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Research Article
(Araştırma Makalesi)

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Anahtar sözcükler: Tarımsal kredi, tarımsal hammadde ihracatı, tarımsal hammadde ithalatı, tarımsal destek, tarımsal katma değer, ARDL sınır testi

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The impact of agricultural support, credit, and raw material trade on agricultural value added in Türkiye

Türkiye'de tarımsal destek, kredi ve hammadde ticaretinin tarımsal katma değer üzerindeki etkisi

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ABSTRACT

Objective: This study aims to examine the impact of agricultural support, credit, and agricultural raw material imports and exports on agricultural value-added in Türkiye using annual data spanning 1988-2022.

Material and Methods: In the study, the stationarity properties of the variables were tested using the ADF and the Fourier ADF unit root test. Long-term and short-term relationships in the established model were determined using the ARDL bounds test.

Results: According to the long-run findings of the study, increases in agricultural support, agricultural raw material imports and exports increase agricultural value added. On the other hand, agricultural credits affect agricultural value added negatively in the long run and positively in the short run. In the long-run findings, the effect of variables other than agricultural raw material exports on value added is statistically significant.

Conclusion: This research is important in determining the structural problems of agriculture in Türkiye. In this framework, increasing agricultural supports and imports of agricultural raw materials, which are seen to increase agricultural value added, and questioning the utilization areas and effectiveness of agricultural credits that reduce value added can be presented as policy recommendations.

ÖZ

Amaç: Bu çalışmanın amacı, 1988-2022 dönemine ait yıllık verileri kullanarak Türkiye'de tarımsal destek, kredi ve tarımsal hammadde ithalat ve ihracatının tarımsal katma değer üzerindeki etkisini incelemektir.

Materyal ve Metot: Çalışmada değişkenlerin durağanlık özellikleri ADF ve Fourier ADF birim kök testi kullanılarak sınanmıştır. Kurulan modeldeki uzun ve kısa dönemli ilişkiler ARDL sınır testi kullanılarak belirlenmiştir.

Araştırma Bulguları: Çalışmanın uzun dönem bulgularına göre tarımsal destek, tarımsal hammadde ithalatı ve ihracatındaki artışlar, tarımsal katma değeri artırmaktadır. Tarımsal krediler ise tarımsal katma değeri uzun dönemde negatif, kısa dönemde ise pozitif etkilemektedir. Uzun dönem bulgularında, tarımsal hammadde ihracatı dışındaki değişkenlerin katma değer üzerindeki etkisi istatistiksel olarak anlamlıdır.

Sonuç: Bu araştırma Türkiye'de tarımın yapısal sorunlarının tespiti açısından önemlidir. Bu çerçevede, tarımsal katma değeri artırdığı görülen tarımsal desteklerin ve tarımsal hammadde ithalatının artırılması, katma değeri azaltan tarımsal kredilerin kullanım alanlarının ve etkinliğinin sorgulanması politika önerileri olarak sunulabilir.

INTRODUCTION

The rapidly increasing global population and climate change have raised questions about the continuity of supply-demand balance in the agricultural sector, while recent technological advancements have fundamentally changed agricultural production patterns and brought significant gains in agricultural productivity/value addition. Countries that can effectively utilize the opportunities presented by advancements in production technologies and integrate into global value chains are offered significant opportunities, whereas those that fail to keep pace face various problems such as sustainability concerns, increasing dependence on imports, and low value-added production. All these developments have prompted countries to reconsider their traditional agricultural policies and develop new agricultural policy tools focused on agricultural technologies, digitalization, R&D activities, foreign trade, and productivity/value addition (Tümen & Özertan, 2020). In most developing countries, the agricultural sector, which is a determinant of national development and a strategic component of economies, functions to provide food for the population, create employment, promote rural development, encourage the conservation of natural resources, and contribute to the development of other sectors in ensuring sustainability of both economic and social activities (Bresciani & Valdes, 2007; FAO, 2009; Popescu, 2013; WTO, 2014; Domagała, 2021).

Coltrain et al. (2000) describe adding value as "the process of economically adding value by changing the current place, time, and form characteristics of a product into preferred characteristics in the market." The driving force behind the pursuit of increasing agricultural value-added is to increase revenues from agricultural production and to enhance employment and investment opportunities in agricultural production areas. Within this framework, it is argued that there are two ways to increase value-added. The first is to increase the efficiency of agricultural production, thereby widening the margin between gross output value and input cost; the second is to change the form, function, quantity, or other product or process characteristics that increase the margin between gross output value and input cost (Lambert et al., 2006). Improvements in agricultural value-added serve as a significant engine for economic growth and development by creating an increase in agricultural productivity. Moreover, this increase in productivity also promotes the development of agriculture-based industries (Timmer, 2002). The agricultural sector plays a critical role in reducing rural poverty and increasing the income levels of the rural population, particularly in developing countries, by creating productivity growth. Consequently, income distribution inequalities between rural and urban areas can also be reduced (Johnston & Mellor, 1961; Wickramasinghe, 2017). On the other hand, the increase in agricultural value-added contributes to securing food supply and reducing fluctuations in food prices (Dorward, 2013). Agricultural value-added can significantly affect a country's trade balance. High-value agricultural product exports can increase export revenues, help reduce trade deficits and enhance economic stability. Agricultural development and increased value-added in agriculture can lead to stronger trade performance and greater resilience to external economic shocks (World Bank, 2008).

The development of the global division of labor worldwide has shifted agricultural trade from single-country production to multi-country production with the increasing role of the agricultural global value chain (Chen & Zhang, 2023). In this context, the trade of agricultural raw materials plays a significant role in the global agricultural value chain. The import and export of agricultural raw materials significantly impact the foreign exchange inflows and outflows of countries. Since these products constitute a substantial share of many countries' imports and exports, understanding their impact on foreign exchange is crucial for policymakers and stakeholders in the agricultural sector. A country with abundant natural resources that can be used as raw materials can achieve higher agricultural value-added per GDP due to increased exports (Sansika et al., 2023). It is argued that the export of agricultural raw materials facilitates the integration of small farmers into global markets, that export markets encourage farmers to produce higher quality products, and as a result, agricultural value-added increases (Barrett et al., 2012). Moreover, agricultural exports are

said to promote modernization in the agricultural sector, and this process can contribute to overall economic growth by increasing agricultural values (Gollin et al., 2002). Valdés and Foster (2010), who argue that agricultural exports improve income distribution inequalities, also assert that agricultural exports stimulate economic activities in rural areas, thereby increasing agricultural value-added and overall welfare. Agricultural raw material imports can also affect agricultural value-added through various channels. Imports can increase agricultural value-added and ensure food security by reducing production costs and increasing agricultural productivity and efficiency (Sarris et al., 1999; Anderson and Martin, 2005; Sansika et al., 2023). Additionally, imports are argued to increase agricultural value-added by facilitating access to technological innovations and modern agricultural practices (Anderson & Martin, 2005; Swinnen & Vranken, 2010).

