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The Effects of Exchange Rate on Sunflower Seed Exports in Turkey: ARDL Bound Test

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Abstract

Although sunflower seed can be easily grown in many regions of Turkey due to its high adaptability, the deficit caused by insufficient production is covered by imports. When the exchange rate and oil prices rise, the prices of these products increase in Turkey, which has been an importer of oilseeds and vegetable oils for many years. In addition, sunflower, which can be grown in many regions of Turkey, contributes to Turkey's agricultural sector and sunflower seed exports are an important part of crop exports. In this study, monthly Turkish sunflower seed exports and exchange rate data for the period 2017-2023 are analysed using the ARDL bounds test method in accordance with the information obtained from the Turkish Statistical Institute and the Central Bank of the Republic of Turkey. According to the findings, a statistically significant correlation exists between the exchange rate and sunflower seed exports, with a 1% rise in the dollar in the long term resulting in a 0,30% increase in sunflower seed exports. Meanwhile, in the short term, 62% of the impact of a shock is absorbed and reaches equilibrium over the long term.

Keywords: Sunflower Seed, Exchange Rate, Export, ARDL

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INTRODUCTION

An exchange rate represents the relative value of one currency compared to another in the foreign exchange market and serves as the pricing mechanism between different currencies. Variations in exchange rates have a direct impact on international trade by affecting both imports and exports. These rates are influenced by factors such as shifts in interest rates, inflation, national policies, and the overall economic conditions of each country. They are determined based on market expectations and the latest developments in the foreign exchange arena. For example, if market participants anticipate that the domestic currency will appreciate, its demand increases, leading to its strengthening. Furthermore, macroeconomic policies play a pivotal role in determining the exchange rate; for instance, regularly implemented fiscal policies can enhance the value of the domestic currency. Additionally, fluctuations in exchange rates can affect various factors, including consumption patterns, export volumes, pricing, productivity, and the number of foreign tourists. (Zhao, 2020).

An increase in the exchange rate is viewed as a depreciation of the country's currency relative to a foreign currency. This results in the country's goods being exported at more competitive, lower prices, thereby boosting exports. Additionally, a higher exchange rate makes imports more expensive. (Oktem and Ozturk, 2022).

On the contrary, a fall in the exchange rate will lead to an increase in the value of the national currency in relation to the value of the foreign currency. It can therefore be concluded that an increase in the exchange rate will increase the demand for foreign goods and will lead to a demand for agricultural products from abroad and an increase in agricultural imports.

In 2020, 50.229.567 tonnes of sunflowers were produced on 27.874.284 hectares worldwide, and while in the 2021-2022 season it was 56 million 850 thousand tonnes, in the 2022-2023 season it fell to 52 million 770 thousand tonnes. The production forecast for the 2023-2024 season is 54 million 800 thousand tonnes.(FAO, 2021; FAO, 2023).

In Turkey, sunflower production is widespread in 59 cities and Edirne is the leading oil sunflower producing city followed by Adana, Tekirdağ, Kırklareli and Konya (TZOB, 2024).

The area under sunflower in Turkey is 728.000 ha in 2020/2021, a decrease of 3,2% compared to the previous season. The area under oil sunflower is 650.000 ha in 2020. The provinces of Tekirdağ (142.000 ha), Edirne (90.000 ha), Adana (60.000 ha), Kırklareli (77.000 ha) and Konya (66.000 ha) account for 67% of the oil sunflower area. Sunflower production decreased by 1.6% compared to the previous period and was estimated at 2 million tonnes. The amount of oil production will be 1.9 million tonnes in 2020. The provinces of Tekirdağ (353.000 tonnes), Konya (278.000 tonnes), Adana (195.000 tonnes), Edirne (240.000 tonnes) and Kırklareli (226.000 tonnes) ranked first in sunflower oil production (TEPGE, 2021). Sunflower production in the 2021/22 season was 2.4 million tonnes, the area under cultivation was (901.000 da) and self-sufficiency decreased to 59%. Tekirdağ, Edirne, Konya, Kırklareli ranked first in production and sunflower production was estimated at 2.6 million tonnes in 2022/23 (TEPGE, 2023).

