A Study on the Effect of Imported Wheat Prices on Türkiye's Pasta Exports: ARDL Approach

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Abstract. Türkiye has possessed significant agricultural opportunities throughout its history. Although the effective utilization of these opportunities is a subject of debate today, the country still plays a significant role in the global trade of some agricultural products. When discussions about Türkiye's exports are examined, a common complaint is the external dependency of the export industry. However, there are also debates about the diminishing agricultural advantages that have been present since the past. When these discussions are brought together, the trade of certain processed agricultural products, whose raw materials are agricultural products, also becomes a noteworthy research topic due to a similar import dependency. In this study, an analysis was conducted using time series and the ARDL model to investigate whether there is a relationship between Türkiye's pasta export quantity, as one of the leading pasta exporter's globally, and the prices of wheat imports from Ukraine, Russia, and Bulgaria. Also robustness checks enhanced the analyzes by employing FMOLS and DOLS methods. The research findings indicate variations in the impact of wheat prices from country to country on the quantity of pasta exported by Türkiye. Recommendations regarding the importance of wheat production in Türkiye are also provided as a result of the research.

Keywords: Export-Import Analyzes, ARDL, FMOLS, DOLS

Introduction

The climate crisis and the sustainability agenda have led to increased discussions on agricultural production and consumption. While high-tech products dominate the lion's share of trade in the current global economic system, the inherent necessity of food in human life is making the importance of food more pronounced with each passing day during global crises. Events such as the COVID-19 pandemic (Hatipoğlu, 2021), the Russia-Ukraine war (Yenginar, 2022), and the ongoing Israel-Palestine conflict underscore the significance of food supply. Particularly in Türkiye, the sunflower oil crisis and food price inflation during the pandemic highlight some agricultural issues that the country needs to carefully address (Gündüz, 2021). From the past to the present, Türkiye has faced challenges in maintaining its title as an agricultural paradise (Aksoylu & Karaalp-Orhan, 2022). Factors such as

rapidly increasing population, global migrations, inefficient use of agricultural land, and a decrease in irrigation areas for various reasons undermine Türkiye's claim of self-sufficiency in agriculture. In addition to these, more of the factors can be seen such as agricultural subsidies and rural-urban migration (Sugozu et al., 2017; Tasci et al., 2023). With these issues unfortunately claiming to be an agricultural heaven is losing its validity in today's context. The presence of products like chickpeas, beans, and lentils originating from the Americas, such as Mexico and Canada, on the shelves of markets indicates that Turkish cities, which were once associated with the production of these products, are now falling short in terms of production (TMO, 2021). Especially lentil import is kind of new for Türkiye (Gulumser, 2016). Apart from these examples, Türkiye occupies a distinctive position in terms of bread consumption compared to other countries around the world (Dolekoglu et. al., 2014). Bread and various dough products hold a significant place within the basic dietary habits of the Turkish population (Koca and Yazici, 2014). In fact, bread is considered a sacred blessing in Türkiye. Turkish women, even without the necessity of local bakeries or industrial bread production facilities, create different types of bread when they have access to flour. The majority of the Turkish population consumes bread or dough products in every meal of the day. This situation also highlights the demand for the fundamental raw material, wheat. The source of wheat is of great importance for Türkiye at this point. The table below shows the countries from which Türkiye imported the most wheat in 2022 (ITC, 2024a).

Table 1. Wheat Exporters for Türkiye (2022)

Exporter Country	Value Imported (USD Thousand)	Share of Türkiye's Imports %
Russia	2,395,449	71,4
Ukraine	719,333	21,4
Brazil	52,825	1,6
Mexico	34,957	1
Bulgaria	32,794	1
Kazakhstan	26,987	0,8
Moldova	23,780	0,7
Argentina	22,520	0,7
Syria	15,009	0,4
Latvia	14,982	0,4

These countries account for more than 99% of Türkiye's wheat imports. Additionally sectors in Türkiye that relies on wheat for sustenance is not limited to bread or pastry alone. Türkiye is one of the leading exporters of pasta worldwide. The ease with which pasta can be prepared for consumption has made it a universally beloved food, elevating it to the status of a significant product globally. It is worth emphasizing that, in terms of potential markets, this important product knows no bounds. The table below shows the countries that exported the most pasta in 2022 (ITC, 2024b).

