THE IMPACT OF AGRICULTURAL SUPPORT POLICIES ON AGRICULTURAL PRODUCTION IN TÜRKİYE

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66

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Anahtar Kelimeler:
Tarımsal Teşvikler,
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Türkiye Ekonomisi,
ARDL.

ABSTRACT

In this study, we investigate the impacts of agricultural support on agricultural produc-tion in the Turkish economy. We use annual data from 1994 to 2023. In this context, we examine the effects of agricultural subsidies, agricultural credits, agricultural employment and fixed capital formation in the agricultural sector on agricultural production. We apply ARDL approach, which consists of the estimation of ARDL model, error correction model and ARDL bounds tests for cointegration. According to our results, agricultural employment does not have any significant impact, and fixed capital formation and agricultural credits have significant positive impacts on agricultural production. Agricultural subsidies exhibit a relatively lower effect on agricultural production, implying that credits are more efficient than subsidies. The results also indicate that the production imbalances caused by short-term shocks in the agricultural sector quickly recover within a year. Our findings imply that agricultural support policies should be organized with a comprehensive approach that prioritizes credit access and reevaluates the allocation of subsidies. The effectiveness and efficiency of the implemented policies should be carefully monitored by policymakers. Therefore, a balanced and strategic agricultural support approach is essential for promoting a sustainable and productive agricultural sector.

ÖZ

Bu çalışmada, Türkiye ekonomisinde tarımsal desteklerin tarımsal üretim üzerindeki etkileri araştırılmaktadır. Çalışmada 1994-2023 dönemini kapsayan yıllık veriler kullanılmıştır. Bu kapsamda, tarımsal sübvansiyonlar, tarımsal krediler, tarımsal istihdam ve tarım sektöründeki sabit sermaye oluşumunun tarımsal üretim üzerindeki etkileri incelenmiştir. Uygulamada ARDL yaklaşımı (ARDL modeli, hata düzeltme modeli ve ARDL sınır testi) kullanılmıştır. Çalışmanın sonuçlarına göre, tarımsal istihdamın tarımsal üretim üzerinde anlamlı bir etkisi bulunmamaktadır; buna karşılık sabit sermaye oluşumu ile tarımsal kredilerin tarımsal üretim üzerinde anlamlı pozitif etkileri vardır. Tarımsal sübvansiyonlar, tarımsal üretim üzerinde daha düşük bir etkiye sahiptir; bu da kredilerin sübvansiyonlardan daha verimli olduğuna işaret etmektedir. Sonuçlar ayrıca, tarım sektöründe kısa vadeli şokların neden olduğu üretim dengesizliklerinin bir yıl içinde hızla düzeldiğini göstermektedir. Bu bulgular doğrultusunda, tarımsal destek politikaları, kredi erişimini önceliklendiren ve potansiyel olarak sübvansiyonların tahsisini yeniden değerlendiren kapsamlı bir yaklaşımla düzenlenmesi gerekmektedir. Uygulanan politikaların etkinliği ve verimliliği politika yapıcılar tarafından dikkatlice izlenmelidir. Bu nedenle, sürdürülebilir ve üretken bir tarım sektörünün teşvik edilmesi için dengeli ve stratejik bir tarımsal destek yaklaşımı esastır.

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INTRODUCTION

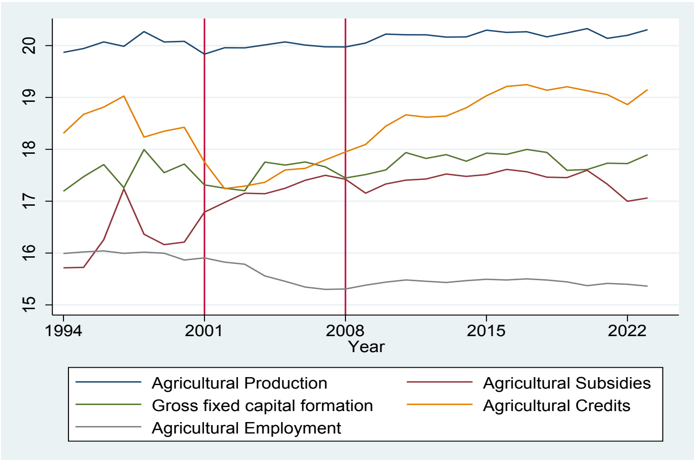
Agricultural production is highly dependent on natural conditions and lacks sufficient division of labor and specialization. This leads governments to implement various support policies for the agricultural sector. The main purpose of these policies is to stabilize the incomes of the agricultural producers, and to ensure food security. The agricultural sector's vulnerability to unpredictable and unavoidable natural risks necessitates interventions to protect producers' incomes, to maintain stability in agricultural production, and to guarantee food security. Therefore, evaluating the efficiency of these support policies is essential.