According to TUIK figures, sunflower seed exports in 2023 were about $238 million. In 2022, this figure was around 200 million dollars. This is an increase of 19% compared to the previous year. In 2021, about 200 million dollars of sunflower seeds were exported, the same amount as in 2022, while in 2020, about 150 million dollars of sunflower seeds were exported, an increase of 33% compared to the previous year. Although crude sunflower oil exports increased, a decline in exports was observed after 2021. Import values, which remained significantly higher than export values, continued to rise despite the decline in 2023 (TUIK, 2024).

Table 1: Turkey's (2017-2023) Sunflower Seeds and Sunflower Crude Oil Foreign Trade Values (Thousand $)

	Sunflower Seed			Crude Sunflower Oil		
Years	Export (E)	Import (I)	E-I	Export (E)	Import (I)	E-I
2017	138.035	356.471	-218.436	9.920	614.662	-604.742
2018	114.590	361.101	-246.511	9.637	370.565	-360.928
2019	129.371	516.431	-387.060	17.165	355.592	-338.427
2020	149.391	586.028	-436.637	30.233	612.504	-582.271
2021	199.558	533.895	-334.337	51.564	1.094.455	-1.042.891
2022	199.315	635.368	-436.053	29.223	1.501.946	-1.472.723
2023	237.704	470.926	-233.222	3.136	1.303.856	-1.300.720

Source: TUIK 2024

Studies on sunflower have been carried out in the literature. When we examined these studies, we determined that they focused on sunflower production, economic analysis and the future of sunflower production, and developments in sunflower foreign trade.

Kaya et al (2010) divided the years 1980-2008 into 5-year periods and presented the area, production, average yield and foreign trade of sunflower in the world and Turkey. In their study, they concluded that although sunflower is the most important source of raw material for the oil industry in our country, Sunflower production is insufficient to fulfill the industrial needs and the country's oil demand.

Semerci and Durmuş (2011) examined the effect of agricultural support on crop income, taking into account the average yield value obtained for oil sunflower in 2018. The study showed that the supply of vegetable oil in the country is far from meeting the demand.

Kaya (2016) assessed the current status and future prospects of sunflower production using data from the Turkish Statistical Institute. The study concluded that sunflower production in

Turkey has the potential to increase rapidly at the desired rate due to its production advantages.

Karaagac et al. (2018) tried to reveal the energy balance sheet and economic aspects of sunflower production under Adana conditions in 2017. The study concluded that sunflower production in Adana is efficient, considering the energy output/input ratio.

Semerci (2019) analysed oil sunflower production in Turkey within the framework of data obtained from 116 agricultural enterprises in Kırklareli province for the 2009–2010 production and marketing period. This data was compared with the production cost table prepared based on the data from the Ministry of Agriculture and Forestry, Kırklareli Provincial Directorate, for the 2017 production period in terms of production costs and support provided for oil sunflower. This study showed that the increase in yield per unit area between 2009 and 2017 in Kırklareli, one of the main oil sunflower production areas in Turkey, was effective in reducing production costs.

Kadakoglu and Yılmaz (2022) analysed the effects of agricultural support for sunflower production in Turkey (differential payment support and diesel fertiliser support), sunflower prices received by producers, sunflower import prices and diesel fertiliser prices, which are the main inputs used in sunflower production, on sunflower area. The study determined that the effects of diesel fertiliser support, import prices and diesel fertiliser prices on sunflower area were significant and that diesel fertiliser support was more effective on area than premium support to producers.

Duru (2023) tried to reveal the production, export and import structure of vegetable oils obtained from the most important oilseeds in terms of demand in Turkey in the period 2001-2022. In his study, he concluded that although the index values change depending on the variables used in the calculation of the competitiveness indices, the highest competitiveness was achieved by sunflower oil in the period studied.

Kadakoglu et al. (2023) analysed the competitiveness of oilseed crops in Turkey, which has a low level of sufficiency and an increasing foreign trade deficit every year. The study concluded that the current support policies for oilseed crops in Turkey should be reviewed, and support policies should be directed towards expanding areas and increasing production.

Nas and Gunal (2024) asessed the production and foreign trade status of sunflower, soybean, peanut, poppy, and sesame, which are among the oilseeds grown in Turkey, before and after the Customs Union. The study revealed that in Turkey's oilseeds trade with the EU, sunflower, soybean, and other oilseeds except poppy generally have a foreign trade deficit, and this deficit has increased in both quantity and proportion after accession to the Customs Union.

