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The effect of alternative product prices on production balance: Empirical findings on the production of oilseed crops in Türkiye

Alternatif ürün fiyatlarının üretim dengesi üzerindeki etkisi: Türkiye'de yağlı tohumlu bitkilerin üretimine ilişkin ampirik bulgular

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ABSTRACT

Objective: The canola and oily sunflower products, which are similar in terms of cultivation areas, techniques, and conditions, are alternatives to each other. It is believed that product prices play an important role in deciding to cultivate these two products. Hence a study was conducted and the objective of this study was to this study was to examine the long and short term effects of product prices, especially alternative product prices, on production.

Materials and Methods: The data for the study included the years 2002-2021 and were analyzed using the ARDL boundary test.

Findings: According to the findings of the ARDL boundary test, a 1% increase in canola prices increases canola production by 4.72% in the long term, while a 1% increase in the prices of sunflower, an alternative product, decreases canola production by 5.37%. The error correction coefficient (-0.96) was found to be negative and statistically significant, indicating that imbalances in the short term will return to equilibrium levels approximately 1.04 years later.

Conclusion: Changes in the prices of these two alternative products affect the increase or decrease in production. In this context, regulations can be made on production through price policies. Additionally, the findings of the study can contribute to production planning and increasing welfare.

Keywords: ARDL boundary testing approach, canola, oily sunflower, price, production

ÖZ

Amaç: Yetiştirildiği alanlar, teknikler ve koşullar bakımından benzer olan kanola ve yağlık ayçiçeği ürünleri birbirinin alternatifleridir. Bu iki ürünün yetiştirilmesine karar vermede ürün fiyatlarının önemli bir rol oynadığı düşünülmektedir. Bu çalışma ürün fiyatlarının, özellikle de alternatif ürün fiyatlarının üretim üzerindeki uzun ve kısa dönem etkilerini incelemeyi amaçlamaktadır.

Materyal ve Yöntem: Çalışmanın verileri 2002-2021 yıllarını kapsamakta olup, ARDL sınır testi kullanılarak analiz edilmiştir.

Araştırma Bulguları: ARDL sınır testi bulgularına göre, uzun dönemde kanola fiyatlarında meydana gelen %1'lik artış, kanola üretimini %4,72 artırırken, alternatif ürün olan yağlık ayçiçeği fiyatlarında meydana gelen %1'lik artış, kanola üretimini %5,37 azaltmaktadır. Hata düzeltme katsayısı (-0,96) negatif ve istatistiksel olarak anlamlı bulunmuş olup, kısa dönemde meydana gelen dengesizlikler yaklaşık 1,04 yıl sonra denge seviyesine dönmektedir.

Sonuç: Bu iki alternatif ürünün fiyatlarındaki değişiklikler üretimin artması veya azalmasında etkilidir. Bu bağlamda, fiyat politikaları ile üretim üzerinde düzenlemeler yapılabilir. Ayrıca çalışmanın bulguları, üretim planlaması ve refahın artırılmasına katkı sağlayabilir.

Anahtar sözcükler: ARDL sınır testi yaklaşımı, kanola, yağlık ayçiçeği, fiyat, üretim

INTRODUCTION

With the increasing global population, access to food and the importance of the agricultural sector has become increasingly debatable (Uzundumlu, 2012). In this regard, one of the essential nutrients necessary for sustaining vital human activities is vegetable oils. A significant portion of vegetable oils is derived from oilseed plants (Gül et al., 2016). Oilseed plants play a crucial role not only in human and animal nutrition but also constitute a significant raw material source within the industrial sector (Arıoğlu, 2010, 2016).

According to the information provided by the Food and Agriculture Organization of the United Nations (FAO), in the year 2021, global vegetable production summed up to a total value of 2,834,602 million US dollars. The category of oilseeds constitutes 12.74% of this production. Specifically, 36.53% of the world's vegetable oil production is derived from palm oil, 28.20% from soybean oil, 12.12% from rapeseed (canola) oil, 9.91% from sunflower oil, and 13.24% from other plants (FAO, 2023).