Due to production instabilities, prices, and incomes, agriculture needs to be supported in many countries. The high dependence of agricultural production on ecological and biological conditions, uncertainties in production, the low price elasticity of demand and supply for agricultural products, farmers' inability to adopt technological innovations, the requirement of specific expertise for activities such as storage, preservation, processing, and distribution of products, the lack of planning regarding input costs like labor, seeds, fertilizers, and feed, the small and scattered nature of agricultural production areas, the weak bargaining power of a producer group unaware of market developments against a few organized traders in the market, and the decreasing relative importance of agriculture in economies are among many factors that necessitate the support of the agriculture sector by governments (Filiz, 1983). The impact of agricultural support on agricultural value-added has been examined in various academic studies, and generally, such supports have been found to increase agricultural productivity, improve incomes, and contribute to rural development (De Gorter & Swinnen, 2002; Fan et al., 2008; Swinnen, 2010). On the other hand, agricultural supports are criticized for disrupting market mechanisms, affecting natural supply and demand balances, causing overproduction and environmental degradation, and encouraging producers to use inefficient production methods (Lankoski & Ollikainen, 2003; Anderson & Martin, 2005; Baylis et al., 2008).

In the process of agricultural development, agricultural support policies such as cash subsidies, credits, and tax advantages can make agriculture competitive, improve investments, and ensure the sustainable continuation of agriculture by increasing resource allocation and profitability (Özdemir, 2024). At this point, the credits provided to the agricultural sector are of great importance. These credits play a significant role in increasing agricultural value-added by promoting productivity and economic growth, enabling farmers to increase their production capacities, thereby enhancing both production volume and product quality, facilitating access to modern agricultural technologies and inputs, increasing productivity, ensuring the financial stability of producers, and helping them manage risks better, thus allowing for more sustainable and profitable production (Feder et al., 1990; Binswanger & Khandker, 1995; Zeller & Sharma, 2000; Reyes et al., 2023). On the other hand, it should be remembered that the misuse or overuse of agricultural credits can lead to financial crises by placing farmers under debt burdens, that when directed towards inefficient investments, the expected productivity increase may not be realized, and that it can cause market imbalances and price fluctuations, which in turn can negatively affect farmers' income stability and agricultural value-added (Carter, 1989; Nuryartono, 2007; Conning & Udry, 2007).

Upon reviewing national and international literature, it was found that there is no current research on the impact of agricultural raw material trade, support, and credits on agricultural value-added using the Turkish sample. Motivated by this gap, the present study was conducted. The study employs an annual dataset from the period 1988-2022, using variables thought to affect agricultural value-added in Türkiye, including agricultural support, agricultural specialty credits, and agricultural raw material imports and exports. The stationarity properties of the variables were determined using the Augmented Dickey-Fuller (ADF) test and the Christopoulos & León-Ledesma (2010) Fourier ADF unit root tests. The established model addresses long-term and short-term relationships using the Autoregressive Distributed Lag (ARDL) approach.

In the literature, the determinants of agricultural value added are identified using various econometric methods with samples from countries/country groups and regions. In these studies, agricultural value added is used as the dependent variable in the regression model, while a different number and variety of economic,

financial, and agricultural indicators are used as independent variables. In this context, summaries of some studies where the variables of this research are included in regression models are presented in Table 1.

Table 1. Literature summary

Çizelge 1. *Literatür özeti*

Research	Sample/Period	Method	Independent Variables	Findings
Iqbal et al. (2003)	Pakistan / 1971-72 to 2001-2002	Multiple regression analysis	Agricultural credit, agricultural labour force, water availability, agricultural area	The relationship between credits and agricultural value added is positive and significant.
Saleem & Jan (2011)	Pakistan/1990-2008	Multiple regression analysis	Fertilizer, medicine, irrigation, tractor and agricultural credit	Agricultural credit has positively affected agricultural value added.
Aktaş et al. (2015)	12 OECD member countries/1995-2010	Panel data analysis	Agricultural support	Agricultural support has been found to increase agricultural value added.
Chisasa &Makina (2015)	South Africa /1970-2011	Johansen and Juselius cointegration test, Error correction model and Granger causality test	Agricultural credit, rainfall, capital formation, labour force	Agricultural credits affect agricultural value added negatively in the short run and positively in the long run.
Udoka et al. (2016)	Nigeria/1970-2014	Multiple regression analysis	Agricultural credit, government expenditure on agriculture, agricultural credit guarantee scheme fund and interest rate	The increase in agricultural credits and government expenditures on agriculture have a positive effect on agricultural value added.
Akyol (2018)	Brazil, China, Mexico, South Africa and Türkiye /2000-2016	Panel simultaneous system of equations	Agricultural support, GDP, agricultural raw material imports	The increase in agricultural support has a positive effect on agricultural value added.
Şaşmaz & Özel (2019)	Türkiye/1980-2016	ARDL bounds and Toda-Yamamoto causality tests	Real GDP per capita growth rate and agricultural support	In the long run, agricultural supports have no significant effect on agricultural value added.
Bakari (2019)	Tunisia, Morocco and Egypt /1965-2016	Johansen cointegration test and Vector Error Correction Model	Agricultural exports and raw material imports	In the long run, imports of agricultural raw materials positively affect the agricultural value added.
Koç et al. (2019)	Türkiye/2004-2014	Spatial panel model	Agricultural employment, number of tractors, amount of fertilizer, amount of pesticides, agricultural credit and support	Increases in agricultural credit and supports have positive and negative effects on agricultural value added, respectively.
Igberi et al. (2020)	Nigeria/1987-2015	ARDL bounds test	Agricultural credit, agricultural support, agricultural credit guarantee fund value and interest rate.	In the long run, agricultural support and credits have a positive effect on agricultural value added.
Bahşi & Çetin (2020)	Türkiye/1998-2016	Bayer and Hanck and Gregory Hansen cointegration tests, VECM Granger causality, OLS regression, FMOLS and DOLS estimators	Agricultural credits	Agricultural credits have a positive effect on agricultural value added.
Nugroho et al. (2021)	17 Emerging countries / 2006-2018	Panel data analysis	Exchange rate, foreign direct investment, agricultural exports, agricultural import taxes, fertilizer imports	Foreign direct capital inflows and agricultural exports increase agricultural value added.

