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The Impact of Exchange Rate and Inflation Rate Fluctuations on Türkiye's Agricultural Exports: A Statistical Analysis

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ABSTRACT

Examining agricultural exports from the specific perspective of the Turkish economy is essential, as it facilitates the development of foreign trade policies, strengthens the agricultural sector, enhances global market competitiveness, and optimizes productivity. This study employs multiple regression analysis to assess the impact of exchange rate volatility and inflation on Türkiye's agricultural exports from 2016 to 2023. The results indicate that these two variables have a moderate effect on the value of Türkiye's agricultural exports. Additionally, the analysis highlights that exchange rate volatility and inflation rates significantly affect these exports. Particularly, the positive impact of exchange rate volatility on exports suggests that firms may benefit from increasing their export share.

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Introduction

Export expansion plays a pivotal role in fostering national economic development, particularly within emerging economies. Notably, since the 1980s, Türkiye has shown a strong commitment to outward-oriented growth strategies within the global economy, a shift marked by the January 24, 1980 Decisions. As a result of these resolutions, Türkiye has experienced a substantial increase in exports and a significant transformation in its economic structure. The growth in exports has benefited the economy by attracting a skilled labor force and enhancing product diversity across multiple sectors. (Genç et al., 2010). Following the January 24 Decisions, trade with both European Union nations and Middle Eastern and Islamic countries experienced a revival, leading to an average 14.7% increase in foreign trade volume from 1980 to 1990 (Özkardeş, 2015). Moreover, this evolving global structure introduces the risk of foreign exchange fluctuations for nations. Türkiye's 2001 economic crisis prompted a shift from a fixed to a flexible exchange rate regime, supporting an export-driven economic growth model. Consequently, the Turkish government aimed to reduce the foreign trade deficit by boosting exports within this framework (Altin and Suslu, 2017).

It can be argued that growth in a country's overall exports, as well as in its agricultural exports, contributes positively to the growth of its GDP (Gilbert et al., 2013; Njimanted and Aqulias, 2015; Ben-Amor et al., 2015; Hyunso, 2015; Verter and Becvár). Since the analysis in this study covers the years 2016-2023, the data representing agricultural exports for these years is displayed in Figure 1. It becomes evident that export values show a general upward trend over time. As illustrated in Figure 1, the average annual value of agricultural exports was approximately USD 1.5 billion in 2013, with projections indicating an increase to USD 3.5 billion by 2023. In 2020, a marked decrease in exports occurred due to the global impact of the SARS-CoV-2 pandemic. The seasonal decline in agricultural exports during winter and summer months may be attributed to these being the primary periods for sowing and harvesting, respectively.

Adopting a distinct approach to studying agricultural product exports within the Turkish economy is essential. Such an approach aims to inform foreign trade policy, support agricultural sector development, enhance international market competitiveness, and boost productivity.

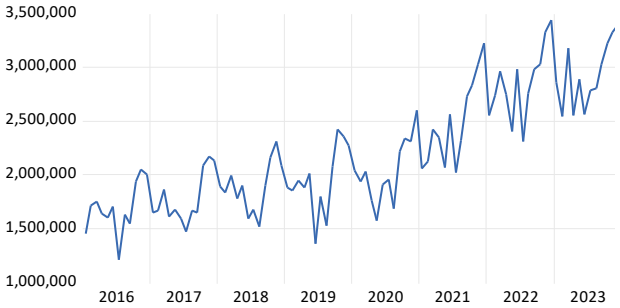

Figure 1. Türkiye's Agricultural Product Exports (Billion USD) Source: TIM

This study's objective is to analyze the relationship between agricultural product exports, inflation, and exchange rates through multiple regression analysis. The study utilizes agricultural export data from the Turkish Exporters Assembly (TIM) and monthly inflation and dollar exchange rate data for the years 2016-2023, sourced from the Central Bank of the Republic of Türkiye's Electronic Data Distribution Centre (EVDS). The importance of agriculture and agricultural production in Türkiye, historically and currently, has attracted substantial interest. The study's significance and originality lie in its examination of agricultural exports in relation to inflation and exchange rates over this period. The observation interval selected is expected to offer valuable insights regarding both dependent and independent variables, contributing unique value to the research.

Literature review

The impact of exchange rate fluctuations and inflation on a country's agricultural exports is a topic of significant interest in the field of economics. Various studies have been conducted to analysed the relationship between exchange rate movements, inflation, and agricultural exports.