Table 2. Leader Pasta Exporters of World (2022)

Exporter Country	Value Exported (USD Thousand)	Share of World's Imports %
Italy	4,169,527	28,7
China	1,195,235	8,2
South Korea	978,361	6,7
Türkiye	964,539	6,6
Thailand	663,258	4,6
Viet Nam	464,706	3,2
USA	438,995	3
Belgium	412,920	2,8
Germany	401,256	2,8
Netherlands	363,691	2,5

Table 2 shows that Türkiye ranks fourth among the world's top pasta exporting countries. However, viewing the pasta trade as a completely profitable and effortless venture would be an erroneous approach. This is because pasta, being a low-value-added product, can be produced and exported by many countries as can be seen from the Table 2 above. Though finding new export markets for many products may be challenging, products like pasta can easily enter any market based on customer preferences.

1. Theoretical Framework

The crucial issue here is whether one country possesses the factors to produce pasta efficiently. Heckscher (1919) and Ohlin's (1933) Factor Endowment Theory suggest that a country has a comparative advantage in exports based on its superiority in the production factors it possesses. When we look at the example of Türkiye, which has been considered throughout this study, it is expected that Türkiye indeed has a historical advantage in agricultural products. Türkiye, with its productive plains, is known as an important center for wheat. However, in contemporary times, Türkiye, despite its historical advantage in wheat production, is not self-sufficient and resorts to importing wheat from abroad. In other words, Türkiye purchases production factors, such as wheat, from other countries to use them in different stages of the production process. Examining Türkiye's imports, it can be observed that the majority of wheat is purchased from Ukraine, Russia, and Bulgaria (see Table 1). This deviation from self-sufficiency in wheat production aligns with the central premise of the Factor Endowment Theory, indicating that countries may engage in international trade to acquire the necessary production factors they lack domestically.

In this study, as the variables expected to influence Türkiye's pasta exports are not limited to imported raw material prices alone, there is a need for a theory to explain the relationship between exchange rates and exports. The Marshall-Lerner Condition, which suggests that increases in exchange rates will boost countries' exports (Bahmani et al., 2013), offers a second theoretical foundation for this study. In fact, the origin of this theory is based on Robinson's (1937) work, and it has been strengthened by criticism from Hirschman (1949),

drawing attention to issues such as price elasticity. However, fundamentally, as mentioned above, it is possible to conclude that increases in exchange rates will lead to higher exports. Additionally, according to the price effect approach, it can be argued that increases in exchange rates will encourage exporters to increase sales to earn more income, thus achieving an increase in the country's exports at the macro level (Zamani et al., 2013).

As seen in this study, the Factor Endowment Theory, an important international trade theory and Marshall-Lerner Condition will form the foundation of the research. Before delving into the methodology section, similar studies conducted globally will also be addressed.

2. Literature Review

Firstly, it is important to note that any product traded in the world is referred to as a commodity. In this context, studies related to factors influencing commodity exports will be examined. Through these studies, variables affecting the export quantity of a commodity will be revealed. Subsequently, research on pasta trade worldwide, especially in countries like Italy, and factors influencing pasta trade will be discussed. In the next stage, studies on the relationship between pasta and wheat in Türkiye will be examined. Last stage of literature review will host the studies about exchange rate and export relationship. This approach aims to provide a better understanding of why such a study is needed before moving on to the methodology section.