Türkiye realized a total agricultural production of 52,968 million US dollars in the year 2021, with oilseed plants constituting 12.31% of this production. In comparison to the global scale, Türkiye significantly meets a substantial portion of its oil demand through sunflower production. Specifically, 56.39% of the total oil production, amounting to 2 304 thousand tons, is supplied through sunflower cultivation. Canola, another notable oilseed product, has begun to stand out in Türkiye since the 2000s and holds approximately a 3% share in Türkiye's production, unlike the global average (%12.12) (FAO, 2023).

In this study, the objective was to investigate the factors that may affect the production of canola, an oilseed plant. The present study, distinct from other studies, reveals the effects of the alternative crop on the production. Within the framework of the study's objectives, the theoretical approach is elaborated in details below.

In Türkiye, in the year 2022, a total of 150 thousand tons of canola production was produced. The provinces constituting approximately 90% of the total production are tabulated in Table 1. Upon general examination, it is observed that the production is concentrated in the provinces of the Thrace region. The domestic self-sufficiency level of canola production has increased in recent years and reached a sufficient level. While canola production is seen at a sufficient level, the quantity of production is quite low compared to other crops. Another evidence, Türkiye remains dependent on imports of oilseeds. Particularly, the self-sufficiency level of widely used oily sunflower in Türkiye remains around 60%, making Türkiye the leading country globally in sunflower seed imports. In this context, it is emphasized that canola, with its high oil content and yield, could play a significant role in reducing the vegetable oil deficit in Türkiye (Kumbar & Unakıtan, 2011).

A noteworthy point is that the areas where canola production takes place are also regions with intense production of oily sunflower. In the Thrace region, wheat, oily sunflower, and canola production stand out, especially under rainfed farming conditions, and they are generally cultivated in rotation (Unakıtan & Abdikoğlu, 2014). Additionally, as stated in the study by Kumbar & Unakıtan (2011), these three crops share similar cultivation techniques, climate requirements, and input use. The data in Table 1 confirms this information.

Considering all these factors, canola and oily sunflower, both falling into the category of oilseeds, can be evaluated as alternative products to each other. One of the factors influencing producers' choices of products is the changes in alternative products (Özkan & Karaman, 2011; Unakıtan & Abdikoğlu, 2014; Özüdoğru & Miran, 2015; Dörtok & Aksoy, 2018; Bıtrak, 2023). In this context, the main objective of the study was to identify the factors affecting canola production and to determine short and long term production sensitivity. The study aims to explain the changes in canola production by examining the relationship between the price of the product itself and the prices of alternative products (oily sunflower). These findings can contribute to production planning and, consequently, be utilized to increase producer income.

Table 1. Status of canola and oily sunflower production in Türkiye

***Çizelge 1.** Türkiye'de kanola ve yağlık ayçiçeği üretiminin durumu*

Crops	Provinces	2010	2015	2020	2021	2022	2022 (%)
Canola / Colza (ton)	Edirne	13,890	5,760	24,370	24,898	30,387	20.26
	Tekirdağ	53,080	73,891	37,831	45,868	28,685	19.12
	Konya	226	1,987	16,607	24,780	27,067	18.04
	Kırklareli	11,113	8,303	15,692	14,163	17,922	11.95
	İstanbul	13,805	18,189	8,261	9,462	10,303	6.87
	Çanakkale	9,520	4,282	6,596	7,343	10,112	6.74
	Balıkesir	1,086	6,896	3,233	2,994	5,479	3.65
	Others	3,730	692	8,952	10,492	20,045	13.36
	Total	106,450	120,000	121,542	140,000	150,000	100.00
	Self-Sufficiency Level (%)	30,90	26,90	111,20	116,70	-	-
Oily Sunflower (ton)	Tekirdağ	259,562	267,012	353,982	399,531	335,561	14.28
	Edirne	332,894	226,573	240,434	285,286	325,812	13.86
	Konya	46,764	210,307	278,546	324,790	254,571	10.83
	Kırklareli	139,407	188,998	226,320	226,163	227,791	9.69
	Çanakkale	51,121	40,787	53,306	62,319	81,549	3.47
	Balıkesir	31,468	30,609	37,740	50,216	57,247	2.44
	İstanbul	46,362	35,795	43,274	49,017	51,570	2.19
	Others	262,422	499,919	666,398	817,678	1,015,899	43.23
	Total	1,170,000	1,500,000	1,900,000	2,215,000	2,350,000	100.00
	Self-Sufficiency Level (%)	52,40	78,90	62,50	59,60	-	-

References: TURKSTAT, 2024a; TURKSTAT 2024b.