In a 2002 study, Sevela examined the impact of agricultural exports on economic growth in the Czech Republic, incorporating variables such as gross national product (GNP), GNP per capita, agricultural exports, and a gravity model accounting for trade flows between exporting countries. The econometric method applied was weighted least squares (WLS). The findings demonstrated a statistically significant positive correlation between agricultural exports and GNP, while a statistically significant negative correlation was identified between agricultural exports and both GNP per capita and geographical distance.

In their study spanning the years 1990 to 2001, Demirel et al. (2004) utilized the Engle-Granger method to investigate the impact of real exchange rate volatility on exports in the mining and agriculture sectors. Their findings indicated that real exchange rate volatility has a negative effect on exports in these sectors.

In the study by Dawson (2005), the contribution of agricultural exports on economic growth was measured for 62 countries for the period 1974-1995. In the study, fixed effects and random effects models were used within the framework of panel data analysis. As a result of the analysis, there are significant structural differences in economic growth between low, lower-middle, and upper-income LDCs. Investment in the agricultural export subsector has a statistically identical impact on economic growth as investment in the nonagricultural export subsector. The marginal productivities in nonexport subsectors are over 30% lower than those in respective export subsectors. From a policy perspective, the results suggest that export-promotion policies should be balanced.

The study by Hatab et al. (2010) aimed to analyze the determinants of agricultural exports in Egypt using the gravity model method. The analysis results indicated that a 1% increase in GDP corresponded to a 5.42% rise in Egypt's agricultural exports. Additionally, the findings suggested that an increase in GNP per capita led to a decrease in trade flows as predicted by the gravity model.

Erdal et al. (2011) investigated the impact of real effective exchange rate volatility on Turkish agricultural exports and imports, using monthly data from January 1995 to November 2007. The study employed the GARCH (1,1) model to assess exchange rate volatility and Johansen cointegration to identify the long-term relationship between the variables. Additionally, Granger causality analysis was applied to determine the direction of these relationships. The findings indicate a positive long-term relationship between exchange rate volatility and agricultural exports, while a negative relationship was observed between volatility and agricultural imports.

Yanıkkaya et al. (2013) and Peker (2014) used panel data analysis to examine the relationship between exchange rates and the agricultural sector. Their findings indicated a positive correlation between agricultural product exports and exchange rate volatility. Specifically, as the exchange rate increases and the Turkish lira depreciates, agricultural product exports tend to rise.

In a 2015 thesis, Karataş examined the effect of the real effective exchange rate (REER) and REER volatility on Türkiye's agricultural foreign trade. Panel data analysis was conducted for the period 1990-2012, focusing on 25 key countries involved in Türkiye's agricultural trade. The FMOLS model was used to assess the relationship between IGARCH variables and volatility. The results showed a 7.61% increase in agricultural imports and a 2.24% increase in agricultural exports.

Toktaş (2017) conducted a statistical and cointegration analysis covering the period from 1997 to 2015. Using the Bound Test Approach, the findings indicated that agricultural product exports are affected by exchange rate volatility, with hazelnuts identified as the most susceptible export product.

Yetiz and Ozden (2017) conducted an investigation into the causal relationship between Türkiye's GDP and the agriculture, industry and services sectors, utilising 1968-2015 annual data. Accordingly, Engle-Granger causality/Block Exogeneity Wald tests, Impulse-Response and Variance Decomposition analyses were employed. Upon evaluation of the results, it was found that although there is a unidirectional Granger causality relationship from the agricultural sector to the GDP and industry and services sectors, the agricultural sector has a stronger relationship with the other sectors.

The United States Department of Agriculture (USDA) published a report titled *"The Competitiveness of the Brazilian Agricultural Sector in 2020: Recent Growth and Future Implications under the Impact of Changing

Macroeconomic Conditions and Currency Weakness."* The report highlights that macroeconomic reforms and policies have played a key role in positioning Brazil as a major competitive agricultural exporter. Despite challenges such as declining international commodity prices, slowed demand, and a severe recession from 2014 to 2016, Brazil's agricultural sector has continued to maintain its export levels, establishing itself as one of the world's most significant and resilient agricultural exporters.