Table 1. Continued

Çizelge 1. *Devamı*

Research	Sample/Period	Method	Independent Variables	Findings
Kaya & Kadanalı (2022)	Türkiye/2003Q1-2018Q4	Engle-Granger cointegration test, Toda-Yamamoto causality test and DOLS estimator	Agricultural credits	Agricultural credits have a positive effect on agricultural value added.
Akça & Altuntaş (2022)	Türkiye/1991-2019	ARDL bounds test, FMOLS and DOLS estimators and Toda-Yamamoto causality test	Agricultural support and GDP per capita	Agricultural support does not have a statistically significant effect on agricultural value added.
Oğul (2022)	Türkiye/1990-2020	Johansen cointegration test, FMOLS, DOLS and CCR estimators	Agricultural credits	The increase in agricultural credits supports agricultural value added.
Elfira et al. (2022)	Indonesia/2007-2021	Multiple regression model	Agricultural exports, imports and exchange rate	The increase in exports has a positive effect on the value added to the agricultural sector, while the import variable has no significant effect.
Gezer &Gezer (2022)	Türkiye/2006Q1-2021Q3	Nonlinear ARDL (NARDL)	Agricultural support and credit	In the short run, increases in agricultural support and credits increase agricultural value added. In the long run, both positive and negative shocks of agricultural support decrease the agricultural value added. Positive shocks of agricultural credit increase the value added, while negative shocks decrease it.
Özşahin & Güven (2023)	6 Emerging Economies/1991-2018 and 1995-2018	Static panel data analysis	Agricultural employment, per capita income, agricultural support, agricultural land, government stability and imports of agricultural raw materials	Agricultural employment, agricultural land, government stability and imports of agricultural raw materials have positive and per capita income have negative significant effects on value added. The effect of agricultural support on agricultural value added is positive but statistically insignificant.
Sansika et al. (2023)	101 countries/2000-2021	Panel data regression	Fertilizer consumption, agricultural employment, imports and exports of agricultural raw materials, trade, exchange rate and foreign direct investment	Agricultural employment, exchange rate and foreign direct investments have a positive effect on agricultural value added.
Özşahin et al. (2023)	6 Emerging countries /2002-2018	Panel Simultaneous Equation Systems	Agricultural support, land and employment	There is a simultaneous positive and statistically significant relationship between agricultural value added and agricultural supports.

MATERIALS

The study utilizes an annual frequency data set for the period 1988-2022, with each variable consisting of 35 observations. The availability of annual agricultural credits was crucial in selecting the study's period range. Summary information of the variables used in the study is presented in Table 2.

Table 2. Summary information of variables

Çizelge 2. *Değişkenlerin özet bilgileri*

Variable	Short Code	Source
Agriculture, forestry, and fishing, value added (% of GDP)	AVA	WB
Agricultural support (% of GDP)	AS	OECD
Agriculture credits (% of total credits)	AC	BAT
Agricultural raw materials imports (% of merchandise imports)	ARMI	WB
Agricultural raw materials exports (% of merchandise exports)	ARME	WB

Note: WB-World Bank; OECD-Organisation for Economic Co-operation and Development; BAT-The Banks Association of Türkiye

The original model, the formal representation of which is given in equation (1), was developed by following Koç et al. (2019), Igberi et al. (2020), Bahşi and Çetin (2020), Sansika et al. (2023), Özşahin and Güven (2023).

$$AVA_t = a_0 + a_1 AS_t + a_2 AC_t + a_3 ARMI_t + a_4 ARME_t + \varepsilon_t \quad (1)$$

Time series plots of the variables are presented in Figure 1. When examining the graphs of all variables, it is observed that they exhibit a decreasing trend over the years.

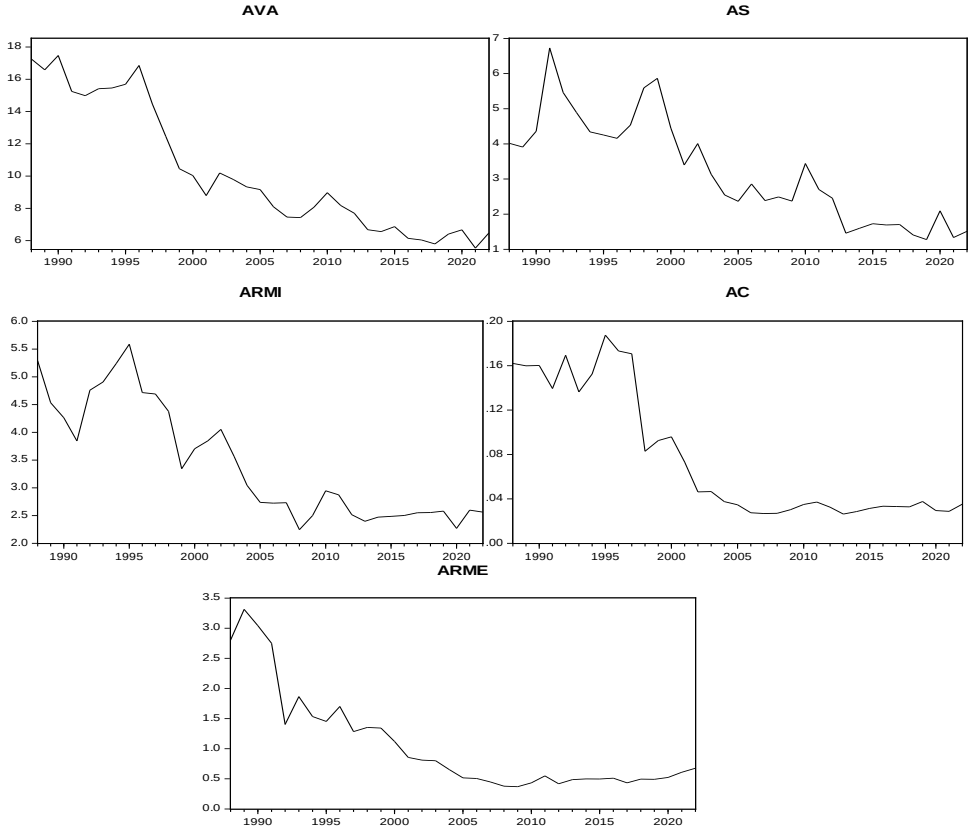


Figure 1. Time series plots of variables.