This section includes studies conducted at both the national and international levels that are relevant to the subject.

Özkan & Karaman (2011) aimed to analyze the impact of factors affecting cotton production in Türkiye in their study. In this context, variables such as product price, alternative product prices, agricultural supports, and labor wages were examined using the ARDL model.

Haile et al. (2015) reveal the responsiveness of supply to price fluctuations for major agricultural products worldwide, such as wheat, rice, corn, and soybeans. Findings indicate that farmers shift towards crops with less price variability, reducing efficiency by approximately 1-2% in response to price volatility.

Özüdoğru & Miran (2015) employed the Tobit model to predict the cotton supply function. According to the analysis results, producers tend to follow substitute product prices, showing a positive response to an increase in cotton prices and a negative response to an increase in substitute product prices.

Önder (2017), in his study on factors influencing cotton supply, found that a 1% increase in cotton prices leads to a 42% increase in cotton supply, while a 1% increase in substitute product prices results in a 41% decrease.

Abdikoğlu & Unakıtan (2017) determined the sensitivity of changes in sunflower cultivation areas in Türkiye to sunflower prices and other product prices. According to the results, the short term elasticity of sunflower price is 0.09, while the long term elasticity is 0.32. These elasticity coefficients suggest that producers are not very sensitive to prices in the short term but become more responsive in the long term. In another study conducted by Unakıtan & Azabağaoğlu (2017), the impact of changes in canola prices on the acreage of cultivation over the years was examined using the Koyck model. The study utilized panel data from the years 1990 to 2014. If short term canola prices increase by 10%, it will lead to a 1.2% increase in the canola cultivation area. According to this estimate, this effect increases the canola cultivation area by up to 4.2% in the long term. The changes in canola prices affect the canola cultivation area after 2.5 years. The findings indicate a weak relationship between canola price and canola cultivation area.

Shahzad et al. (2018) used the ARDL approach to predict the supply response of tobacco producers to price and non-price variables. The study utilized time series data covering the period from 1981 to 2014. Long term predictions indicate that tobacco price and tobacco area coefficients are positive and statistically significant, while wheat price (a competitive product) is negative and statistically significant.

Waqas et al. (2019) analyzed the supply response of wheat, grown under dry conditions in Pakistan, using the ARDL approach. ARDL results indicated that wheat price, chickpea price (an alternative product), minimum temperatures, and seasonal rainfall produced statistically significant results in both the short and long term.

Abdullah (2020) examined the supply sensitivity of wheat, corn, and cotton in the Kirkuk province of Iraq from 1994 to 2015 using the ARDL method. The study considered cultivated area as the dependent variable and explanatory variables included the current price of the product, the current price of the competitor's product, yield risk, price risk for cotton, and irrigation and precipitation rates for wheat.

Mithiya et al. (2021), in their studies in India, investigated the dynamic relationship between the production area and price of oilseeds. Empirical results indicate that prices of competitive products have a significant impact on cultivation areas, either positively or negatively.

In the study conducted by Çukur et al. (2021), the relationship between organic farming area and agricultural value added was examined using the Dynamic Panel ARDL method. In this study, which includes nine EU countries between 2010 and 2018, a positive relationship was found between organic farming area and agricultural value added, leading to the conclusion that organic agricultural production should be increased accordingly.