Aslan (2024) utilized various analytical techniques—including stationarity tests, impulse-response analysis, variance decomposition, and causality analyses—to clarify the impact of exchange rate shocks and fluctuations on the value of Türkiye's agricultural exports. Findings indicated that in the months following dollar exchange rate shocks, the error variance of agricultural exports increased within a range of 0.01% to 1.76%. This outcome suggests a significant interaction between open exchange rate movements and the value of agricultural exports.

Materials and Methods

Data Set

This study employs a dataset covering monthly agricultural export values, exchange rate volatility, and inflation from 2016 to 2023. Given that there are two independent variables, the dataset is considered sufficiently large (Akbulut and Çapık, 2022, p. 133). Data on Türkiye's agricultural exports were obtained from the Turkish Exporters Assembly (TIM), while exchange rate and inflation data, used as independent variables, were sourced from the Central Bank of the Republic of Türkiye's Electronic Data Distribution System (EDDS).

Figure 2 illustrates changes in the USD/TL exchange rate in relation to fluctuations in agricultural exports. Analysis of the relationship between these two variables indicates that increases in the dollar exchange rate are associated with a moderate rise in export values.

In general, exchange rate shocks positively influence exports in the short term. To assess the resilience of exports to exchange rate fluctuations, the daily standard deviation of the USD/TL exchange rate within each month was used as an indicator of monthly dollar volatility. Analysis of the relationship between agricultural exports and the monthly standard deviation of the dollar exchange rate revealed that higher exchange rate volatility, particularly after 2021, had a positive effect on agricultural exports.

Figure 4 illustrates changes in the inflation rate alongside agricultural exports. An examination of the relationship between these variables shows that during periods of rising inflation, export values generally increase as well, evidenced by the parallel upward trends in both inflation and exports in Türkiye post-2018. Notably, in 2023, even as inflation declined, export values continued to follow an upward trajectory.

Research method

The objective of this study is to analyse the effect of exchange rate volatility in Türkiye's agricultural sector on agricultural exports in monthly periods, taking inflation into account. To achieve this, a multiple regression model was employed as the research method.

Multiple regression

Regression analysis is a technique used to investigate the relationship between a dependent variable and one or more independent variables. When only one independent variable is present, univariate regression analysis is applied. In contrast, when multiple independent variables are involved, multivariate regression—also referred to as multiple regression—is the primary analytical approach. In economic research, a variable may be influenced by multiple factors simultaneously, and these factors may interact with each other as well. In this study, considering the potential influence of multiple variables on investments, multiple regression analyses were conducted.

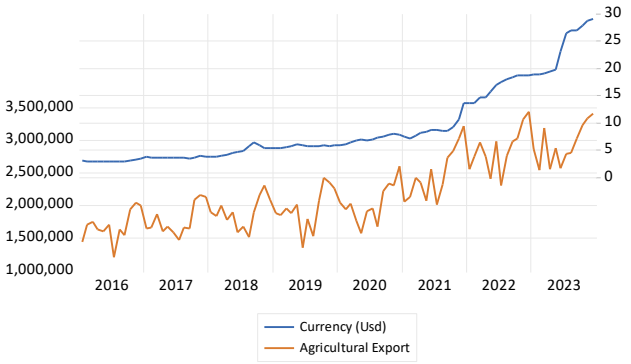

Figure 2. US Dollar/TL Exchange Rate and Agricultural Products Exports (Billion $)
Source: The data Organized by author using the data from TIM

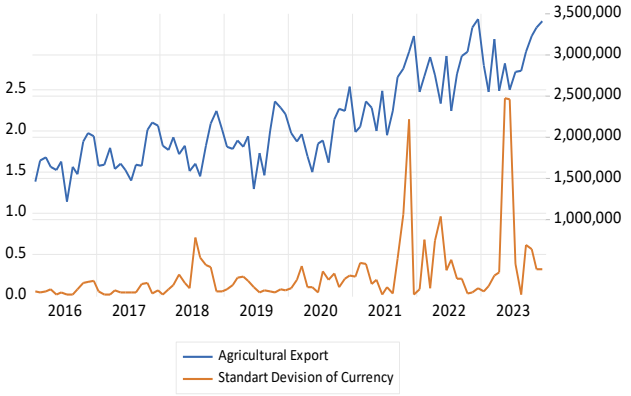

Figure 3. Standard Deviation of US Dollar/TL Exchange Rate and Exports of Agricultural Products (Billion)
Source: The data were organized by the author using outputs from TIM