Nikonenko et al. (2020) state that the volatility in raw material prices affects the exports of commodity-exporting countries in world trade. Similarly, there are empirical studies that examine different countries for different commodities (McGregor, 2017; Jawaid and Waheed, 2011; Schmitt-Grohe and Uribe, 2018). In these studies, relationships between increases in commodity prices and the variability of global markets and economic growth are observed. In his research emphasizing the importance of commodity supply for different commodities, Tiess (2010) has stated that price increases can affect competition in various ways. In another study, Wlodarczyk (2018) has expressed that price volatility in commodity markets significantly affects the real economy. Niemi (2018) has stated that exports may vary depending on the price. Also, Khalifa (2016) has revealed that raw material prices are determinant for exports. The assumption that this highly probable change could be reflected in Türkiye's pasta exports through the change in raw material, namely wheat prices, is crucial for this study. Golikova et. al., (2020) have conducted research at a crucial point that will contribute significantly to this study. According to their study, price fluctuations in agricultural raw materials affect the planning of agricultural production. The existing research in the literature that examines the relationship between raw material prices and commodity exports strengthens the starting point and theoretical foundation of the study. Subsequent studies, however, focus specifically on pasta, which is the central focal point of this research.

Turning into international studies on the commercial structure of pasta, it is possible to encounter examinations from different perspectives. In their research highlighting modern pasta production in the context of sustainability, Recchia et al. (2019) emphasized

that companies engaged in global pasta exports using imported wheat are strong in this sector. It has been particularly noted that Mexico and Canada hold significant positions in wheat exports. In Italy, on the other hand, wheat is mainly supplied by local wheat suppliers, and wheat from France, the United States, and Australia are integrated into pasta production (Andrade-Sanchez, 2014; Samson et al., 2016). Mukhametzyanov et al. (2021), in their study on the production and export potential of grains and their sub-groups, including wheat and other agricultural products that serve as raw materials for many products, including pasta, have indicated that these play a significant economic role. Therefore, the export of these products is also emphasized to have strategic importance. The strategic importance of the wheat used in pasta production aside, its quality is another noteworthy aspect. Bruneel et al. (2010) underscored the paramount importance of the quality of wheat utilized in pasta production, asserting that the nutritional characteristics of pasta vary depending on the type of wheat employed. Correspondingly, Hare (2017) emphasized the correlation between the quality of the wheat used and the resulting pasta quality. Menesatti and Bucarelli (2007), in their study, accentuated that achieving high quality in the pasta sector entails elevated costs. They elucidated that consumers with a strong inclination to pay value for pasta crafted through traditional production methods for its superior quality are willing to invest in such premium pasta without hesitation. In addition, Simeone et al. (2015) highlighted in their study on the Italian pasta sector that pasta prices play a crucial role in shaping competitive strategies. In a parallel vein, Cacchiarelli and Sorrentino (2018) identified the effectiveness of regulations imposed by market regulators in pasta markets. They specifically noted that regulations on wheat have a substantial impact on the pasta supply chain. Quality and market conditions also play a significant role in pasta trade and the supply chain. All these studies indicate that there are various areas providing research opportunities regarding the relationship between the wheat used and the produced pasta.

When it comes to research conducted in Türkiye, especially those related to the pasta trade, they have been included in this study. Keskin and Demirbaş (2011) emphasized the potential of the pasta sector in Türkiye during the relevant period in a study highlighting the potential of processed agricultural products in the country. In another study, Özaydın and Karakayacı (2023) examined the structure of the flour and bakery products industry in the food industry, underlining the necessity of imported wheat for pasta exports. Çetin (2020) emphasized the dependence on imports for exports in his study, which investigated agricultural production through foreign trade data. In a study examining the foreign trade structure of wheat and wheat products in Türkiye, Duru et al. (2019) identified that wheat was imported through the inward processing regime and exported as wheat-based products. Turhan (2018), in a study analyzing the competitiveness of the pasta sector, determined that Türkiye has developed competitive capabilities in the global pasta markets. In addition to these studies, some research highlights the presence of pasta production facilities in Türkiye equipped with leading technologies (Varlık, 2021). Furthermore, it is mentioned that certain cities in Türkiye could make significant contributions to wheat production, which is essential for pasta manufacturing (Acibuca, 2021).