Bıtrak (2023) used the ARDL border test in a study investigating the determinants of potato production decisions in Türkiye. Variables such as annual potato cultivation area, annual average potato price, and annual yield per hectare for potatoes and onions (alternative products) constitute the main material of the study. Factors positively influencing potato cultivation areas, in the long term, were determined as potato price and potato yield per hectare. However, the factor negatively affecting it was found to be onion yield per hectare.

Bulut & Bayraktar (2023) employed the ARDL model to investigate agricultural supports in selected 11 agricultural products. Findings suggest that increases in input prices have a short term negative impact on production, but in the long term, the effect is the opposite. Agricultural product prices, on the other hand, are not a significant indicator for producers.

In their study, Erdal et al. (2023) examined the relationship between production quantity and price in cotton production in Azerbaijan using the Koyck model with data from the period 1995-2022. According to the average number of lags, it was found that for a significant and noticeable effect of price changes on cotton production, it takes approximately 2.86 years. While a one-unit increase in cotton prices leads to an increase in production by 2.524 tons, a one-unit change in prices in the previous period increases cotton production by 1.870 tons.

Some studies examine the factors affecting the production of various products using the ARDL border test approach. Additionally, there are other studies with similar objectives that employ different methods. However, it has been observed that studies focusing on time series data for canola and oilseed plants are quite limited. Furthermore, there are studies on the current state of canola production, input use, cost analysis, and resource efficiency (Bayramoğlu et al, 2010; Kumbar & Unakıtan, 2011; Semerci, 2020, 2022).

MATERIALS and METHODS

Materials

The data about the main material of the study were obtained from the Food and Agriculture Organization (FAO) of the United Nations, and the Türkiye Statistical Institute (TURKSTAT). Additionally, sector reports and academic studies published in national and international domains were utilized.

Methods

The study aims to examine the factors influencing canola production in Türkiye. When considering canola and sunflower oil prices as independent variables, the production quantity has been determined as the dependent variable. The dataset used covers the years 2002-2021. In the study, the Producer Price Index (2003=100) published by the Türkiye Statistical Institute was used to convert current prices into real prices. Initially, a logarithmic transformation has been applied to the series. Following this process, the stationarity of the series has been examined using Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root tests. After the unit root test, the existence of a long term equilibrium relationship was evaluated with the Autoregressive Distributed Lag Model (ARDL) boundary test (Pesaran et al., 2001). The following equation was formed for this study:

$\ln CQ = \beta_0 + \beta_1 \ln CP + \beta_2 \ln SP + \mu t$ (1)

The definitions of the variables in the equation are presented below;

lnCQ: Canola Production Quantity (ton) – Depended Variable

lnCP: Canola Price (TL/ton) – Independent Variable

lnSP: Oily Sunflower Price (TL/ton) - Independent Variable

Detailed explanations regarding the conducted tests and preliminary tests in the study are provided below.

Correlation matrix

The correlation coefficients measure the direction and strength of the linear relationship between pairs of variables. Additionally, the correlation matrix helps detect the issue of multicollinearity in the created model. An important assumption in time series analyses is the absence of a high correlation among independent variables (Voss, 2005). To avoid multicollinearity issues, it is expected that the correlation coefficients between pairs of independent variables are below 0.80 (Grewal et al., 2004). This study examined with Pearson correlation coefficient.

Unit root tests

The presence of unit roots or non-stationarity in time series indicates that the series is influenced by past values. Consequently, analyses conducted with non-stationary series may yield inaccurate results. Additionally, the decision regarding cointegration tests is based on the stationary levels of the variables. In the research, commonly used "Augmented Dickey-Fuller (ADF)" and "Phillips-Perron (PP)" unit root tests have been employed (Dickey & Fuller, 1979; Phillips & Perron, 1988).