Government support is crucial for stabilizing market prices, ensuring food security, and promoting rural development. Such support helps farmers adopt new technologies, increase productivity, mitigate risks associated with weather and market fluctuations, and improve overall agricultural productivity. In developing countries, where agricultural production is the primary source of income, agricultural support makes substantial contributions to employment, especially in rural areas. Agriculture continues to play a crucial role in the development of industry and services in the later stages of economic development despite its diminishing share in the economy. Even countries with high levels of development provide substantial financial support to the agricultural sector due to its strategic importance.

The specific implementation of these policies can vary significantly across countries and over time. For instance, Türkiye reduced its agricultural subsidy budget and shifted towards privatization policies, limiting the state's role in the sector particularly in the 1990s under the structural adjustment programs of the IMF and the World Bank. In the early 2000s, new regulations were introduced to align with the EU's Common Agricultural Policy, such as Direct Income Support (DIS) and rural development projects. While the DIS implementation and the Farmer Registration System (FRS) made significant contributions to the institutionalization and sustainability of the sector, they also led to a decrease in the production share of small farmers. With the termination of the DIS system in 2009, the area-based support system was implemented, which aimed to support the production of pre-determined products on an input basis.

The share of the agricultural sector in GDP gradually decreased in Türkiye, falling from 15% in 1995 to 9% in 2010, and further to 6.2% in 2023. A similar decline was observed in agricultural employment, with the share of agriculture in total employment falling from 41% in the 1990s to 23.3% in 2009 and 14.8% in 2023. However, the agricultural sector remains important in the Turkish economy due to its fundamental functions.

Figure 1 demonstrates the trend of the variables in the agriculture sector for the Turkish economy from 1994 to 2023. The variables are real values and in logarithmic form. Agricultural production appears to have followed a steady path, while agricultural employment has decreased gradually in this period. The increasing mechanization in agriculture, the small-scale structure of agricultural land ownership, and the impact of migration from rural areas to urban areas confirm this fact. Agricultural credits have been on a downward trend in the late 1990s and have gradually increased after the structural reforms in financial sector implemented after the 2001 banking crisis. In the early 2000s, the agricultural support policies were restructured with the stand-by agreement signed with the IMF. This restructuring has induced agricultural subsidies to show limited growth until 2008 and has moved horizontally after 2008 with a slight decline in recent years. Following 2008, the observed trends in the agricultural subsidy payments and credits indicate a policy shift towards relying on bank credits rather than public resources to finance agriculture. Agricultural fixed capital investments, on the other hand, have generally followed a balanced path, although they have shown some increases and decreases over the years.



Note: Red lines indicate 2001 Turkish financial crisis and 2008 Global financial crisis. The variables are in real values and in logarithmic form.

Figure 1. Trends of Variables

In this study, we investigate the impacts of agricultural support on agricultural production for Turkish economy. We use yearly data from 1994 to 2023. In this context, we examine the effects of agricultural subsidies, agricultural credits, agricultural employment, and fixed capital formation in the agricultural sector on agricultural production. In our empirical model, we use real values, and the variables are in logarithmic form. We apply ARDL estimation approach. In our estimation process, we first determine the stationary levels and lag structure for the empirical model. Then, we estimate the ARDL model and error correction model to reveal long-run relationships and short-run dynamics. In the final stage of the application, we implement ARDL bounds test for cointegration and apply several diagnostic tests to see if our estimates are robust.

The remaining sections of this study are organized as follows. Section 2 reviews empirical literature. Section 3 introduces the methods applied. Section 4 exhibits empirical results, and Section 5 concludes the study.

LITERATURE

In the empirical literature, the impacts of agricultural subsidies on agricultural production have been widely studied for Turkish economy using various models. Erdal and Erdal (2008) investigate the relationship between the prime payments, and the production of cotton, sunflower, soybean, canola, corn and safflower for Türkiye from 1980 to 2006 using Granger causality analysis. According to their findings, there is one-way causal relationship from the prime payments to the canola production, and a two-way causal relationship between prime payments and the corn production. Erdal and Erdal (2008) find no causal relationship between prime payments and the production of cotton, sunflower, and soybean. Uzmay (2009) investigates the impact of deficiency payments and support purchases on the cotton production using partial equilibrium for Türkiye between 1990 and 2006. Her results indicate that both support policies lead to an increase in cotton production. Furthermore, Uzmay (2009) points out that support purchases are more costly in terms of budget burdens, whereas deficiency payments are more beneficial in terms of consumer welfare. Terin et al. (2013) examine the factors that affect the agricultural sector in Türkiye between 1990 and 2012 using Johansen cointegration technique. The results of their study demonstrate that total fixed capital investments in agriculture, agricultural subsidies, and the share of agriculture in GDP have positive effects on agricultural growth, while the increase in the number of people employed in the agricultural sector has a negative effect on agricultural growth.