Şekil 1. *Değişkenlerin zaman serisi grafikleri.*

Descriptive statistics of the study are presented in Table 3. It is observed that the variables showing the highest and lowest means are agricultural value added and agricultural raw material exports, respectively. The variables with the highest and lowest deviations from the mean are agricultural credits and agricultural raw material exports, respectively. According to the Jarque-Bera normality test, all variables except agricultural raw material exports exhibit normal distribution at the 5% significance level.

Table 3. Descriptive statistics

Çizelge 3. *Tanımlayıcı istatistikler*

	AVA	AS	AC	ARMI	ARME
Mean	10.2482	3.2146	7.5838	3.4283	1.0550
Median	8.9669	2.8600	3.7539	2.9464	0.6540
Maximum	17.4762	6.7300	18.7523	5.5871	3.3132
Minimum	5.5337	1.2770	2.6295	2.2453	0.3687
Standard Deviation	3.9745	1.4732	5.8005	1.0328	0.8213
Skewness	0.6166	0.4924	0.7752	0.6067	1.4634
Kurtosis	1.8501	2.3162	1.8706	1.9399	4.1219
Jarque-Bera (JB) Statistic	4.1460	2.0965	5.3658	3.7864	14.3295
JB Probability Value	0.1258	0.3505	0.0683	0.1505	0.0007

METHODS

Stationarity means that the mean, variance, and autocovariance of a series are constant over time (Gujarati & Porter, 1999). Stationarity is an important requirement for establishing meaningful relationships between economic variables (Tarı, 2010). In time series analyses, the stationarity characteristics of variables can influence the progression of the research and the types of cointegration or causality tests that may be applied. In this research, the stationarity characteristics of the variables were determined using the Augmented Dickey-Fuller (ADF) test and the Christopoulos & León-Ledesma (2010) Fourier ADF unit root tests. Although there are many tests available in the time series literature for testing the stationarity of variables, the pioneers of this process are the studies by Dickey & Fuller (1979, 1981). The unit root test procedure pioneered by Dickey and Fuller (1979) tests whether a series has a unit root. If the error terms of the series exhibit autocorrelation, this issue is mitigated by using the lagged values of the series. In the ADF test, the lagged value of the dependent variable is included as an independent variable in the model. In the ADF test developed because of Dickey and Fuller's (1979, 1981) studies, the stationary properties of the series are tested using constant and constant/trend models presented in Equations (2) and (3). In the following model equations, Δ represents the difference operator, t denotes time, and p represents the lag length. In the test, the null hypothesis $H_0: \gamma = 0$ suggests that the series has a unit root, while the alternative hypothesis $H_1: \gamma \neq 0$ indicates that the series is stationary. If the absolute value of the ADF test statistic is smaller than the critical values, it is concluded that the series is not stationary.

Model with constant term:

$$\Delta y_t = \alpha + \gamma\, y_{t-1} + \sum_{j=1}^{p} \delta_j\, \Delta y_{t-j} + \epsilon_t \qquad (2)$$

Model with constant term and trend:

$$\Delta y_t = \alpha + \gamma\, y_{t-1} + \beta_t + \sum_{j=1}^{p} \delta_j\, \Delta y_{t-j} + \epsilon_t \qquad (3)$$

Some time series may also contain sudden jumps or drops. Perron (1989) suggested that sudden jumps and drops could lead to structural breaks in series and initiated the process of unit root testing that allows for structural breaks. In his study, Perron (1989) stated that if structural breaks are not considered when testing the stationarity of series, a stationary series might be modelled as non-stationary. In such cases, inferences and predictions from the regression model could be erroneous. Many unit root tests have been developed, considering whether a time series may contain one or more structural breaks and whether the break date is known or unknown. Seeing the determining the number and dates of shocks that cause structural breaks is a major challenge, Becker et al. (2004) developed the Fourier approach, which allows for the modelling of structural breaks when their form is unknown. In this process,

Christopoulos & León-Ledesma (2010) contributed by advancing the unit root testing process based on Fourier functions, developing the Fourier ADF unit root test. The Fourier ADF is a form of the classical ADF unit root test that allows for Fourier functions. In the test, which consists of two stages, firstly, the regression model in Equation (4) is considered.

$$y_t = \delta_0 + \delta_1 \sin\left(\frac{2\pi kt}{T}\right) + \delta_2 \cos\left(\frac{2\pi kt}{T}\right) + v_t \quad (4)$$

Here, t is the deterministic trend, k is the number of frequencies and T is the number of observations. The main hypothesis of the test is presented in Equation (5). It is assumed that h_t follows a stationary process with zero mean. A three-step procedure is required to calculate the test statistic.

$$H_0: v_t = \mu_t, \quad \mu_t = \mu_{t-1} + h_t \quad (5)$$

In the first step of the procedure, the appropriate k value should be found. This k value is the value that minimises the sum of residual squares. In the next process, the residuals of the model are obtained by Equation (6).

$$\widehat{v_t} = y_t - [\hat{\delta}_0 + \hat{\delta}_1 \sin\left(\frac{2\pi \hat{k}t}{T}\right) + \delta_2 \cos\left(\frac{2\pi \hat{k}t}{T}\right)] \quad (6)$$

The unit root test is applied to the residuals obtained by Equation (6). The Fourier ADF test is applied by applying the model in Equation (7) below to the residuals.

