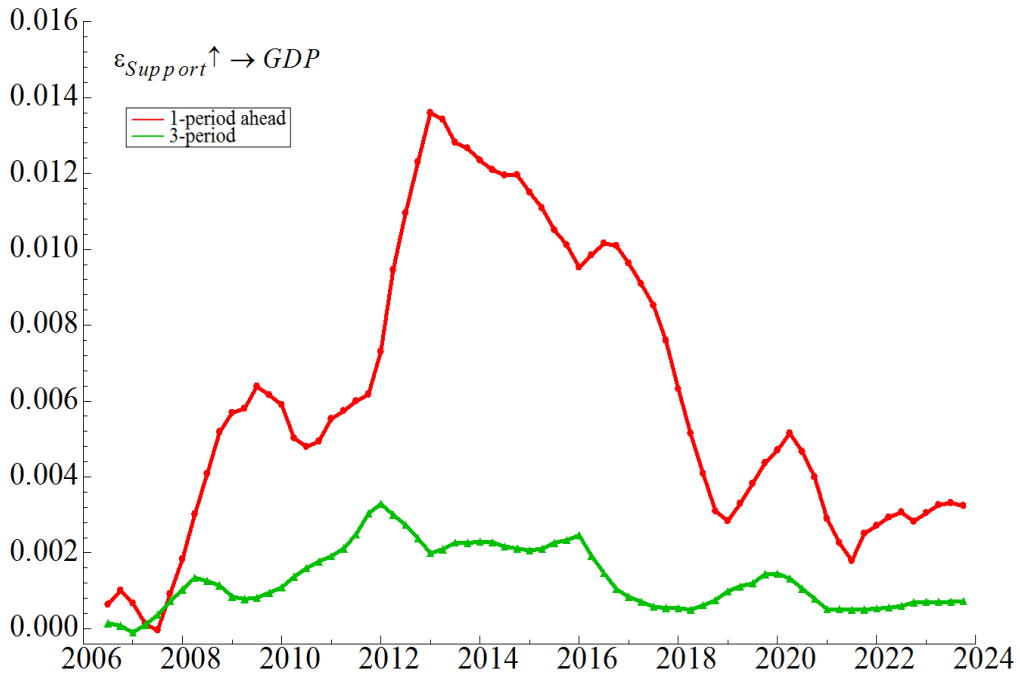


Figure 3: TVPVAR Model (Time Varying Impulse Responses)

(**Source:** Author's estimation)

After the parameters of the TVP-VAR model have been estimated, the time-varying relationships between agricultural support, agricultural credit, and agricultural GDP variables have been evaluated using impulse response functions. The time-varying response of agricultural GDP to a standard deviation positive shock in agricultural support has been estimated using the TVP-VAR model and has been presented in Figure 3. The time-varying responses of agricultural GDP to positive shocks in agricultural support in the first and third quarters have been shown by the red and green lines, respectively. Based on the impulse response functions of the TVP-VAR model, the transition effect from agricultural support to agricultural GDP has been found to be positive. Accordingly, positive shocks in agricultural support have increased agricultural GDP. The highest positive response of agricultural GDP to agricultural credit shocks during the study period has been calculated as 1.4%. Additionally, it has been found that the transition effect from agricultural support to agricultural GDP has gradually decreased since 2014.

5. CONLUSION

The transition effect from agricultural supports allocated from the central government budget to agricultural GDP in Turkey has been examined in this study. The effect of agricultural support shocks on agricultural GDP has been evaluated for the first time using TVP-VAR model. For this purpose, quarterly data between 2006:Q1-2023:Q3 have been used, and the changing structure for each period has been predicted. In the predictions, 10,000 iterations have been performed to ensure the convergence of parameters. Furthermore, structural breaks that occurred during the analysis period have been considered in VAR models. First, it has been determined whether all variables in the vector of internal variables are stationary. The stationarity of all variables in the first differences indicates that the TVP-VAR model is more effectively applicable and enhances the model's predictive ability. Furthermore, the TVP-VAR model has been found to estimate effectively in the sample, and its parameter estimates have been deemed reliable. The parameters have been estimated using VAR models after the variables have been transformed by taking the natural logarithms and first difference. When the impulse response functions of the TVP-VAR model have been examined, it has been found that the transition effect from agricultural supports to agricultural GDP has been positive during the period 2006-2022. Positive shocks in agricultural supports have increased agricultural GDP throughout the research period. The highest positive response of agricultural GDP to agricultural support shocks during the study period has been calculated as 1.4%. Another noteworthy result is the gradual decrease in the transition effect since 2014. It has been determined that although the amount of agricultural support has increased quantitatively during this period, the transition effect has decreased while increasing.

Based on the results obtained from the study, it is recommended to increase the share of agricultural supports in the national income to the level of other developing countries and to distribute them more effectively. In this situation, it is essential to increase support for technology-focused production to increase agricultural productivity. Furthermore, increasing support for agricultural inputs that will provide a competitive advantage in strategic markets is also thought to increase Turkey's competitiveness. It is believed that policies should be developed to enable both large and small agricultural enterprises to benefit more effectively from supports.

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