Işık and Bilgin (2016) use the Johansen cointegration technique to analyze the effects of agricultural subsidies on agricultural product production in Türkiye between 1986 and 2015. According to their findings, agricultural subsidies increase agricultural production in general, and market price support plays a significant role in this increase. Demirdöğen et al. (2016) evaluate the effects of agricultural output and input support on the cotton and corn production in Adana province between 2008 and 2012. The results of the study show that both types of support have positive effects on production, but input support is more effective than deficiency payments. Yılmaz and Çobanoğlu (2017) investigate the effects of different agricultural subsidies implemented in Türkiye between 1986 and 2015 on the value of agricultural production using the ordinary least squares (OLS) method. Their findings demonstrate that market price support, variable input use, and marketing and agricultural support have positive effects on agricultural production. Şaşmaz and Özel (2019) evaluate the effects of agricultural subsidies on the development of the agricultural sector in Türkiye between 1980 and 2016 using the ARDL and Toda-Yamamoto causality methods. The ARDL analysis reveals that agricultural subsidies do not play a statistically significant role in the development of the agricultural sector. Causality analyses, on the other hand, show that there is a one-way causal relationship from developments in the agricultural sector to agricultural subsidies.

Bulut (2020) examines the effects of area-based direct supports and deficiency payments on agricultural production in Türkiye during the 2002-2018 period using the panel ARDL analysis. His findings indicate that both types of support have a positive and statistically significant effect on agricultural production. However, deficiency payments have a relatively stronger positive effect on agricultural production compared to area-based direct support, both in the short and long term. Akça and Altuntaş (2022) analyze the effects of agricultural subsidies on agricultural output in Türkiye with data from 1991 to 2019 using ARDL and Toda-Yamamoto causality tests. Their research reveals that agricultural subsidies do not have a statistically significant effect on agricultural output. Gezer and Gezer (2022) examine the effects of support and credits provided to the agricultural sector on agricultural production in Türkiye with the NARDL model with quarterly data from the 2006Q1-2021Q3 period. The results obtained from the research indicate that while agricultural supports and credits increase production in the short term, positive support shocks decrease production in the fourth lag period. In the long term, on the other hand, the positive and negative shocks of agricultural support decrease agricultural production, and these findings reveal that agricultural support does not have permanent effects and that there are structural problems in the agricultural sector. Oğul (2022) analyzes the relationship between agricultural subsidies and agricultural production in the Turkish economy from 2006Q1 to 2021Q3 using ARDL bounds test approach. According to her findings, agricultural subsidies reduce agricultural production in the short-term while increasing in the long-term. Merdan (2023) evaluates the economic factors that have impact on agricultural growth with the regression analysis using yearly data from the 2000 to 2022. In his study, agricultural subsidies, agricultural fixed capital investments of the public and private sectors, the share of agriculture in GDP and agricultural employment are examined. The findings reveal that agricultural subsidies and fixed capital investments have a positive effect on growth, while agricultural employment has a negative effect on growth.

Our study differs from previous empirical research on the Turkish economy by jointly examining the effects of subsidies and credits alongside fundamental production factors.

METHOD

This study examines the determinants of agricultural production in Turkish economy for the 1994-2023 period. The empirical model is in the form of a production function:

$$AP_t = f(AS_t, GFC_t, AC_t, AE_t) \quad (1)$$

$$AP_t = \beta_0 AS_t^{\beta_1} GFC_t^{\beta_2} AC_t^{\beta_3} AE_t^{\beta_4} e^{\varepsilon_t} \quad (2)$$

AP_t is the agricultural production at the given year t and the dependent variable in the empirical model. AS_t is the agricultural subsidies, GFC_t is the gross fixed capital formation in agriculture, AC_t is the agricultural credit measure and AE_t is the agricultural employment level at the given time t. β_k are the estimated coefficients for each independent variable and ε_t is the error term. The nominal values in the model are converted into real values using the domestic producer price index (D-PPI).

$$\log AP_t = \beta_0 + \beta_1 \log AS_t + \beta_2 \log GFC_t + \beta_3 \log AC_t + \beta_4 \log AE_t + \varepsilon_t \quad (3)$$

The data used in the study are yearly data and obtained from the Central Bank of the Republic of Türkiye (CBRT) Electronic Data Delivery System (EVDS), Turkish Statistical Institute (TurkStat), Presidency of Strategy and Budget (SBB) and Banks Association of Türkiye (TBB). The variables are introduced in Table 1, and descriptive statistics are provided in Table 2.

Table 1: The Units and Sources of the Variables

Abbreviation	Variables	Unit	Source
AP	Agricultural Production	Thousand TRY	EVDS
AS	Agricultural Subsidies	Thousand TRY	EVDS
GFC	Gross fixed capital formation in agriculture	Thousand TRY	SBB
AC	Agricultural Credits	Thousand TRY	TBB
AE	Agricultural Employment	Thousand	TurkStat

Table 2: Descriptive Statistics

Variable	Observation	Mean	Std Dev.	Min.	Max.
AP	30	20.11	0.137	19.835	20.328
AS	30	17.07	0.558	15.715	17.612
GFC	30	17.66	0.242	17.192	17.997
AC	30	18.46	0.632	17.242	19.247
AE	30	15.60	0.259	15.299	16.041