$$\Delta v_t = \alpha_1 v_{t-1} + \sum_{j=1}^{p} \beta_j \Delta v_{t-j} + \mu_t \quad (7)$$

The null and alternative hypothesis of the Fourier ADF test is expressed in Equation (8).

$$H_0: \alpha_1 = 0, \quad H_1: \alpha_1 < 0 \quad (8)$$

In the last step, the significance of the trigonometric terms is tested with the tests in Equation (9) through the F test. The critical values required for the F test are calculated in Becker et al. (2006). If the null hypothesis indicating the insignificance of the trigonometric terms is accepted, the conventional ADF test is applied instead of the FADF test.

$$H_0: \delta_1 = \delta_2 = 0, \quad H_1: \delta_1 \neq \delta_2 \neq 0 \quad (9)$$

In the study, the ARDL bounds test was used to determine long-term and short-term relationships. The test approach developed by Pesaran et al. (2001) does not require all variables to be stationary of the same order, as in classical cointegration tests. In other words, the condition that variables must be stationary of the same order has been removed, allowing the estimation of long-term and short-term equilibrium relationships whether the variables are I(0) or I(1). Additionally, it can produce more reliable results compared to traditional cointegration approaches even when the sample size is small and there are issues such as autocorrelation, heteroscedasticity, and non-normality in the models. This two-step approach involves, in the first stage, testing the long-term equilibrium relationship in the model. If cointegration is found among the variables, the second stage involves estimating the long-term coefficients and, for the short term, estimating the error correction coefficient within the framework of the error correction model (Pesaran et al., 2001; Narayan & Smyth, 2005).

FINDINGS

The empirical finding process of the study starts by reporting the ADF and Fourier ADF (FADF) unit root tests presented in Table 4.

Table 4. ADF ve FADF unit root tests findings

Çizelge 4. *ADF ve FADF birim kök test bulguları*

Variable	ADF	k (Frequency Number)	FADF	F Statistic	Min SSR
AVA	-1.6101 (0.7678)	1	-3.4109	18.0328	31.7344
AS	-3.6041 (0.0444)	1	-4.4110	4.1011	14.9229
AC	-1.6446 (0.7535)	1	-3.0125	27.8178	111.0601
ARMI	-2.2520 (0.4473)	1	-3.8623	11.8220	4.9119
ARME	-2.3199 (0.4095)	1	-3.4487	39.1845	2.1285
ΔAVA	-3.8142 (0.0297)	5	-4.2442	4.3452	22.7338
ΔAS	-6.0355 (0.0001)	4	-5.4814	1.5378	16.7183
ΔAC	-6.8001 (0.0000)	2	-5.3947	1.1940	119.5345
ΔARMI	-5.6845 (0.0003)	4	-4.8543	3.0761	4.3072
ΔARME	-5.4378 (0.0005)	5	-5.5752	1.0686	2.5430

Note: The values in parentheses represent probability values, and the "Δ" notation indicates the first-order differences of the series. In the ADF and FADF tests, a model with a constant term and trend is used. The critical values for the ADF unit root test are -4.2528 (1%), -3.5484 (5%), and -3.2070 (10%). The Schwarz Information Criterion (SIC) is used in the ADF test. Considering the number of observations in the study, the critical values in the FADF unit root test at frequency k=1 are -5.11 (1%), -4.46 (5%), and -4.15 (10%); at frequency k=2 are -4.83 (1%), -4.16 (5%), and -3.79 (10%); at frequency k=3 are -4.50 (1%), -3.83 (5%), and -3.49 (10%); at frequency k=4 are -4.39 (1%), -3.70 (5%), and -3.36 (10%); and at frequency k=5 are -4.37 (1%), -3.63 (5%), and -3.28 (10%). The critical values used to test the significance of trigonometric terms are 6.873 (1%), 4.972 (5%), and 4.162 (10%).

According to the ADF unit root test results presented in Table 4, the null hypothesis that the value added, credit, import and export variables have unit root cannot be rejected at 5% significance level. This indicates that these variables are non-stationary at their level values and become stationary when their first differences are taken. The rejection of the null hypothesis that the support variable has a unit root indicates that this series is stationary at level. According to the ADF unit root test, the value added, credit, import and export variables are I(1), while the support variable is I(0). According to the findings of the Fourier ADF unit root test, the absolute values of the FADF test statistics calculated at level values are smaller than the critical values determined for different frequency numbers. Therefore, the null hypothesis indicating the existence of a unit root cannot be rejected. This result indicates that the variables have unit root at level values. Furthermore, the significance of the trigonometric terms of the variables needs to be tested. The F-statistic values at level values are greater than the 5% significance level value of 4.972 in the Becker et al. (2006) table, thus the null hypothesis of insignificance of trigonometric terms is rejected. The trigonometric terms of the variables are significant at their level values. In this case, the FADF unit root test with constant term can be applied and reported. As a result, the FADF test shows that all variables are non-stationary (I (1)) at 5% significance level.

The different results obtained from the ADF and FADF unit root tests in the study, due to the variables becoming stationary at different levels, have allowed for the use of the ARDL bounds test in determining long-term relationships. In the ARDL bounds test, it is necessary to identify the model that minimizes the relevant criterion. According to the Akaike Information Criterion, the ARDL (2, 3, 4, 4, 3) model has been identified, as shown in the graph in Figure 2.

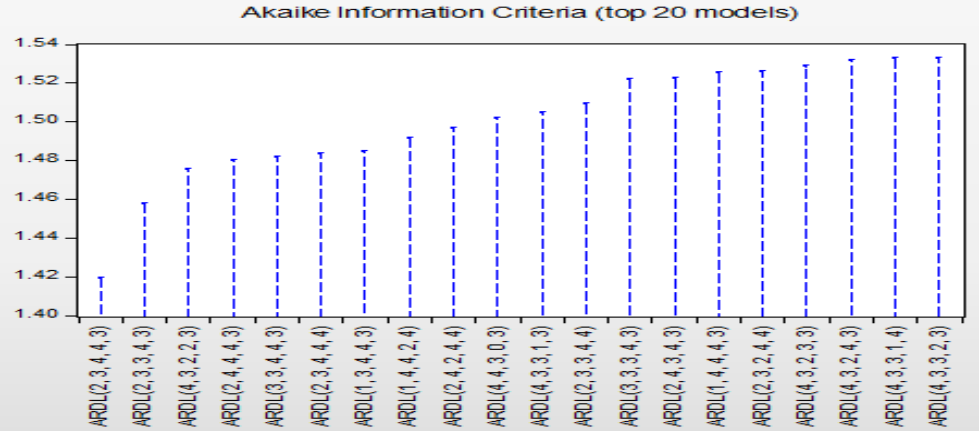


Figure 2. Model selection.