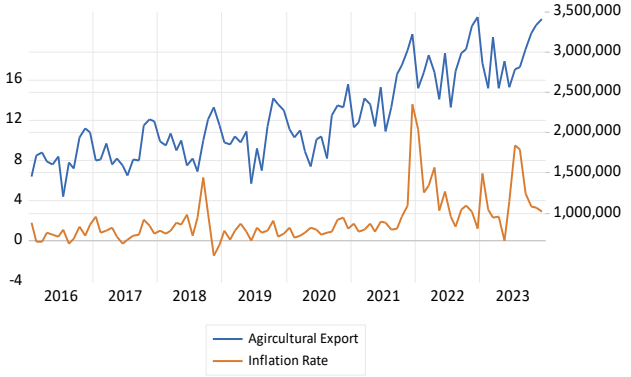

Figure 4. Türkiye's Agricultural Product Exports and Inflation Rate (Billion USD)

In regression analysis, independent variables are represented as model inputs, while the dependent variable serves as the model output. This approach allows for the examination of the relationship between the dependent variable and independent variable(s). In the current study, the dependent variable is defined as the "export values of agricultural products," with "exchange rate volatility" and "inflation" serving as the independent variables.

Following this methodology, the econometric model to be estimated is structured as follows:

$$\text{export}i = \alpha + \beta 1(\text{e})i + \beta 2(\text{in}f)i + \varepsilon$$

Findings

Descriptive Statistics

In this study, the Eviews 12 software package was used to perform all statistical and econometric analyses. First, the descriptive statistical values of the data were calculated and are presented in Table 1. As shown, logarithmic transformations of the variables were applied in the descriptive statistical analyses. Given the substantial differences in the numerical magnitudes of the variables at their level values, regression analyses were conducted using logarithmic transformations. This approach minimized differences in magnitude across variables, allowing them to be analyzed on a comparable scale in logarithmic form.

A fundamental assumption in linear regression models is that the independent variables should follow a normal distribution. In this study, descriptive statistics were used to determine whether the variables exhibit normal distribution characteristics. The skewness and kurtosis values indicate the degree to which the variables align with a normal distribution. As noted by Günlük-Şenesen (2007), a skewness value close to zero suggests symmetry around the mean, while a kurtosis value of 3 indicates a mesokurtic (normal) distribution. A kurtosis value below 3 suggests that the series is less peaked, or more platykurtic, than a normal distribution. Conversely, a kurtosis value of exactly 3 indicates that the series is mesokurtic, aligning with a normal distribution. If the skewness value is less than zero, it suggests the distribution is left-skewed, meaning the tail on the left side is longer. Positive skewness values indicate right skewness, where the distribution tail extends more on the right. Typically, skewness values between -1.5 and 5 are considered within acceptable limits for normality (George and Mallery, 2010). Values within this range suggest the dataset is moderately skewed to the right. Based on these criteria, all variables, including the logarithmic transformation of the foreign exchange variable, were found to be normally distributed.

Stationarity Tests

The stationarity test is a fundamental requirement in time series analysis, as non-stationary series may fail to accurately represent the relationships between variables (McKinnon, 1991). Therefore, it is essential to conduct stationarity tests on the series and transform any non-stationary series into a stationary form.

Data Stationarity Tests

The test results indicated that the Agricultural Export series was non-stationary at level, exhibiting a unit root. However, after taking the first difference of the series, it became stationary in the first-lagged form without a constant or trend. Additionally, the critical absolute value (4.31) exceeded the thresholds of 3.51, 2.89, and 2.58 at the 1%, 5%, and 10% significance levels, respectively, thereby rejecting the \(H_0 \) hypothesis. The results of the corresponding ADF test are displayed in Table 2.

The test results indicated that the inflation series was stationary at level. Moreover, the critical absolute value of the series (4.51) exceeded the thresholds of 3.50, 2.89, and 2.58 at the 1%, 5%, and 10% significance levels, respectively, leading to the rejection of the \(H_0 \) hypothesis. The results of the corresponding ADF test are shown in Table 3.