As observed up to this point in the study, Türkiye stands out as a significant hub for pasta production. Moreover, it has the capability to produce the wheat necessary for pasta manufacturing; however, for various reasons, the wheat produced is not sufficient to meet the required quantity for export. Çığ et al. (2022) explained this situation by stating that Turkey produces enough wheat for its own consumption but imports wheat for pasta exports by taking advantage of the inward processing regime. Despite the inherent potential for Türkiye to be a pasta exporter based on the Factor Endowment Theory, scientific studies emphasizing the necessity of importing wheat have contributed to the formulation of hypotheses in this research. As indicated in the data and methods section of the study, there are ideas suggesting that the prices determined by the countries from which Türkiye imports the most wheat could be related to Türkiye's pasta export quantity.

Nevertheless, an entire model should not be built solely on the structure of imported raw materials. Therefore, it would be appropriate to include not only the purchase of imported raw materials but also the foreign currencies obtained in exchange for exports in the research. In other words, the exchange rate variable is also a crucial factor affecting exports, particularly for developing countries such as Türkiye. Various outcomes can be observed in studies investigating the influence of the exchange rate on trade. While some studies argue that exchange rate volatility reduces foreign trade (Baak et al., 2007; Cheung & Sengupta, 2013), other studies have found that exchange rate volatility does not affect exports (Lee & Masih, 2018). Of course, there are also studies observing that exchange rate volatility increases exports (Kasman & Kasman, 2005; Kılıç and Yıldırım, 2015). Similar studies exist regarding the impact of exchange rates on Türkiye's exports. Aktaş (2012) stated that the exchange rate does not affect exports, Nazlıoğlu (2013) found that changes in the exchange rate have different effects on sectors' exports, Uysal and Doğru (2013) indicated that exports decrease as the exchange rate increases, and Karakaş and Erdal (2017) mentioned that agricultural product exports increase as the exchange rate rises. Considering these studies, the model determined for the research in the next section is appropriate in terms of theory and literature.

3. Data and Methodology

3.1. Data

Econometric model of the study explains Türkiye's pasta exports using variables such as Russia's wheat export price, Ukraine's wheat export price, Bulgaria's wheat export price, and the exchange rate. Türkiye's pasta exports represent the quantity of pasta exported from the country. The prices of countries represent the average wheat selling prices in their exports to the world. The exchange rate shows the Central Bank of the Republic of Türkiye's USD/TRY rate. This exchange rate is included in the model due to the relationship between the exchange rate and exports as per classical economic thought. Graphs for these variables are presented in following figures. As the figures for the variables are at significantly different levels, the graphs are presented individually, as depicted in Figures below.
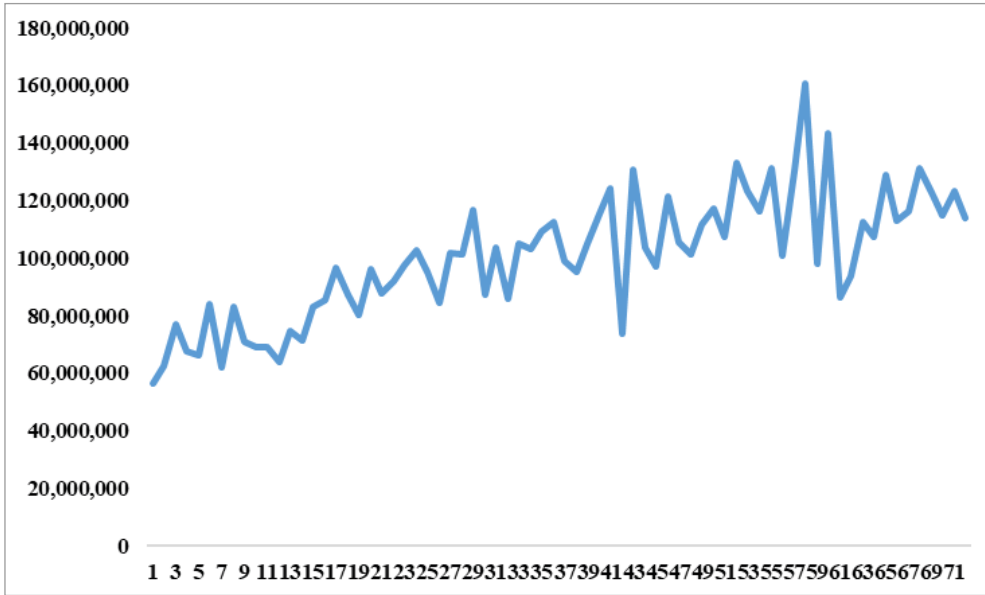
Figure 1. Trend of the Pasta Quantity (Kilograms) Exported from Türkiye