ARDL cointegration test

ARDL (Autoregressive Distributed Lag) method was developed by M. Hashem Pesaran, Yongcheol Shin, and Richard J. Smith in 2001. The ARDL method yields effective results when the dependent variable is I (1) and the independent variables are either I (0) or I (1) (Shahbaz et al., 2013). Due to this characteristic, it is more flexible compared to traditional cointegration tests such as those by Engle & Granger (1987), Johansen & Juselius (1990), and Phillips & Hansen (1990). Additionally, it provides consistent empirical evidence for small-sample models and contributes to understanding the long term relationships between variables (Narayan & Smyth, 2005). Pesaran et al. (2001), considering the presence of constant, time trend, and restrictive conditions, have proposed five different models. In this study, a model with unrestricted constant and trend has been applied. The long term ARDL equation was specified as follows:

$$\Delta \ln CQt = \beta 0 + \beta 1t + \sum_{i=1}^{p} \beta i \, \Delta \ln CQt - i + \sum_{i=0}^{q} \gamma i \, \Delta \ln CPt - i + \sum_{i=0}^{r} \delta i \, \Delta \ln SPt - i + \epsilon t \quad (2)$$

In this equation, t represents the time trend, β_0 is the unrestricted constant, β_1 is the coefficient for the time trend, βi represents the coefficients for lags, γ_i , and δ_i represent the coefficients for lags of other independent variables. Additionally, p, q, and r denote the lag numbers for *lnCQ*, *lnCP*, and *lnSP* variables, respectively. For the lag lengths of the ARDL method, information criteria such as AIC (Akaike information criterion), SC (Schwarz information criterion), and HQ (Hannan-Quinn information criterion) can be utilized. The short term dynamics of the variables were described by employing the Error Correction Model (ECM). The ECM representation was specified as follows:

$$\Delta \ln CQt = \beta 0 + \beta 1t + \sum_{i=1}^{p} \beta i \, \Delta \ln CQt - i + \sum_{i=0}^{q} \gamma i \, \Delta \ln CPt - i + \sum_{i=0}^{r} \delta i \, \Delta \ln SPt - i \; + \lambda ECMt - 1 + \epsilon t \quad (3)$$

In this equation, the error term ϵ_t is corrected with the error term from the previous period. λ represents the error correction coefficient. If λ is negative and statistically significant, it indicates a tendency for short term equilibria to correct towards long term equilibria.

Bound tests

In the classical ARDL (Autoregressive Distributed Lag) method, "F-Bounds" and "t-Bounds" tests are employed to test for cointegration. The F-Bounds test takes into account the lagged values of all dependent and independent variables in the model. The hypotheses for the F-Bounds test are stated as follows: H_0: $\alpha_1 = \alpha_2 = \alpha_3 = 0$ and H_A: $\alpha_1 = \alpha_2 = \alpha_3 = 0$. The F-Bounds test statistics will be compared with the lower and upper critical values calculated by Narayan & Smyth (2005). If the calculated F-Bounds statistic value exceeds the specified upper critical values for I (1), the null hypothesis H_0 indicating no cointegration is rejected, concluding the presence of cointegration. As a second test in the cointegration analysis, the t-bounds test considers only the lagged values of the dependent variable. The hypotheses for the t-Bounds test are H_0: $\alpha_1 = 0$ and H_A: $\alpha_1 \neq 0$. The test statistics of this test will be compared with the lower and upper critical values calculated by Pesaran et al. (2001).

Diagnostics tests

Diagnostic tests were used to assess the robustness of the findings obtained from the estimated model. Within the scope of the study, the "Jarque-Bera" test was applied to examine the normality assumption. In regression analyses, there should be no relationship among the error terms (Ünver & Gamgam, 1996). In the case of an autocorrelation problem, parameter estimators are unbiased and ineffective (Yavuz, 2009). The "Breusch-Godfrey Serial Correlation LM" test has been conducted to test for autocorrelation issues. Constant variance, or "homoscedasticity," implies that the variance of the error term remains unaffected by changes in the independent variables and remains constant (Yamak & Köseoğlu, 2006; Albayrak, 2008). The "ARCH" test was also applied to test this assumption. To detect any specification or model misspecification errors in the estimated model, the "Ramsey-RESET" test has been conducted. The “Cusum and Cusumq” tests were applied to test the stability or consistency of the estimated coefficients in time series analysis.