In this study, the effects of the determinants of agricultural production in Türkiye are analyzed by the ARDL approach with ARDL bounds test for cointegration and error correction model. The following two conditions must be met in order to apply ARDL model. First, the integration order of the variables must be I(1). This is only possible when the dependent variable is stationary at first difference I(1) and independent variables are I(0) or I(1). Second, the variables should be cointegrated (Pata & Isik, 2021). The existence of an equilibrium relationship between a dependent variable y_t and a set of independent variables with K elements $x_t=(x_{1t},x_{2t},\ldots,x_{Kt})'$ is expressed as follows:

$$y_t = b_0 + b_1 t + x_t'\theta + e_t \qquad (4)$$

Here, b_0 represents the intercept of the regression model and b_1 represents the slope coefficient of the linear time trend. The data represents observations over time, $t=1,2,\ldots,T$. If the error term is not stationary due to the non-stationarity states of the y_t and x_t variables, a spurious regression problem will arise when the coefficients are estimated by the ordinary least squares (OLS) method in such a static model. The model (4) continues to be a valid regression model if some of or all the variables independent x_t and dependent y_t are cointegrated when y_t and x_t are individually individually I(1) . However, a linear combination of these variables yields a stationary error term (Kripfganz & Schneider, 2023). Equation (4) shows the conditional long-term equilibrium relationship. Although it describes the long-run equilibrium, it is necessary to consider additional dynamic factors to understand the process's behavior during periods of disequilibrium.

To solve the problems arising from such a static model, we need to expand the regression equation with the lagged values of the dependent and independent variables. In this case, we can add a set of z_t exogenous variables with L elements. Here, although the selected z_t variables affect the short-term fluctuations of y_t, they will not affect the long-term equilibrium path. Following Kripfganz and Schneider (2023), a complete dynamic model is established with the model expanded in this way:

$$y_t = c_0 + c_1 t + \sum_{i=1}^{p} \phi_i y_{t-i} + \sum_{i=0}^{q} \beta_i' x_{t-i} + \gamma' z_t + u_t \qquad (5)$$

$$t = 1 + p^*, \ldots, T$$

Equation (5) is a standard ARDL *(p,q,…,q)* model with an intercept c_0, linear trend $c_1 t$ and lagged values of $p\epsilon(1,p^*)$ and $q\epsilon(0,p^*)$. We posit that the ARDL model (5) contains sufficient lags to address residual serial correlation. This ensures they act as long-run forcing variables, meaning there is no instantaneous or contemporaneous feedback from y_t to x_t. Once the optimal lag orders p and q are found, then we can utilize the model by setting p*=max(p,q). In the presence of a stable long-run relationship, standard asymptotic theory is applicable for statistical inference on the coefficients, even if some variables are non-stationary (Pesaran & Shin, 1998).

To gain a better insight from the regression coefficients, we can express the ARDL model in an error correction representation (Hassler & Wolters, 2006):

$$\Delta y_t = c_0 + c_1 t - \alpha(y_{t-1} - \theta x_{t-1}) + \sum_{i=1}^{p-1} \psi_{yi} \Delta y_{t-i} + \omega' \Delta x_t + \sum_{i=1}^{q-1} \psi_{xi}' \Delta x_{t-i} + \gamma' z_t + u_t$$

$$\alpha = 1 - \sum_{i=1}^{p} \phi_i \text{ and } \theta = \sum_{j=0}^{q} \beta_j / \alpha \qquad (6)$$

The deviations from the hypothesized long-run relationship between y_t and x_t from equation (4), $e_{t-1}=y_{t-1}- \theta x_{t-1}$, can be found again in the error correction model (6) if we ignore the intercept and linear trend. The speed-of-adjustment parameter α indicates the rate of convergence of y_t to its long-run equilibrium after a disruption. A value of $\alpha=1$ signifies instantaneous adjustment in the subsequent period, in the absence of short-run fluctuations. A value of $\alpha=0$ suggests that the process will not revert to its equilibrium. The values of α between 0 and 1 represent a partial adjustment mechanism, where the equilibrium gap is reduced gradually over time (Kripfganz & Schneider, 2023).

ESTIMATION RESULTS

In the first stage of our application process, we apply unit root tests to identify the stochastic properties of the variables. Augmented Dickey-Fuller (1981) (ADF) unit root test is employed, and results are given in Table A.1 in the appendix. ADF test determines if a variable follows a unit-root process. The null hypothesis posits a unit root, while the alternative suggests a stationary variable. The results in the first column contain a constant term, while the results in the second columns contain a constant term and a trend. According to results, the dependent variable AP is I(1) at the 5% significance level, but I(0) at the 10% level. For the remaining variables, GFC is I(0) and AS, AC and AE are I(1). As the results indicate, all the variables are either I(0) or I(1). In this situation, we are able proceed with the ARDL approach since none of the variables are I(2). Following this, an unrestricted intercept is included ($c_0 \neq 0$) but time trend is excluded ($c_1 = 0$). This is appropriate if y_t appears to be trending in an I(1) process with drift under the null hypothesis. The alternative hypothesis implies that is trend stationary or cointegrated with x_t.