Turkey's pasta exports reached 114 million kilograms by the end of 2021, up from 60 million kilograms at the beginning of 2016. At one point, it was also observed that it reached levels of 160 million kilograms.
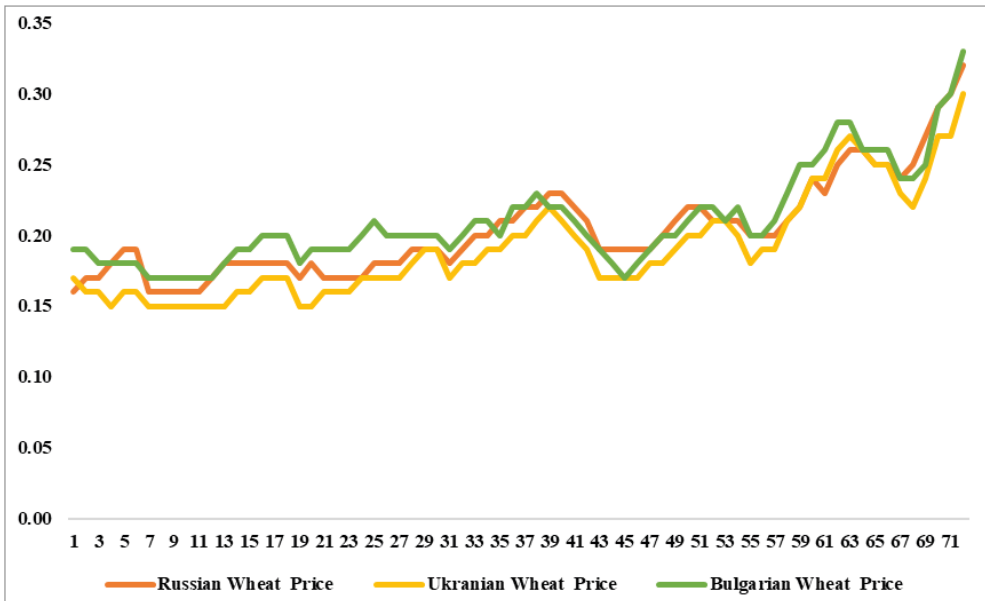

Figure 2. Trend of Russian, Ukrainian and Bulgarian Wheat Prices (USD)