This study analyzes the impact of the exchange rate on sunflower exports, a crucial crop for Turkey's agricultural production, using the ARDL bounds test method.

MATERIAL AND METHOD

Material

For the analysis, time series data on monthly sunflower seed exports and exchange rate datas for the period 2017-2023 are obtained from the Turkish Statistical Institute and the Central Bank of the Republic of Turkey's Electronic Data Distribution System.

Method

The ARDL bounds test is used to analyze the relationship between Turkey's monthly sunflower seed exports and exchange rate data for the period 2017–2023. In addition, the following model was established for this analysis.

$$Y_1=\alpha+\beta_1X+\varepsilon \quad (1)$$

Y_1= Value of seed exports (\$), X=Dollar exchange rate (\$), ε=Error term.

Before applying the ARDL bounds test, the stationarity of the data must be verified through unit root tests.

Augmented Dickey Fuller (ADF) and (PP) Unit Root Tests

To investigate the relationship among variables, a stationarity test must be performed before incorporating them into the econometric model. This test assesses whether the series contain unit roots. If the series are found to be non-stationary (i.e., if they exhibit unit roots), they should be differenced to achieve stationarity, thereby preventing the issue of spurious regression.

The initial unit root test method was developed by D. Dickey and W. Fuller in 1979 and is known as the Dickey-Fuller Unit Root Test. Two years later, the same researchers introduced the Generalized (Augmented) Dickey-Fuller (ADF) Unit Root Test. In the original test model, if autocorrelation is observed in the error term, an additional lag is incorporated to mitigate its effects. The Dickey-Fuller (1981) Unit Root Test offers three distinct model options.

$$\Delta Y_t=\lambda Y_{t-1}+\mu_t \quad (2)$$

$$\Delta Y_t=\alpha_0+\lambda Y_{t-1}+\mu_t \quad (3)$$

$$\Delta Y_t=\alpha_0+\alpha_1 t+\lambda Y_{t-1}+\mu_t \quad (4)$$

The first model (2) is used for the cases without the constant term and trend effect. The second model (3) is applied in cases where there is a constant term effect, while the third model (4) is suitable for cases where there is both a constant term and a trend effect.

The ADF unit root test is based on the assumption that the error terms are independent and maintain constant variance. Therefore, for the test to yield reliable results, the error terms should not be correlated and their variance must remain constant. In response to these conditions, P. Phillips and P. Perron (PP) introduced a new unit root test in 1988 that is particularly sensitive to autocorrelation and variability in the error terms. This PP unit root test examines the same model and produces results that are similar to those of the ADF unit root test.

Autoregressive Distributed Lag Bound Test (ARDL)

The Engle-Granger Cointegration Test developed by R. F. Engle and C. W. Granger in 1987 or the Johansen Cointegration Test developed by S. Johansen in 1988 are generally used to examine the cointegration relationship between variables. However, for these tests to be valid, the variables used must be stationary at the same level. If one or more of the variables have different levels of stationarity, these tests cannot be applied. In such cases, the ARDL Frontier Test developed by M. H. Peseran, Y. Shin and R. J. Smith in 2001 can be used. The ARDL bounds test facilitates the identification of both short-term dynamics and long-term cointegrating relationships, even when the variables exhibit stationarity at different levels. A key advantage of this method over other cointegration tests is that it imposes no restrictions on the error correction model, which in turn makes the results more robust and precise.

When ARDL bounds test is applied, three basic equations are used. The first equation is called the bounds test equation and the cointegration relationship is investigated here. The other two equations are the equations in which long-term and short-term relationships are analysed respectively. The bounds test equation is shown in equation 6 (Peseran and Shin, 1997).

$$\Delta y_t=\alpha+ \sum_{i=1}^{m}\beta_1\Delta y_{t-i}+ \sum_{i=1}^{m}\beta_2\Delta x_{1t-i}+\beta_3 y_{t-1}+\beta_4 x_{t-1}+e_t \qquad (6)$$

In this equation, the coefficients β_3 and β_4 are examined. If these coefficients equal zero, it indicates that there is no cointegration relationship between the variables. Conversely, if β_3 and β_4 are non-zero and differ from each other, a cointegration relationship is inferred. To assess these scenarios, the computed F-statistic is compared with the asymptotic critical values. Should the F-statistic exceed the upper limit, it confirms that β_3 and β_4 are non-zero and distinct, thereby establishing a cointegration relationship. If the F-statistic is below the lower bound, it suggests that the coefficients are both zero and equal, indicating the absence of cointegration. Finally, if the F-statistic falls between the lower and upper bounds, no definitive conclusion can be drawn regarding cointegration, as this interval is considered an indeterminate region.(Akcan, Kurt and Kılıç, 2022).