RESULT and DISCUSSION

When examining the descriptive statistics of the variables, there are 20 observations obtained from the years 2002-2021 for all variables. Descriptive statistics including the mean, median, minimum, and maximum values, as well as standard deviation values for the logarithmically transformed level data, are provided in Table 2.

Table 2. Descriptive statistics

Çizelge 2. *Tanımlayıcı istatistikler*

Variables	Mean	Std. Dev.	Maximum	Minimum	Observations
lnCQ	10.692880	1.583606	12.100710	7.090077	20
lnCP	6.148267	0.167174	6.505058	5.767331	20
lnSP	6.487213	0.178579	6.777308	6.161486	20

When examining the correlation matrix table in Table 3, it is observed that the correlation coefficient between the LnCP variable, which is an independent variable in the model, and the LnSP variable is 0.55. According to these results, it is evident that there is no issue of multicollinearity among independent variables. This is because the correlation coefficients are below 0.80 (Balkı, 2023; Göksu & Balkı, 2023).

Table 3. Results of correlation coefficient between variables

Çizelge 3. *Değişkenler arasındaki korelasyon katsayısı sonuçları*

	ln*CQ*	ln*CP*	ln*SP*
lnCQ	1		
lnCP	0.489**	1	
lnSP	0.039	0.551***	1

***1%; **5%; significance level

Before analyzing the model with the ARDL boundary test, the optimal lag length was examined using the Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), and Hannan-Quinn Information Criterion (HQ). As a result of the conducted test, the optimal lag length was determined to be “1” (Table 4).

Table 4. Optimum lag length

Çizelge 4. *Optimum gecikme uzunluğu*

Lag	Log L	LR	FPE	AIC	SC	HQ
0	44.48985	NA	2.00e-06	-4.609983	-4.461588	-4.589521
1	72.10570	42.95800*	2.58e-07*	-6.678411*	-6.084830*	-6.596565*
2	77.13091	6.141921	4.47e-07	-6.236768	-5.198001	-6.093536

* Indicates lag order selected by the criterion

According to the Augmented Dickey Fuller (ADF) and Philips Perron (PP) test results, the LnCQ and LnSP series contain unit roots at the level for both models. When the first differences of these variables are taken, they become stationary at all significance levels (prob<0.05). The LnCP series is stationary at the level (Table 5). Due to the variables being stationary at different levels, the long term relationship between the variables will be analyzed using the ARDL Bound Test Approach.

Table 5. Unit root test results (ADF and PP)

Çizelge 5. *Birim kök testi sonuçları (ADF ve PP)*

Variables		ADF		PP	
		I (0)	I (1)	I (0)	I (1)
LnCQ	With Constant	-2.2553	-4.8069***	-2.7568	-4.7983***
	With Constant & Trend	-2.0678	-4.7649***	-1.9663	-4.8121***
	Without Constant & Trend	0.7959	-4.7138***	1.1765	-4.7138***
LnCP	With Constant	-0.3642	-3.7730***	-1.1611	-7.2109***
	With Constant & Trend	-3.5788*	-3.9915**	-5.3896***	-8.1003***
	Without Constant & Trend	0.8345	-3.7273***	0.4124	-4.7068***
LnSP	With Constant	-1.6648	-5.0014***	-1.7797	-4.9659***
	With Constant & Trend	-1.9548	-5.3081***	-1.9548	-5.8112***
	Without Constant & Trend	0.6061	-5.1921***	0.6748	-5.1516***

***1%; **5%; *10%; significance level

In the study, it was found that the most suitable model was ARDL (1, 0, 0). F-Bounds Test and t-Bounds Test indicate that the model constructed for the boundary test results is symmetric/linearly cointegrated at a 5% significance level (Table 6). This is because the test statistic values are larger than the absolute values of the upper limit values determined for I (1). Therefore, it was concluded that the variables converge to the equilibrium point of their linear combinations, indicating that they move together in the long term (Göksu, 2022; Göksu & Balkı, 2023).