Şekil 2. *Model seçimi.*

In the ARDL (2, 3, 4, 4, 3) model, the Unrestricted Error Correction Model used to test the cointegration relationship is presented with Equation (10).

$$\Delta AVA_t = \beta_0 + \sum_{i=1}^{p=2} \beta_{1i}\,\Delta AVA_{t-i} + \sum_{i=0}^{r=3} \beta_{2i}\,\Delta AS_{t-i} + \sum_{i=0}^{s=4} \beta_{3i}\,\Delta AC_{t-i} + \sum_{i=0}^{k=4} \beta_{4i}\,\Delta ARMI_{k-i} + \sum_{i=0}^{l=3} \beta_{5i}\,\Delta ARME_{l-i} + a_1 AVA_{t-1} + a_2 AS_{t-1} + a_3 AC_{t-1} + a_4 ARMI_{t-1} + a_5 ARME_{t-1} + \varepsilon_t \quad (10)$$

The notation Δ in Equation (10) denotes the difference operator, ε_t denotes the error term, β_0 denotes the constant term, $\beta_{1,2,3,4,5}$ denotes the short-run coefficients, $a_{1,2,3,4,5}$ denotes the long-run coefficients, and p, r, s, k and l denote the lag lengths determined by the information criterion. In the ARDL approach, the F bounds test is used to test the cointegration relationship. In the related test, the alternative hypothesis $H_1: a_1 \neq a_2 \neq a_3 \neq a_4 \neq a_5 \neq 0$ is tested against the null hypothesis $H_0: a_1 = a_2 = a_3 = a_4 = a_5 = 0$. If the F bound test statistic is greater than the upper bound critical value, the null hypothesis H_0, which states that there is no cointegration, is rejected and the existence of cointegration relationship is confirmed. If the F boundary statistic value is below the lower boundary critical value, the null hypothesis of no cointegration is rejected, and if it is between the lower and upper boundary critical values, other tests are applied by causing uncertainty. After the long-run coefficients of the ARDL model are determined, the Error Correction Model is established to determine the short-term relationships. For the error correction mechanism to work, the error correction coefficient (ECT) must be negative and statistically significant. The Error Correction Model is given in Equation (11) and the notation λ in this equation refers to the error correction coefficient that shows how long after the short-run deviations are eliminated in the long run.

$$\Delta AVA_t = \beta_0 + \sum_{i=1}^{p=2} \beta_{1i}\,\Delta AVA_{t-i} + \sum_{i=0}^{r=3} \beta_{2i}\,\Delta AS_{t-i} + \sum_{i=0}^{s=4} \beta_{3i}\,\Delta AC_{t-i} + \sum_{i=0}^{k=4} \beta_{4i}\,\Delta ARMI_{k-i} + \sum_{i=0}^{l=3} \beta_{5i}\,\Delta ARME_{l-i} + \lambda\, ECT_{t-1} + \varepsilon_t \quad (11)$$

The robustness of the ARDL (2, 3, 4, 4, 3) model is checked by diagnostic tests. In the diagnostic test results presented in Table 5, it is seen that the probability values (p) of the tests are greater than the test statistics at 5% significance level. According to these results, the model exhibits a normal distribution

and does not contain serial correlation and changing variance problems. Finally, the Ramsey RESET was used to test whether there is a specification error in the model. The null hypothesis of no model specification error was not rejected at the 5% significance level and as a result, no model specification error was detected.

Table 5. ARDL (2, 3, 4, 4, 3) model diagnostic test results

Çizelge 5. *ARDL (2, 3, 4, 4, 3) modeli tanısal test sonuçları*

Diagnostic Tests	Test Statistic	Probability Value
Breusch-Pagan-Godfrey Test	0.3596	0.9753
Breusch-Godfrey LM Test	2.5112	0.1424
Jarqua-Bera Test	1.3395	0.5118
Ramsey Reset Test	0.1483	0.8854

The findings of the ARDL bounds test are presented in Table 6. The F-statistic for the bounds test is calculated as 5.5257, and since this value is above the upper critical bounds I (1) at the 5% and 10% significance levels, the null hypothesis of no cointegration in the model is rejected. Therefore, the series in the ARDL (2, 3, 4, 4, 3) model are cointegrated at the 5% and 10% significance levels. The model, where the agricultural value-added variable is the dependent variable, and agricultural support, agricultural credits, agricultural raw material imports, and agricultural raw material exports are the independent variables, indicates a long-term relationship.

Table 6. ARDL boundary test results

Çizelge 6*. ARDL sınır test sonuçları*

Test Statistic	Value	Signif.	I (0)	I (1)
F Statistic	5.5257	10%	2.696	3.898
k	4	5%	3.276	4.63
		1%	4.59	6.368

Table 7 presents the long-term and short-term parameter estimates of the model. In the long term, the coefficient of the agricultural support variable (1.1655) is positive and statistically significant; the coefficient of agricultural credits (-0.5228) is negative and statistically significant; the coefficient of agricultural raw material imports (2.3400) is positive and statistically significant; and finally, the coefficient of agricultural raw material exports (4.1214) is positive but statistically insignificant. The long-run coefficient estimates show that a 1% increase in agricultural support, agricultural raw material imports and agricultural raw material exports in Türkiye leads to increases in agricultural value added by approximately 1.46%, 2.34% and 4.12%, respectively. While the increases caused by support and import variables are statistically significant, the effect of exports on value added is insignificant. Moreover, a 1% increase in the amount of agricultural credit in Türkiye leads to a decrease of approximately 0.52% in agricultural value added.