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The changes in the prices per kilogram of wheat, the primary raw material for pasta production, applied by Russia, Ukraine, and Bulgaria, which are among the countries Turkey imports the most from, can be seen in Figure 2. According to this, while Ukraine offers the lowest prices and Russia offers the highest, the three prices are quite close to each other. Nevertheless, it is understood that wheat prices have almost doubled over the years.
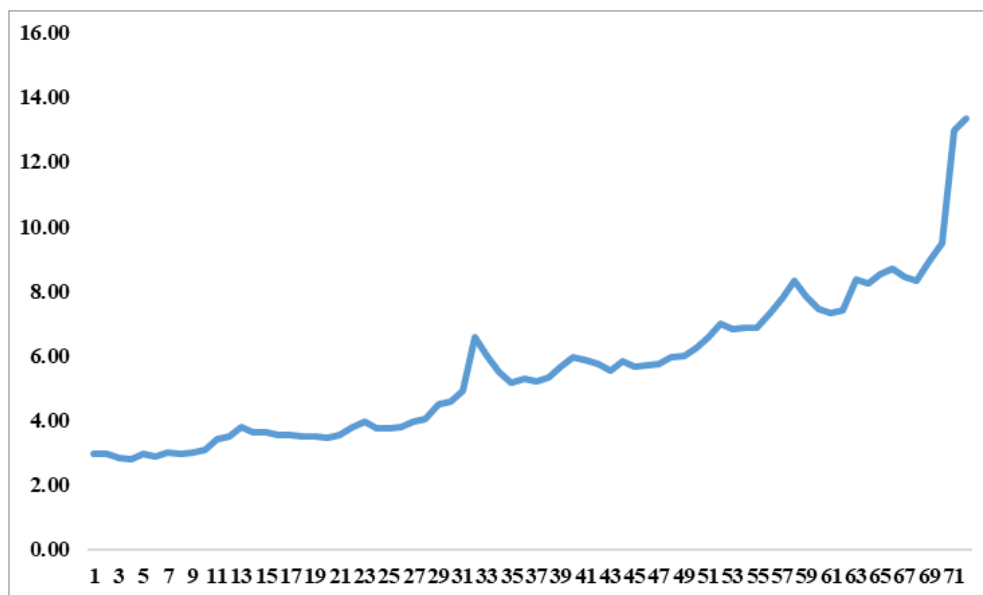
Figure 3. Trend of Exchange Rate in Türkiye (USD/TRY)

Finally, the changes in the exchange rate of the Turkish Lira against the US Dollar over the years are presented in Figure 3. Accordingly, the exchange rate has tripled from the beginning of 2016 to the end of 2021.

With these information, analyses were conducted using monthly data covering January 2016 to December 2021. The analysis period was determined based on the availability of data for all variables. Definitions of the variables and their sources are summarized in Table 3. All variables in the analysis were used in logarithmic form.

Table 3. Data and Sources Used in the Research

Variable	Description*	Period (Monthly)	Source
lnexp	Export quantity of Turkish pasta (ton)	2016(1) - 2021(12)	International Trade Center
lnuwp	Average price of Ukranian wheat (USD)	2016(1) - 2021(12)	International Trade Center
lnrwp	Average price of Russian wheat (USD)	2016(1) - 2021(12)	International Trade Center
lnbwp	Average price of Bulgarian wheat (USD)	2016(1) - 2021(12)	International Trade Center
lnexc	Exchange rate (USD/TL)	2016(1) - 2021(12)	Central Bank of Turkish Republic

* ln= Natural Logarithm of

In this study, conducted within the context of variables affecting the export of a specific sector, a model has been established. The model incorporates the above data and variables, taking into account the theoretical framework and support from the literature, as well as the consideration of raw material needs and costs. Constraints related to other variables that could not be included in the model are explained in the limitations section of the research.

3.2. Methodology

The empirical method chosen for this study is the ARDL boundary test approach proposed by Pesaran, Shin, and Smith (2001). This approach eliminates the necessity of having cointegration of the same order in standard cointegration tests and inefficiency in multivariate models (Pesaran, et. al., 2001). Furthermore, the boundary test approach ensures statistically efficient predictions, particularly in estimations conducted with small or limited samples (Altıntaş, 2013). In this study, the following model has been formulated to determine the potential impact of imported raw material prices on Türkiye's pasta export quantity.

$$lnexp = \alpha_0 + \alpha_1\, lnrwp_t + \alpha_2\, lnuwp_t + \alpha_3\, lnbwp_t + \alpha_4\, lnexc_t + \varepsilon_t \qquad (1)$$