Among the other equations in the ARDL bounds test, the equation that reveals the long-run cointegration relationship is equation 7.

$$y_t=\alpha+\sum\nolimits^{m}_{i=1}\beta_1 y_{t-i}+\sum\nolimits^{m}_{i=1}\beta_2 x_{t-i}+e_i \tag{7}$$

By adding (λ_3ECMt-i), which is one lagged value of the residuals of the long-term equation, to the equation indicating the long-run relationship, the equation indicating the short-run relationship is obtained. This equation is given in equation 8.

$$\Delta yt=\alpha_0+\sum\nolimits^{m}_{i=1}\beta_1\Delta y_{t-i}+\sum\nolimits^{m}_{i=1}\beta_2\Delta x_{t-i}+\lambda_3 ECMt-1+e_i \tag{8}$$

These equations are employed to ascertain the cointegration relationship among the variables and to derive the interaction coefficients for both long-run and short-run dynamics. (Peseran & Shin, 1997).

RESULTS

At the decision stage of econometric analysis, the first way to determine the appropriate method is to test whether the series have unit root. In this direction, the results of the unit root test applied to the series are presented in Table 1.

Within the scope of the unit root test, PP and ADF root tests were used. According to the test results, sunflower seed exports, which is considered as the dependent variable, is stationary at the level and the dollar exchange rate, which is the independent variable, is stationary at the first difference level. As a result of these findings, it is understood that the ARDL model is appropriate for analysing the short and long term relationships between the series.

Table 2. Unit Root Tests

	ADF		PP	
Variable	I(0)	I(1)	I(0)	I(1)
lnY_1	-4.24***	-7.67***	-3.89***	-7.72***
lnX	0.44	-6.72***	1.07	-5.52***

(*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1%.

Initially, appropriate lag lengths were selected based on the Akaike Information Criterion, and diagnostic tests were conducted to verify that the data exhibit a long-run relationship. The computed F-statistic of 24.4178 exceeds the 1% upper critical limit, which confirms the existence of a cointegration relationship among the variables. Moreover, the diagnostic tests indicate that the model is correctly specified, showing no autocorrelation, no heteroscedasticity, and no specification errors, with the residuals following a normal distribution.

Table 3. ARDL Bound Test

ARDL (4,0)	Value	I(0) Bound	I(1) Bound
F istatistic	24.4178	6,84	7,84
t istatistic	-6.982722	-3,43	-3,82
Ramsey Reset Test	0.397688(0.6920)		
Jarque Bera Normality Test	0.862896(0.6495)		
Breusch-Godfrey Serial Correlation LM Test:	1.625573(0.0820)		
Heteroskedasticity Test: Breusch-Pagan-Godfrey	1.280199(0.2816)		

Significant at the 1%.

According to the long-term test results, there is a statistically significant positive relationship between lnX and lnY_1. The estimated coefficient of 0.304043 (p-value = 0.0191) indicates that a 1% increase in the USD is associated with a 0.30% rise in exports. It can be said that the results obtained in the ARDL analysis are similar to studies such as Orman (2022), Öktem (2022), Tekin (2022).

Table 4. Long Run Form and Bounds Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnX	0.304043	0.126914	2.395666	0.0191
EC = lnY_1 - (0.3040*lnX)				

Significant at the 1%.

In an error correction model (ECM), the coefficient associated with the error correction term is typically expected to be both negative and statistically significant. This suggests that the model inherently contains a mechanism for reverting to its long-run equilibrium. Moreover, the size of the coefficient reflects the speed at which short-run deviations are corrected. Specifically, in this study, an error correction coefficient of -0.622 implies that roughly 62% of a short-run shock is corrected in the subsequent period, steering the system back toward its long-run equilibrium.