The short-term estimates section in Table 7 presents the error correction model results. For the dependent variable agricultural value-added, there is a negative and statistically insignificant effect of its own lagged value up to one period. This situation technically indicates that changes in agricultural value added in the previous period do not have a significant effect on the current period. The negative sign may suggest that an increase in agricultural value added in the previous period tends to lead to a decrease in the following period. However, the fact that this effect is statistically insignificant implies that interpreting this relationship has limited value. In other words, this negative relationship could be random and does not hold significant meaning within the model. In the short term, agricultural support has a statistically significant positive effect on agricultural value-added, while the two-period lagged effect of support turns

negative. Although agricultural support increases agricultural value added in the short term, the fact that this effect turns negative with a two-period lag suggests that support may create sustainability issues in the long term or that the positive effect diminishes rapidly. This indicates that the impact of agricultural support changes over time and should be carefully monitored. Agricultural credits are observed to have a positive impact on agricultural value-added up to their own and three lagged values in the short term. This effect is statistically significant up to two lags, but the third lag is insignificant. Although agricultural credits have a positive effect on agricultural value added in the short term, this effect is strong and significant for two periods. However, in the third period, this effect weakens or disappears. This indicates that while credits support short-term increases in production and value added, their impact diminishes in the long run. Lastly, agricultural raw material imports and exports are seen to have a positive effect on agricultural value-added; however, the effect of imports is statistically insignificant, while the effect of exports is significant. Although the effect of agricultural raw material imports on value added is positive, it is statistically insignificant, meaning that the contribution of imports in this area is not distinct. On the other hand, the positive and significant effect of agricultural exports on value added indicates that exports play an important role in the short-term increase of agricultural value added. The error correction coefficient of the model (CointEq (-1) = -0.7844) is negative and statistically significant, indicating that the error correction mechanism is functioning. This result shows that short-term shocks or disequilibria will be corrected by approximately 78% in the following period. Short-term disequilibria (1/0.7844) are observed to resolve and reach long-term equilibrium after approximately 1.27 years.

Table 7. Long and short-term estimates

Çizelge 7*. Uzun ve kısa dönem tahminler*

Variable	Coefficient	Standard Error	T Statistic	Probability Value
		Long Term Estimates		
AS	1.4655	0.3761	3.8962	0.0030***
AC	-0.5228	0.2708	-1.9304	0.0824*
ARMI	2.3400	0.8849	2.6443	0.0246**
ARME	4.1214	2.5041	1.6458	0.1308
		Short Term Estimates		
C	-1.8573	0.2760	-6.7278	0.0001***
D (AVA (-1))	-0.1949	0.1200	-1.6235	0.1355
D (AS)	1.2907	0.2123	6.0797	0.0001***
D (AS (-1))	-0.1052	0.1328	-0.7923	0.4465
D (AS (-2))	-0.3724	0.1090	-3.4143	0.0066***
D (AC)	0.2268	0.0507	4.4733	0.0012***
D (AC (-1))	0.7271	0.0946	7.6800	0.0000***
D (AC (-2))	0.3599	0.0919	3.9147	0.0029***
D (AC (-3))	0.1268	0.0823	1.5413	0.1543
D (ARMI)	0.1574	0.3060	0.5145	0.6180
D (ARMI (-1))	-1.0701	0.3633	-2.9451	0.0147**
D (ARMI (-2))	-0.1043	0.3866	-0.2699	0.7927
D (ARMI (-3))	0.6598	0.3046	2.1660	0.0555*
D (ARME)	2.1797	0.5062	4.3052	0.0015***
D (ARME (-1))	-1.2570	0.3999	-3.1427	0.0105**
D (ARME (-2))	-1.6930	0.4181	-4.0483	0.0023***
CointEq (-1)	-0.7844	0.1261	-6.2193	0.0001***

Note: *, ** and *** denote 10%, 5% and 1% significance level, respectively.

The CUSUM and CUSUM2 specification tests reported in Figure 3 test the structural break problem and the stability of the long-run coefficients in the model. If the boundary value in the graphs is exceeded, it is accepted that there is a structural error in the model. It is seen that the parameter estimates are within the desired limits at 95% confidence interval and the model is stable. In this case, it has been concluded that the long-term parameters have not changed over time. This indicates that the model is reliable, and the parameter estimates have remained consistent.

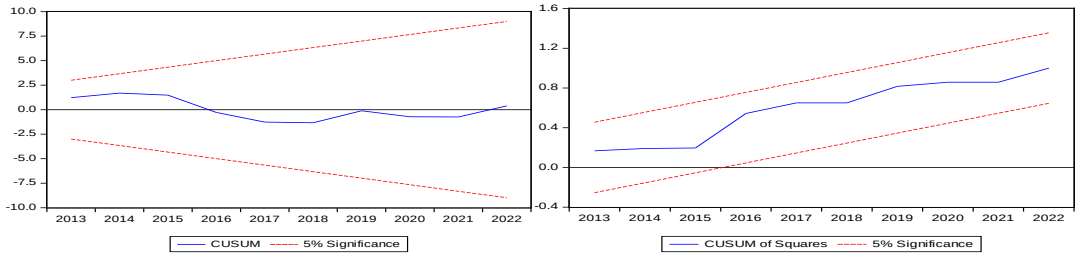


Figure 3. CUSUM and CUSUM^2 graphs.

Şekil 3. *CUSUM and CUSUM^2 grafikleri.*

CONCLUSION and EVALUATION

This study examines the impact of agricultural support, agricultural credit, agricultural raw material imports, and exports on agricultural value-added in Türkiye using an annual frequency data set for the period 1988-2022. The stationarity properties of the variables were determined by ADF and Fourier ADF unit root tests. Due to the different findings and various advantages of both unit root tests, the ARDL bounds test approach was used to determine long-term and short-term relationships in the model. The long-term results of the study indicate that increases in agricultural support, agricultural raw material imports, and exports increase in agricultural value-added. However, increases in agricultural credits during the study period were found to decrease agricultural value-added. In the long-term coefficient estimates, the effects of support, credit, and imports on value added are statistically significant, while the effect of exports is insignificant. In the short term, there are mixed findings regarding the impact of the independent variables on agricultural value-added; specifically, agricultural credits were found to positively affect agricultural value-added.