Table 6. ARDL cointegration test results

Çizelge 6. *ARDL eşbütünleşme testi sonuçları*

ƒ (lnCQ │ lnCP, lnSP) ARDL (1, 0, 0) k:2 m:1 n=20					Test Statistics		Result
					F-Bound Test Value	6.897263**	Cointegrated
					t-Bound Test Value	-4.126016**	
Table CV	1%		5%		10%		
Tests	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)	
F-Bound Test	7.98	9.41	5.55	6.75	4.58	5.60	n=30
t-Bound Test	-3.96	-4.53	-3.41	-3.95	-3.13	-3.63	

** ; represents the 5% significance level; k, the number of independent variables; m, the maximum lag length; and n indicates the number of observations.

According to the diagnostic test results as presented in Table 7, the probability value for the Breusch-Godfrey Serial Correlation LM test is 0.6419. Since the probability value is greater than 0.10, there is no autocorrelation problem in the model. The probability value for the ARCH test applied in the test of changing variance is 0.7132. As the probability value is greater than 0.10, there is no heteroscedasticity problem in the model. The Jarque-Bera probability value is also 0.3761. Since the probability value of the Jarque-Bera test is greater than 0.10, it can be said that the model is suitable for a normal distribution. The probability value for the Ramsey RESET test is 0.2210. Since the probability value is greater than 0.10, there is no model specification error. According to Figure 1, the CUSUM and CUSUMQ graphs are within a 95% confidence interval and within the desired boundaries, indicating that the constructed model is stable.

Table 7. ARDL diagnostic test results

Çizelge 7. *ARDL tanısal test sonuçları*

Diagnostic Tests	Test Value	Probability Value
Heteroscedasticity Test: ARCH	0.675994	0.7132
Breusch-Godfrey Serial Correlation LM Test	0.886706	0.6419
Jarque-Bera Normality Test	1.955840	0.3761
Ramsey Reset Test	1.652529	0.2210

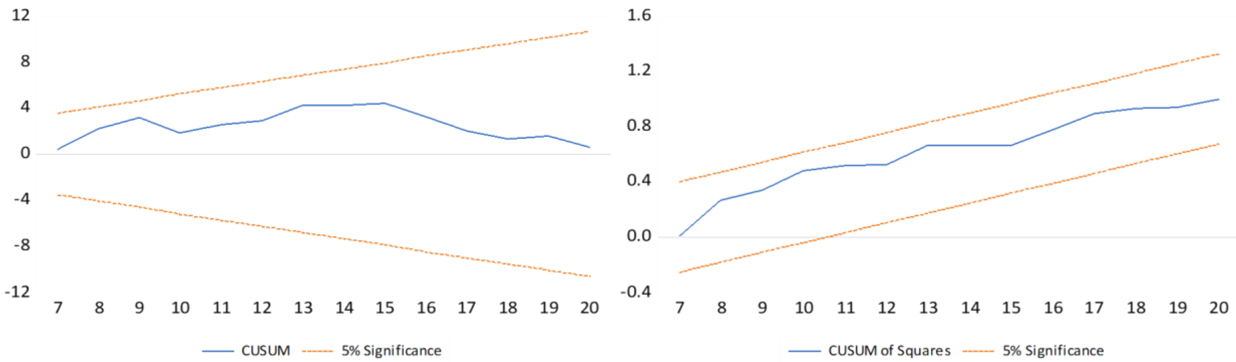

Figure 1. Qusum and qusum q results.

Şekil 1. *Qusum ve qusum q sonuçları.*

According to the long term coefficient results presented in Table 8, the coefficients of lnCP and lnSP variables are positive. A 1% increase in the lnCP variable results in approximately a 4.72% increase in the lnCQ variable. Since there is a linear relationship between these variables, the opposite interpretation can also be made. In other words, if the lnCP variable decreases by 1%, the lnCQ variable also decreases by approximately 4.72%. This result is statistically significant at 95% probability level. A similar interpretation can be made for the lnSP variable. A 1% increase in the lnSP variable reduces the lnCQ variable by 5.37%. If the lnSP variable decreases by 1%, the lnCQ variable increases by 5.37%. This result is statistically significant at 99% probability level.