Tablo 3: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)
AP	1.000				
AS	0.452	1.000			
GFC	0.765	0.366	1.000		
AC	0.684	0.161	0.471	1.000	
AE	-0.453	-0.816	-0.440	-0.145	1.000

Table 3 demonstrates the correlation matrix and reveals that agricultural production is in positive correlation with gross fixed capital formation, agricultural credit, and agricultural subsidies. It also shows a negative correlation between agricultural employment and agricultural production.

Table 4: Optimal Lags

Lag	LL	LR	df	p-value	AIC	SBIC
0	16.653				-0.832	-0.594
1	103.408	173.51	25	0.000	-5.243	-3.816
2	137.059	67.302	25	0.000	-5.861	-3.245
Autocorrelation Test	**chi2**		**df**		**Prop>chi2**	
Durbin-Watson	0.202		1		0.6543	

According to Table 4, the Akaike Information Criterion (AIC) recommends that the ARDL model should be estimated at the second lag, whereas Schwarz Bayesian Information Criterion (SBIC) recommends for the first lag. The ARDL model is established by SBIC which provides fewer lags since our data consists of annual observations. Moreover, according to the Durbin-Watson (1971) autocorrelation test, there is no autocorrelation problem at the first lag. The Log-Likelihood (LL) and the df (degrees of freedom) results support the first lag criterion and p-value shows that selected lags are statistically significant.

Table 5 presents the ARDL long-run estimation results using OLS estimator with a restriction at the first lag. Results indicate that AS L.1, GFC and AC have positive and statistically significant impacts on agricultural production. AS, AP L.1 and AE do not appear to have any significant impact on the real agricultural output.

Table 5: ARDL Results

ARDL Model (1,1,0,0,0)	Coefficients
AP L.1	*-0.071 (0.162)*
AS	*-0.032 (0.056)*
AS L.1	*0.124 (0.055)***
GFC	*0.186 (0.830)***
AC	*0.114 (0.031)****
AE	*0.063 (0.103)*
Constant	*13.601 (3.483)****
Observation	29
R2	0.781
F (6,22): 13.04 (0.000)	

Note: ****, ** and * indicate a 1%, 5% and 10% significance, respectively.*

Tablo 6: Error Correction Model

Error Correction Model (1,1,0,0,0)	Coefficients
Speed of adjustment (ADJ)	
AP L1.	*-1.072 (0.162)****
Long-Run (LR)	
AS	*0.086 (0.047)**
GFC	*0.174 (0.077)***
AC	*0.106 (0.023)****
AE	*0.059 (0.095)*
Short-Run (SR)	
AS D1.	*-0.124 (0.055)***
Constant	*13.601 (3.483)****
Observation	29
R2	0.702

Note: ****, ** and * indicate a 1%, 5% and 10% significance, respectively.*

The error correction model (ECM) examines the process of returning to long-term equilibrium by analyzing both short-run and long-run relationships. The results from ECM are displayed in Table 6 and the coefficients are divided into three categories. The ECM is useful for making predictions and separating long-term relationships from short-term dynamics. Long-term coefficients are shown under Long-Run (LR), short-term coefficients under Short-Run (SR) and the speed of adjustment under Speed of adjustment (ADJ). Long-term coefficients represent the equilibrium effects of independent variables on the dependent variable. In the presence of cointegration, it corresponds to the negative cointegration coefficients once the dependent variable's coefficient is normalized. Under LR, it shows how much a 1% permanent increase in the coefficients of the independent variables affects real agricultural output in the long run. According to this, a 1% increase in AS, GFC and AC positively affects real agricultural output in the long run by 0.086%, 0.174% and 0.106%, respectively. On the other hand, the effect of agricultural employment is found to be statistically insignificant in the long run.

Short-term coefficients are shown in the SR output section and account for short-term fluctuations not caused by deviations from the long-term equilibrium. According to the findings, agricultural subsidies have a negative effect on agricultural production in the short term at the 5% level. In other words, a 1% increase in agricultural subsidies in the short run reduces real agricultural production by 0.124%. This shows that agricultural subsidies have an inverse effect on agricultural production in the short run.

The error correction coefficient is negative and reported in the ADJ section. Accordingly, the coefficient of the AP L1. variable is estimated as -1.072 and is found to be statistically significant at the 1% level. This shows how strongly the dependent variable AP reacts to the deviation from the equilibrium relationship in a period, in other words, how quickly such an equilibrium disruption is corrected. According to the ADJ result, short-run imbalances quickly disappear and the system returns to its long-term equilibrium.

We need to apply ARDL bounds test for cointegration to interpret the results obtained from Table 6 if there exists a long-run relationship. The bounds test does not directly indicate cointegration among the independent variables themselves. A rejection of the bounds test null hypothesis always means that there is evidence for a long-run relationship including the dependent variable.