Table 1. Descriptive Statistics

	Currency (e)	Exp	Inf	LogCur	LogExp	LogInf
Mean	9.169697	2198144	2.059063	1.969647	14.57378	0.334790
Median	6.057865	2064513	1.33	1.801357	14.54040	0.336064
Maximum	29.07486	3435761	13.58	3.369874	15.04975	2.608598
Minimum	2.839848	1206270	-1.44	1.043750	14.00304	-3.506558
Std.Dev.	7.068800	542995.7	2.415763	0.680845	0.242496	1.053424
Skewness	1.356458	0.550534	2.438306	0.529054	0.159906	-0.813778
Kurtosis	3.780544	2.338479	10.02326	2.143405	2.177245	5.201467
Jarque-Bera	31.87664	6.599848	292.4301	7.413387	3.116822	28.10773
Probability	0.00000	0.036886	0.00000	0.024559	0.210470	0.000001
Sum	880.2910	2.11E+08	196.6700	189.0861	1399.083	30.13113
Sum Sq.Dev.	4746.954	2.80E+13	554.4114	44.03725	5.586392	98.76352
Observations	96	96	96	96	96	96

Source: The data were organized by the author using outputs from Eviews.

Table 2. Export Data ADF Unit Root Test

Augmented Dickey-Fuller test statistic		T-Statistic	Prob.*
		-4.311371	0.00008
Test critical values	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

Source: The data were organized by the author using outputs from Eviews.

Table 3. Inflation ADF Unit Root Test

Augmented Dickey-Fuller test statistic		T-Statistic	Prob.*
		-4.512039	0.0004
Test critical values	1% level	-3.500669	
	5% level	-2.892200	
	10% level	-2.583192	

Source: The data were organized by the author using outputs from Eviews.

Table 4. Currency ADF Unit Root Test

Augmented Dickey-Fuller test statistic		T-Statistic	Prob.*
		-5.682593	0.0000
Test critical values	1% level	-3.501445	
	5% level	-2.892536	
	10% level	-2.583371	

Source: The data were organized by the author using outputs from Eviews.

Table 5. Estimation Results of the Model

		Dependent Variable export
e	$\boldsymbol{\beta 1}$	(0.280214) (0.0000)
inf	$\boldsymbol{\beta 2}$	(0.030565) (0.0488)
C	a	(14.00951) (0.0000)
R2	0,72	
F-statistic	114.978	
Prob(F-statistic)	0.000000	
Durbin-Watson	127	

Source: The data were organized by the author using outputs from Eviews.

Table 6. White Variable Variance Test Results

F-statistic	0.71	Prob. F(5,84)	0.6171
Obs*R-squared	3.652589	Prob. Chi-Square(5)	0.6004
Scaled explained SS	2.888743	Prob. Chi-Square(9)	0.7171

Source: The data were organized by the author using outputs from Eviews.

The test results indicated that the Currency series was non-stationary at level, exhibiting a unit root. However, after taking the first difference of the series, it became stationary in the first-lagged form without a constant or trend. The critical absolute value (5.68) exceeded the thresholds of 3.50, 2.89, and 2.58 at the 1%, 5%, and 10% significance levels, respectively, leading to the rejection of the \(H_0 \) hypothesis. The results of the corresponding ADF test are shown in Table 4.

Model

In this study, model (1) was utilized to determine the proportional change in the dependent variable (xu30) in response to proportional changes in the independent variables. Thus, the proportional change in "exports" in response to a 1% change in the independent variables was estimated. The resulting estimates were then analyzed.

Assumptions regarding the error term are crucial for ensuring the validity and significance of the analyses. Therefore, it is essential that the error term remains free of autocorrelation (Çakmak and Yılmaz, 2018, p. 280).

The R^2 value, representing the explanatory power of the independent variables on the dependent variable, is 0.72, indicating a satisfactory level of explanatory capability for the model. The F-test, which evaluates the statistical significance of a regression model, relies on the model's associated probability value. If this probability is less than 0.05 at a 95% confidence level, the regression model is considered statistically significant. In other words, the collective explanatory power of the independent variables on the dependent variable is deemed meaningful. In this case, the F-value is 114.978, with a probability of 0.00, thus confirming the overall significance of the model through the statistical relevance of the joint effect of the independent variables, as verified by the F-test.

White Variable Variance

If the variance of the error terms depends on the values of the independent variables, this issue is known as heteroskedasticity. Table 6 presents the results of the White Heteroskedasticity test, which is used to detect the presence of heteroskedasticity. The F-statistic values shown in the table are used to determine whether the error term variance remains constant. If the F-statistic is significant ($p < 0.05$), it indicates the presence of a heteroskedasticity problem. Conversely, if the p-value is greater than 0.05, it suggests that heteroskedasticity is not an issue.