The findings of this study, which indicate that increases in agricultural support enhance agricultural value-added, align with similar findings by Aktaş et al. (2015), Udoka et al. (2016), Akyol (2018), Igberi et al. (2020), and Özşahin et al. (2023). Generally, the literature (Table 1) suggests that increases in agricultural credits lead to higher value-added; however, this study produced contrary results in the long term. Findings that increase in agricultural raw material imports lead to an increase in agricultural value added are consistent with the results of Bakari (2019) and Özşahin & Güven (2023).

The increase in agricultural support in Türkiye activates various economic and social dynamics that contribute to the rise in agricultural value-added. Agricultural support, including subsidies, credit facilities, and support for inputs such as seeds, fertilizers, and fuel, enables farmers to access these inputs at lower costs. This reduces the cost of agricultural production, increases profit margins, and enhances the total value-added. Furthermore, support encourages the use of modern agricultural techniques and technology. For instance, improved speeding, irrigation systems, or mechanization can increase productivity in agriculture. Increased productivity results in higher yields, which in turn boosts agricultural value-added. Support also helps in mitigating price fluctuations in the agricultural sector and raising awareness about the risks of natural disasters. Such support ensures stable incomes for farmers and encourages investment. Lastly, agricultural support improves living standards in rural areas, reduces rural-urban migration, and helps preserve the agricultural workforce, contributing to the continuation of economic activities in these regions. Thus, the

overall development of the agricultural sector is ensured, and the increase in value-added is supported. This study shows that agricultural support increases agricultural value added in Türkiye, which is consistent with various examples in the literature. For example, Aktaş et al. (2015) found that agricultural support positively affects agricultural value added in 12 OECD countries. Similarly, Udoka et al. (2016) found that agricultural support increase productivity and positively affect value added by reducing production costs in the case of Nigeria. Akyol (2018) obtained similar results in countries with different economic structures such as Brazil, China, Mexico, South Africa and Türkiye, while Igberi et al. (2020) in Nigeria and Özşahin et al. (2023) showed the positive effect of agricultural support in six developing countries. These different samples emphasize that agricultural support has positive effects on agricultural value added in general, regardless of geography and economic structure. In the case of Türkiye, these findings indicate that support policies should be continued effectively.

The findings of this study, which reveal that an increase in agricultural credits in Türkiye leads to a decline in value-added, do not align with the results of other studies in the literature. However, this situation necessitates various interpretations and inquiries into its underlying causes. Mismanagement or ineffective use of credits, high interest rates during certain periods, the inability of credit-provided financing to cover or reduce the costs of agricultural inputs (such as seeds, fertilizers, and pesticides), and deficiencies in credit management and financial planning can prevent producers from using the credits effectively. As a result, this can lead to a decrease in investments in agricultural production, the expected level of increased production capacities through credit utilization not being achieved, wastage of resources, and a decline in agricultural value-added.

Finally, the fact that increases in agricultural raw material imports in Türkiye lead to an increase in agricultural value added can be explained by various reasons. The increase in agricultural raw material imports can be considered in terms of costs and agricultural production capacity. Firstly, imports can enable producers to obtain the necessary raw materials at lower costs. This can reduce input costs, decrease production expenses, and allow producers to increase output. Especially in cases where local resources are insufficient due to climate or soil conditions, access to raw materials through imports can support the sustainability of production. Secondly, imported raw materials can enhance agricultural production capacity. Access to higher-quality or more efficient input can increase the efficiency of the agricultural sector, leading to higher production per unit and greater value added. Thus, through imports, producers can benefit from lower costs and achieve a broader production capacity, which can raise agricultural value added. Moreover, agricultural imports can help the country integrate more into international trade networks and participate in global value chains. On the other hand, it is also essential to implement measures to protect domestic producers regarding agricultural raw material imports. In this study, the positive effect of agricultural raw material imports on agricultural value added in Türkiye is consistent with the results of Bakari (2019) and Özşahin & Güven (2023). Bakari (2019), analyzed the impact of agricultural raw material imports on agricultural value added in Tunisia, Morocco and Egypt and concluded that these imports increase agricultural value added in the long run. Similarly, Özşahin & Güven (2023) found that agricultural raw material imports have a positive and significant effect on agricultural value added in the analysis of six developing countries. This result shows that the structural characteristics of the agricultural sectors of developing countries support the productivity increase in the production processes of raw materials supplied through imports. This study confirms a similar positive effect of agricultural raw material imports in the Turkish sample. Although the positive effect of agricultural raw material imports on agricultural value added has been demonstrated in all three studies, it should be considered that the size of this effect may vary according to the usage areas of imported raw materials, their place in agricultural production processes and the agricultural structures of countries.

Based on the findings of this research, the following conclusions can be drawn regarding the agricultural sector in Türkiye. The study reveals that agricultural support and raw material imports increase agricultural value-added, while agricultural credits reduce it. Therefore, the research indicates that certain structural insights are necessary for the sector. First, despite the positive impact of agricultural support, the

long-term sustainability of these supports should be questioned. If not directed correctly, support may be limited to short-term gains instead of increasing added value. Agricultural raw material imports can weaken the competitiveness of domestic producers and increase external dependency. This suggests that local resources are not being utilized efficiently, and producers are becoming excessively reliant on imports. The observation that increases in agricultural credit fails to contribute to value-added may suggest inefficiencies or ineffectiveness in the utilization and allocation of these financial resources within the agricultural sector. Considering these results, it should be ensured that agricultural supports, dependence on raw material imports and allocation of agricultural credits should be handled with a strategic approach to ensure sustainable growth in Türkiye's agricultural sector. Although the research has important implications for the agricultural sector, it has some limitations. Firstly, the study covers the period 1988-2022 with an annual data set. Secondly, agricultural support, credit and raw material foreign trade components, which are thought to affect agricultural value added, are included in the research process as independent variables. Finally, for future research, it is suggested to address this issue with different variables and different statistical/ econometric methods and enrich literature in this field.

Data Availability

Data will be made available upon reasonable request.

Author Contributions

Conception and design of the study: OŞ; acquisition of data: OŞ; analysis and interpretation of data: OŞ; statistical analysis: OŞ; visualization: OŞ; writing manuscript: OŞ.

Ethical Statement

We declare that there is no need for an ethics committee for this research.

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