Tablo 7: ARDL Bounds Test for Cointegration

Test Statistics	Significance	Critical Values	
	F-statistics	**I (0)**	**I(1)**
8.988	1%	5.029	6.963
	5%	3.433	4.897
	10%	2.790	4.090
	p-value	0.000	0.002
	t-statistics	I (0)	I(1)
-6.593	1%	-3.719	-5.044
	5%	-2.937	-4.117
	10%	-2.563	-3.672
	p-value	0.000	0.001

Table 7 presents the results of the Pesaran et al. (2001) ARDL bounds test, based on the critical values determined by Kripfganz and Schneider (2020). With the bounds test procedure, we can draw a definitive conclusion without knowing the degree of integration of the variables, whether it is I(0) or I(1) (Pesaran et al., 2001). The bounds test examines the existence of a long-term relationship based on the error correction representation of the ARDL model. There is a long-run relationship between the independent and dependent variables in the ARDL model according to the calculated F-statistic and t-statistic values. In the presence of a long-term relationship, the coefficients estimated in the ARDL model are reparametrized using the error correction model.

The reliability and stability of the coefficients are revealed as a result of the CUSUM test. In Figure 2, the 95% confidence intervals of the CUSUM tests result are given. The test based on recursive residuals does not reject the null hypothesis of parameter stability at the 5% significance level. Accordingly, there is no structural break in the ARDL boundary test model and the coefficient results in the model follow a stable path.

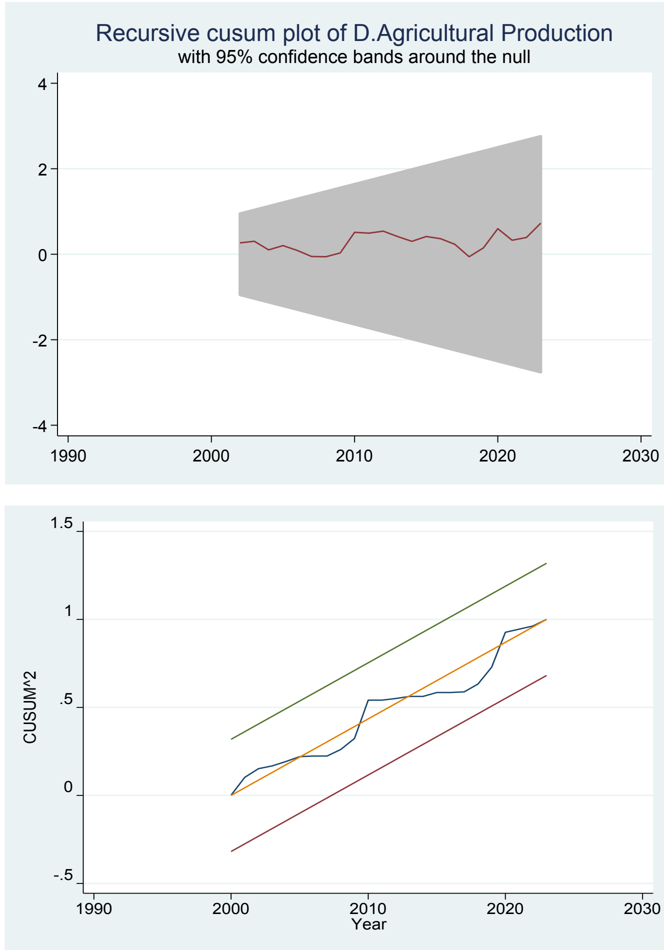


Figure 2. CUSUM and CUSUMSQ plots for Parameter Stability

Diagnostic tests are tools used to test the validity of a model's assumptions. Table 8 lists the diagnostic tests that examine whether the estimated model is stable. The heteroskedasticity, kurtosis and skewness of the model are checked with the Cameron and Trivedi (1990) test. The results indicate that there is no heteroskedasticity, kurtosis and skewness problem in the analysis. Similarly, according to the heteroskedasticity test developed by Breusch and Pagan (1979) the errors are homoscedastic. According to the Durbin-Watson (1971) autocorrelation test, there is no autocorrelation in the model. And Ramsey RESET (1969) test result suggests that there is no omitted variable error in the model.

Tablo 8: Diagnostic Tests

Method	chi2	df	p-value
Heteroskedasticity	28.170	27	0.402
Skewness	7.970	6	0.240
Kurtosis	0.540	1	0.462
	chi2	**df**	**Prop>-chi2**
Durbin-Watson	0.202	1	0.6543
	chi2	**Prop>-chi2**	
Breusch-Pagan	0.25	0.6195	
	F (3, 19)	**Prop>F**	
Ramsey	1.26	0.3152	

CONCLUSION

In this study, we investigate the impacts of agricultural support on agricultural production for Turkish economy using annual data from 1994 to 2023. For our analysis, we employ ARDL estimation approach which consists of ARDL model, error correction model, and ARDL bounds test for cointegration. Our results from the ARDL model indicate that agricultural credits, fixed capital formation in agriculture and the first lag of agricultural subsidies have statistically significant positive effects on agricultural production. In the same model, agricultural employment, agricultural subsidies, and the first lag of agricultural production do not have statistically significant effects on agricultural production. For the error correction model, agricultural credits (at 1% level), fixed capital formation in agriculture (at 5% level), and agricultural subsidies (at 10% level) have positive effects on agricultural production in the long run. But agricultural subsidies have a negative impact on agricultural production in the short run. These results suggest that agricultural support through credit is more efficient and in a stable structure than agricultural subsidies. This finding is in line with Gezer and Gezer's (2022) and Oğul's (2022) results.