Descriptive Statistics

Table 7 presents the descriptive statistics and Jarque-Bera test statistics for the error terms. Based on the results, the skewness and kurtosis values fall within the acceptable range for normal distribution, and the significance probabilities of the Jarque-Bera statistic exceed 0.05. This indicates that the error terms are normally distributed

Table 7. Descriptive Statistics for Error Terms

	E
Mean	3.05-15
Median	0.010155
Maximum	0.215112
Minimum	-0.31536
Std.Dev.	0.128154
Skewness	-0.346434
Kurtosis	2.692718
Jarque-Bera	2.154330
Probability	0.340560
Observations	96

Source: The data were organized by the author using outputs from Eviews.

Table 8. Ramsey Rest Test

	Value	Df	Prob.
T-statistic	0.809239	86	0.4206
F-statistic	0.654867	(1,86)	0.4206
Likelihood ratio	0.682730	1	0.4086

Source: The data were organized by the author using outputs from Eviews.

Ramsey Reset Analysis

The Ramsey RESET (Regression Specification Error Test) was employed to assess whether the regression model is correctly specified. This test is a specialized diagnostic tool used to determine if additional explanatory variables should be included to improve model accuracy.

The results of the Ramsey RESET test are presented in Table 8. The t-statistic is used to determine whether the coefficients of the added square terms are zero. Here, the t-statistic value is 0.80 ($p > 0.05$), indicating that including these terms does not significantly enhance the model's predictive performance. Additionally, the F-value assesses the model's overall significance. An F-statistic value of 0.65 ($p > 0.05$) suggests that the additional terms do not improve the model's overall significance. The likelihood value, representing the likelihood ratio of the added terms, is 0.68 ($p > 0.05$), further indicating that the added terms do not significantly increase the model's likelihood.

Contrary to expectations, the test results show that the additional terms do not significantly enhance the explanatory power of the model. Thus, the Ramsey RESET test suggests that further variables should *not* be incorporated into the existing model to augment its explanatory capacity.

The estimation results revealed a 0.28% decrease in the dependent variable for a 1% change in the independent variable, currency. The findings suggested that fluctuations in foreign exchange rates had a significant impact on exports. Furthermore, the estimation results for inflation, another independent variable, indicated that a 1% change in inflation would lead to a 0.03% increase in agricultural exports. An increase in inflation was found to have a positive and significant effect on agricultural exports.

Results

This study utilizes multiple regression analysis to investigate the impact of exchange rate volatility and inflation on Türkiye's agricultural exports. The findings suggest that the effects of these two variables on Türkiye's agricultural export values are moderate.

It has been demonstrated that an increase in exchange rate volatility is correlated with a rise in export values. A higher exchange rate lowers unit costs in TL, enabling firms to offer more competitive export prices.

Another key finding of the study is the discovery that an increase in the inflation rate is associated with a rise in agricultural export values. While conventional economic theory suggests that inflation typically has a negative impact on exports, the results of this study indicate that it may actually have a positive effect.

The results of the analyses presented in this study indicate that exchange rate volatility and inflation have a significant impact on Türkiye's agricultural exports. Specifically, the positive effect of exchange rate volatility on exports suggests that companies should adopt strategies aimed at increasing their export share.

Discussion

The study demonstrates that increased exchange rate volatility is linked to higher export values. A rise in the exchange rate reduces unit costs for expenses paid in TL, allowing companies to offer more competitive prices as their costs in dollar terms decrease. Another key finding is that higher inflation is associated with an increase in agricultural export values. While economic theory typically suggests that inflation negatively impacts exports, this study finds a positive effect. The analysis indicates that both exchange rate volatility and inflation significantly influence Türkiye's agricultural exports. Notably, the positive effect of exchange rate volatility suggests that companies should aim to expand their export shares.

Conclusion

The estimation results indicated a 0.28% decrease in the dependent variable for every 1% change in the independent variable, Currency. The findings demonstrated that fluctuations in foreign exchange rates had a favorable impact on exports. Additionally, the estimation results for inflation, another independent variable, suggest that a 1% change in inflation will lead to a 0.03% increase in agricultural exports. An increase in inflation has a positive and statistically significant effect on agricultural exports.

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