Studies conducted by Unakıtan & Azabağaoğlu (2017), Shahzad et al. (2018), and Erdal et al. (2023) have found statistically significant relationships between price and production quantity in various products. In this regard, they support the findings of this study. Additionally, Özüdoğru & Miran (2015), Önder (2017), and Waqas et al. (2019) reported that the price of the product itself increases production quantity, while the price of the alternative product decreases production quantity. Evidence from the literature provides results consistent with the findings of this study.

Table 8. ARDL short and long term forecast results

Çizelge 8. ARDL kısa ve uzun dönem tahmin sonuçları

a) Long Term (Dependent Variable: lnCQ)	Coefficients	t-statistic	Probability
lnCP	4.716407**	2.714594	0.0168
lnSP	-5.369091***	-5.490787	0.0001
b) Short Term	Coefficients	t-statistic	Probability
C	14.68766***	5.061252	0.0002
Trend	0.140040***	3.262414	0.0057
CointEq (-1)	-0.958588***	-4.862896	0.0003

***1%; **5%; significance level

When examining the short term forecast results, the coefficient of the error correction term is -0.96 with a probability value of 0.0003. The probability value being less than 0.05 indicates the significance of this coefficient, and its negative sign implies that an imbalance in the model will be corrected (Özçelik & Göksu, 2019; Göksu & Balkı, 2023). In other words, the calculated value of -0.96 for the CointEq (-1) coefficient indicates that shocks occurring in the short term will return to the long term equilibrium level approximately 1.04 years later (1/0.96). This suggests that shocks in canola and oily sunflower prices will return to equilibrium approximately 1 year later. Additionally, the constant term and trend coefficients are positive and statistically significant (Table 8). In addition, the negative and statistically significant coefficient of the error correction term provides further evidence that the model is cointegrated (Akçay & Karasoy, 2017).

CONCLUSION

In Türkiye, the primary use of oilseed crops is dominated by oily sunflower. However, the inability to meet the demand for oily sunflowers has positioned Türkiye as a significant importer in this field. Conversely, canola production has increased as an alternative to oily sunflower in Türkiye since the 2000s, owing to favorable growing conditions, high oil content, and yield. Observations indicate that a substantial portion of canola production areas in Türkiye also lead to oily sunflower production, supporting this situation. It is believed that product prices play a significant role in decision-making for the cultivation of these two similar products. Indeed, numerous studies in the literature support this hypothesis. This study aims to examine the effects of product prices, especially alternative product prices, on production in both the long and short terms, differing slightly from previous research.

The data for the study were obtained from the years 2002-2021 and were analyzed using the ARDL boundary test. Preconditioning unit root tests, diagnostic tests, and boundary tests providing co-integration relationships were conducted for the ARDL test, all yielding successful results. According to the ARDL boundary test findings, a 1% increase in canola prices increases canola production by 4.72% in the long term, while a 1% increase in oily sunflower prices, an alternative product, decreases canola production by 5.37%. These findings can also be interpreted inversely. The results are statistically significant.

Examining the short term forecast results, the coefficient of error correction term was found to be -0.96, which is statistically significant. The negative and statistically significant finding of the error correction coefficient implies that imbalances that occur in the short term in the model will return to the equilibrium level in the long term. They determined that this correction would occur approximately 1.04 years later (1/0.96).

Generally, fluctuations in the prices of two alternative products with similar conditions affect the increase or decrease of production. Therefore, price policies can be implemented to regulate production. An important finding of the study is that changes or shock effects that may occur in the short term while implementing these policies in canola production will return to the equilibrium level approximately one year later. Additionally, it is believed that this study will contribute to efforts related to production planning and welfare improvement.

Data Availability

Data will be made available upon reasonable request.

Author Contributions

Conception and design of the study: FÇ, EK; sample collection: nope; analysis and interpretation of data: EK; statistical analysis: EK; visualization: FÇ; writing manuscript: FÇ, EK.

Conflict of Interest

There is no conflict of interest between the authors in this study.

Ethical Declaration

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

Article Description

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