Agricultural employment does not have any impact on agricultural production in the error correction model. Beyond this, along with our bivariate correlation analysis, Merdan (2023) and Terin et al. (2013) find that agricultural employment has a negative impact on agricultural production for Türkiye. These findings suggest that there is a negative correlation between agricultural employment and agricultural production since agricultural employment has decreased while agricultural productivity has increased in the 1994-2023 period. But our results from the ARDL model and error correction model propose that these revealed negative relationship from other estimations could only be circumstantial and not statistically significant. The error correction coefficient of the model shows how quickly the short-term shock will be corrected in the long term, and it is expected that this value will be negative and significant. According to the analysis, the error correction coefficient is estimated as -1.072 and is found to be significant at the 1% level. The fact that the error correction coefficient is statistically significant and negative shows that the imbalances in agricultural output tend to quickly return to the long-term equilibrium in the short run. Considering the positive effect of fixed capital investments made in agriculture, entrepreneurs should be encouraged to increase investments to be made in the agricultural sector, the bureaucracy in this area should be simplified, and appropriate project-based grants and loans should be offered. The project-based grants and loans should be audited, and their effectiveness and efficiency should be carefully measured.

Agricultural support plays a crucial role in shaping production levels and ensuring food security. These interventions can stimulate investment, encourage innovation, and alleviate risks. However, the design and implementation of these supports must be carefully monitored to avoid unintended consequences such as market distortions. Therefore, a balanced and strategic approach to agricultural support is essential for promoting a sustainable and productive agricultural sector.

REFERENCES

Akça, H., & Altuntaş, H. (2022). Tarımsal desteklerin tarımsal çıktı üzerindeki etkisi: Türkiye için ampirik bir analiz. *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *31*(2), 560–572. https://doi.org/10.35379/cusosbil.1125443

Breusch, T. S., & Pagan, A. R. (1979). A simple test for heteroscedasticity and random coefficient variation. *Econometrica*, *47*(5), 1287. https://doi.org/10.2307/1911963

Bulut, E. (2020). *Türkiye'de uygulanan tarımsal destekleme politikalarının üretim etkisi* [PhD]. İstanbul Universitesi.

Cameron, A. C., & Trivedi, P. K. (1990). *The information matrix test and its implied alternative hypotheses*.

Demirdöğen, A., Olhan, E., & Chavas, J.-P. (2016). Food vs. fiber: an analysis of agricultural support policy in Turkey. *Food Policy*, *61*, 1–8. https://doi.org/10.1016/j.foodpol.2015.12.013

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*, *49*(4), 1057. https://doi.org/10.2307/1912517

Durbin, J., & Watson, G. S. (1971). Testing for serial correlation in least squares regression.III. *Biometrika*, *58*(1), 1–19. https://doi.org/10.1093/biomet/58.1.1

Erdal, G., & Erdal, H. (2008). Türkiye'de tarımsal desteklemeler kapsamında prim sistemi uygulamalarının etkileri. *Gaziosmanpaşa Üniversitesi Ziraat Fakültesi Dergisi*, *25*(1), 41–51.

EVDS Data Central. (n.d.). Central Bank of the Republic of Turkey. Retrieved July 7, 2024, from https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket

Gezer, T., & Gezer, M. A. (2022). Tarımsal destek ve kredilerin tarımsal üretim üzerindeki etkinliği. *Türk Tarım ve Doğa Bilimleri Dergisi*, *9*(4), 1102–1113. https://doi.org/10.30910/turkjans.1151057

Hassler, U., & Wolters, J. (2006). Autoregressive distributed lag models and cointegration. *Allgemeines Statistisches Archiv*, *90*(1), 59–74. https://doi.org/10.1007/s10182-006-0221-5

Işık, H. B., & Bilgin, O. (2016). The effects of agricultural support policies on agricultural production: the case of Turkey. *2nd Multidisciplinary Conference*, 111–119. https://doi.org/10.19275/RSEPCONFERENCES017

Kripfganz, S., & Schneider, D. C. (2020). Response surface regressions for critical value bounds and approximate p-values in equilibrium correction models1. *Oxford Bulletin of Economics and Statistics*, *82*(6), 1456–1481. https://doi.org/10.1111/obes.12377

Kripfganz, S., & Schneider, D. C. (2023). ardl: estimating autoregressive distributed lag and equilibrium correction models. *The Stata Journal: Promoting Communications on Statistics and Stata*, *23*(4), 983–1019. https://doi.org/10.1177/1536867X231212434

Merdan, K. (2023). Türkiye'de tarımsal büyümeye etki eden ekonomik faktörler (bir regresyon analizi). *KMÜ Sosyal ve Ekonomik Araştırmalar Dergisi (KMUSEKAD)*, *25*(45), 1125–1142.