Table 5 . Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.644.989	1.369.654	7.041.917	0.0000
D(LN_H(-1))	0.315710	0.093090	3.391.466	0.0011
D(LN_H(-2))	0.483720	0.101694	4.756.612	0.0000
D(LN_H(-3))	0.356143	0.111305	3.199.705	0.0020
CointEq(-1)*	-0.622500	0.088482	-7.035.307	0.0000

Significant at the 1%

The cusum test was applied to determine whether there is any structural break in the model. Figure 1. According to the CUSUM tests, it is seen that the graph is within the 5% confidence limits. When we look at the CUSUMQ test, it is seen that the graph is also within the confidence limits. Consequently, we can infer that the model is robust and valid.

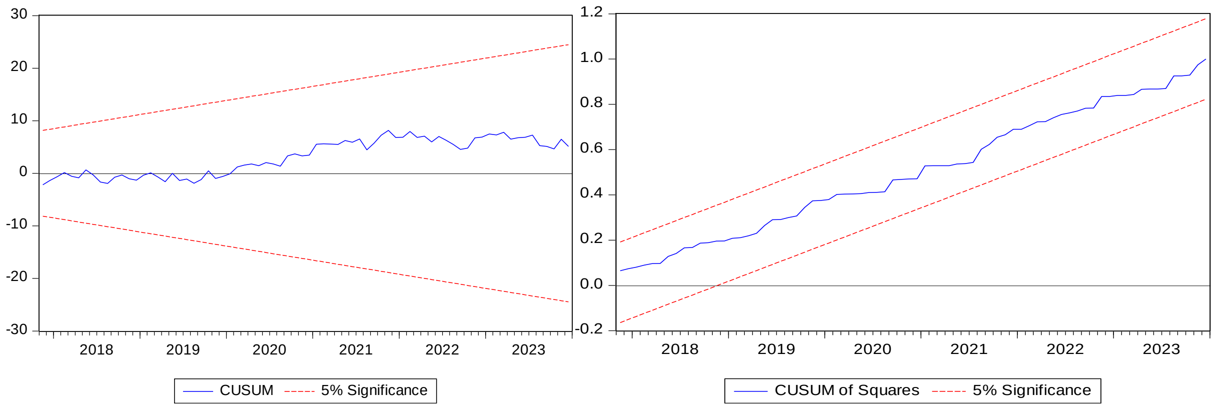

Figure 1. Cusum and Cusumq Graphs

CONCLUSIONS

In this research, the effects of exchange rate on sunflower seed exports are examined using monthly Turkish sunflower seed exports and exchange rate data between 2017 and 2023. ARDL bounds test is used to analyse the data and the short and long run effects of exchange rate on sunflower seed exports are examined. Firstly, unit root test is used to determine whether the data is stationary for analysis and the dependent variable sunflower seed is determined to be stationary at I (0) level and the independent variable exchange rate is determined to be stationary at I (1) level.

The significance of the model constructed as (1,0) with the appropriate lag interval was determined by diagnostic tests. As a result of the test, it was concluded that a 1% unit increase in the exchange rate increased sunflower exports by 0.30% unit in the long-term. With the existence of the error correction coefficient, it was determined that 62% of a shock occurring in the short-term can be compensated in the long-term. Ultimately, it was assessed whether a structural break existed, and it was concluded that the model fell within the appropriate confidence limits, indicating its stability and significance.

Turkey's sunflower seed exports have a significant relationship with the exchange rate and in this context, sustainable agricultural and trade policies are of great importance. Increasing local production, protecting natural resources and focusing on exporting value-added products can support both economic stability and environmental sustainability. Long-term planning of foreign trade strategies, taking into account the exchange rate and trade balance relationship, contributes to sustainable growth and international competitiveness in Turkey's agricultural sector. In this context, comprehensive policies that ensure economic and environmental sustainability need to be implemented.

Support for sunflower producers should be increased and remedial policies should be developed in order to disseminate modern agricultural techniques and enable farmers to achieve higher yields and profitability at lower costs. In order to realise the goal of sustainable sunflower production, projects aimed at increasing the quality of life and income levels of farmers, especially in research regions, should be implemented. Infrastructure investments to be made in rural areas will increase the socio-cultural and economic welfare of farmers in the long term and will enable the young population to contribute to agricultural production. Sunflower production should be economically, ecologically and socially sustainable, productive and internationally competitive and every stage from production to marketing should be supported. This process will enable Turkey to achieve sustainable development in the globalisation process.

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