Oğul, B. (2022). Tarımsal destekler ve tarımsal üretim ilişkisi: Türkiye ekonomisi üzerine ampirik bulgular. *Tarım Ekonomisi Araştırmaları Dergisi*, *8*(1).

Pata, U. K., & Isik, C. (2021). Determinants of the load capacity factor in China: a novel dynamic ARDL approach for ecological footprint accounting. *Resources Policy*, *74*, 102313. https://doi.org/10.1016/j.resourpol.2021.102313

Pesaran, M. H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters*, *58*(1), 17–29. https://doi.org/10.1016/S0165-1765(97)00214-0

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289–326. https://doi.org/10.1002/jae.616

Ramsey, J. B. (1969). Tests for specification errors in classical linear least-squares regression analysis. *Journal of the Royal Statistical Society Series B: Statistical Methodology*, *31*(2), 350–371. https://doi.org/10.1111/j.2517-6161.1969.tb00796.x

Şaşmaz, M. Ü., & Özel, Ö. (2019). Tarım sektörüne sağlanan mali teşviklerin tarım sektörü gelişimi üzerindeki etkisi: Türkiye örneği. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*, *61*, 50–65.

SBB. (n.d.). Presidency of Strategy and Budget. Retrieved September 9, 2024, from https://www.sbb.gov.tr/wp-content/uploads/2018/11/Sekt%C3%B6rler-%C4%B0tibar%C4%B1yla-Sabit-Sermaye-Yat%C4%B1r%C4%B1mlar%C4%B1-Toplam.pdf

TBB Data Query System. (n.d.). Banks Association of Türkiye. Retrieved July 7, 2024, from https://verisistemi.tbb.org.tr/index.php?/tbb/report_bolgeler

Terin, M., Aksoy, A., & Güler, İ. O. (2013). Tarımsal büyümeye etki eden ekonomik faktörlerin belirlenmesi üzerine bir çalışma. *Iğdır Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, *3*(3), 41–50.

TurkStat. (n.d.). Turkish Statistical Institute Data Portal for Statistics. Retrieved September 9, 2024, from https://data.tuik.gov.tr/Kategori/GetKategori?p=Istihdam,-Issizlik-veUcret-108

Uzmay, A. (2009). Türkiye'de pamukta uygulanabilir destekleme araçlarından destekleme alımı ve fark ödeme sisteminin refah etkileri: kısmi denge analizi. *Ege Üniversitesi Ziraat Fakültesi Dergisi*, *46*(1), 53–62.

Yılmaz, H. İ., & Çobanoğlu, F. (2017). Türkiye'de tarım sektörünü desteklemeye yönelik sağlanan çeşitli araçların tarımsal üretim değeri üzerine etkilerinin analizi. *Tarım Ekonomisi Dergisi*, *23*(2), 145–155. https://doi.org/10.24181/tarekoder.364880

Author Contributions

All the authors have equal contributions.

APPENDIX

Table A.1: ADF Unit Root Test Results

Variables	Constant	Constant and Trend
AP	-2.576	-3.790
	(0.0981)*	(0.0171)**
1%	-3.723	-4.343
5%	-2.989	-3.584
10%	-2.625	-3.230
ΔAP	-7.669	-7.510
	(0.0000)***	(0.0000)***
1%	-3.730	-4.352
5%	-2.992	-3.588
10%	-2.626	-3.233
AS	-2.753	-2.341
	(0.0653)*	(0.4116)
1%	-3.723	-4.343
5%	-2.989	-3.584
10%	-2.625	-3.230
ΔAS	-5.133	-5.544
	(0.0000)***	(0.0000)***
1%	-3.730	-4.352
5%	-2.992	-3.588
10%	-2.626	-3.233
GFC	-3.860	-4.523
	(0.0024)***	(0.0014)***
1%	-3.723	-4.343
5%	-2.989	-3.584
10%	-2.625	-3.230
ΔGFC	-8.589	-8.417
	(0.0000)***	(0.0000)***
1%	-3.730	-4.352
5%	-2.992	-3.588
10%	-2.626	-3.233
AE	-1.234	-0.999
	(0.6587)	(0.9442)
1%	-3.723	-4.343
5%	-2.989	-3.584
10%	-2.625	-3.230
ΔAE	-3.774	-3.843
	(0.0032)***	(0.0145)**

1%	-3.730	-4.352
5%	-2.992	-3.588
10%	-2.626	-3.233
AC	-0.890	-1.450
	(0.7914)	(0.8455)
1%	-3.723	-4.343
5%	-2.989	-3.584
10%	-2.625	-3.230
ΔAC	-4.396	-4.472
	(0.0003)***	(0.0017)***
1%	-3.730	-4.352
5%	-2.992	-3.588
10%	-2.626	-3.233
Note: The p-values in parentheses indicate the stationarity levels and higher p-values indicate that the variable contains a unit root. .		