Here, α_0 represents the constant term, ε denotes the random error term, and t represents the time period ranging from t=1,2,...,72. The first step of the ARDL procedure involves applying a boundary test; upon favorable results from this test, the estimation of long- and short-term coefficients can be conducted. To implement the boundary test, an unrestricted error correction model (UECM) is initially estimated using the least squares technique. Accordingly, adapting Model (1) to the UECM is feasible as follows:

$$
\begin{aligned}
\Delta lnexp &= \omega_0 + \omega_1\, lnexp_{t-1} + \omega_2\, lnrwp_{t-1} + \omega_3\, lnuwp_{t-1} + \omega_4\, lnbwp_{t-1} + \omega_5\, lnexc_{t-1} \\
&+ \sum_{i=1}^{p_1} \varphi_{1i}\, \Delta lnexp_{t-i} + \sum_{i=0}^{p_2} \varphi_{2i}\, \Delta lnrwp_{t-i} + \sum_{i=0}^{p_3} \varphi_{3i}\, \Delta lnuwp_{t-i} + \sum_{i=0}^{p_4} \varphi_{4i}\, \Delta lnbwp_{t-i} \\
&+ \sum_{i=0}^{p_5} \varphi_{5i}\, \Delta lnexc_{t-i} \\
&+ \varepsilon_t \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (2)
\end{aligned}
$$

Here, ω_0 represents the constant term, εt denotes the random error term, Δ signifies the first difference operator, and pi represents the lag length of the respective variable. At this stage, utilizing Model (2), a null hypothesis stating the absence of a long-term cointegration relationship among the variables, expressed as "H0: $\omega_1 = \omega_2 = ... = \omega_5 = 0$", is tested against an alternative hypothesis, articulated as "Ha: $\omega1 \neq \omega2 \neq ... \neq \omega5 \neq 0$", using the Wald or F-statistic [FIII(lnexp/lnrwp,lnuwp,lnbwp,lnexc,)] (Pesaran et al., 2001). Accordingly, the test statistic value is compared with the table boundary values provided in Pesaran et al. (2001). When making this comparison, if the stationarity degrees of the variables are I(0)

or I(1), the table's lower or upper boundary value is used, respectively. If the t-statistic is smaller than the lower boundary value, it is concluded that there is no cointegration relationship. Conversely, if the calculated statistic exceeds the upper boundary value, it is determined that there is cointegration. If the computed statistic falls between the upper and lower boundaries, no inference can be drawn regarding cointegration. If all variables have a stationarity degree of I(0), the table's lower boundary value is used. If all variables have a stationarity degree of I(1), the table's upper boundary value is utilized. In both cases, if the calculated t-statistic exceeds the table value, it is concluded that there is a cointegration relationship (Bayir and Kutlu, 2019).

In determining the optimal lag length for each variable in the UECM, a total of (p + 1)k regression models are estimated using an information criterion such as Akaike or Schwarz, where p represents the chosen maximum lag length and k indicates the number of explanatory variables in the model (Ciftci and Yildiz, 2015). As emphasized by Pesaran et al. (2001), the presence of autocorrelation issues should be absent in the UECM for the validity of the boundary test. Additionally, for adequacy, the selected model is expected to pass diagnostic tests for changing variance, modeling error, and non-normal distribution aspects. If the boundary test confirms the presence of a long-term relationship between the variables, the analysis proceeds to the second stage. In this stage, using the Ordinary Least Squares OLS technique once again, a general ARDL model is estimated, where the dependent variable is regressed on its own lags and lags of explanatory variables (Pesaran and Shin, 1998). It is argued that combining the OLS technique in the ARDL method yields good results in calculating long- and short-term dynamics in models with 30-80 observations (Sulaiman & Abdul-Rahim, 2018); therefore, these methods have been employed. Within this scope, the general ARDL (q1, q2,q3,q4,q5) model, formulated based on Model (1), is presented below:

$$lnexp = \theta_0 + \sum_{i=1}^{q_1} \theta_{1i} \, lnexp_{t-i} + \sum_{i=0}^{q_2} \theta_{2i} \, lnrwp_{t-i} + \sum_{i=0}^{q_3} \theta_{3i} \, lnuwp_{t-i} + \sum_{i=0}^{q_4} \theta_{4i} \, lnbwp_{t-i}$$

$$+ \sum_{i=0}^{q_5} \theta_{5i} \, lnexc_{t-i} + v_t \tag{3}$$

In Equation (3), θ_0 represents the constant term, v_t denotes the random error term, and q_i signifies the lag length of the respective variable. According to the Granger Representation Theorem, when there is a cointegration relationship between two or more time series, there will also be a valid Error Correction Model (ECM) that reflects this relationship and the short-term dynamics (Engle and Granger, 1987). Therefore in the third and final stage of the ARDL procedure, leveraging the general ARDL model, an Error Correction Model (ECM) is constructed to link the long-term relationship with short-term dynamics, and this model is estimated using the OLS technique. Within this context, the ECM formulated based on Model (1) and consequently Model (3) can be formally expressed as follows:

$$\Delta lnexp = \lambda_0 + \sum_{i=1}^{r_1} \lambda_{1i} \Delta lnexp_{t-i} + \sum_{i=0}^{r_2} \lambda_{2i} \Delta lnrwp_{t-i} + \sum_{i=0}^{r_3} \lambda_{3i} \Delta lnuwp_{t-i}$$

$$+ \sum_{i=0}^{r_4} \lambda_{4i} \Delta lnbwp_{t-i} + \sum_{i=0}^{r_5} \lambda_{5i} \Delta lnexc_{t-i} + \sigma ECT_{t-1} + \mu_t \tag{4}$$

In Equation (4), λ_0 denotes the constant term, μt represents the random error term, Δ signifies the first difference operator, and ri represents the lag length of the respective variable (which, according to the lag lengths in Model (3), is qi - 1. Here, differenced lagged terms indicate short-term dynamics, while the term ECTt−1 represents the lagged error term derived from the long-term (cointegration) equation. The last term, referred to as the error correction term, reflects the rate at which variables converge to their equilibrium values after a shock occurs in the short term. For the correction of short-term imbalances and the system's ability to converge to a long-term equilibrium, the coefficient of the error correction term (σ) should be statistically significant and negative (Ciftci and Yildiz, 2015).

3.3. Findings

In this section, firstly Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were conducted to determine the integration levels of the variables. The results of the ADF and PP unit root analyses in Table 4 indicate that the lnexp variable is stationary at the level, while the other variables are stationary at their first differences.

Table 4. Unit Root Test Results

Variables	ADF Test Statistics		PP Test Statistics		Result
	Level Values	1st Dif. Values	Level Values	1st Dif. Values	
lnexp	-1.907	-11.839	-4.448	-25.761	I(1)
lnrwp	0.252	-7.176	-0.082	-7.125	I(1)
lnuwp	0.123	-7.128	-0.025	-7.176	I(1)
lnbwp	1.194	-5.751	0.154	-6.833	I(1)
lnexc	0.753	-7.469	0.992	-7.427	I(1)

When evaluating the results in Table 4, it is observed that the conditions required for the use of the ARDL procedure are met. The results of the boundary test conducted as the first stage of the ARDL procedure are presented in Table 5. The calculated F-statistic for the joint significance of the one-period lagged level variables in the UECM exceeds the upper critical value at the 5% significance level. Consequently, the null hypothesis suggesting no cointegration among the variables can be rejected. This finding, indicating that the variables move together in the long run, is considered reliable in terms of diagnostic tests as well.

Table 5. ARDL Bound Test (Cointegration) Analysis

Estimated Model (T=64)	F-Statistics	Critical Values	Lower Limit	Upper Limit	Result
FIII(lnexp/lnuwp, lnrwp, lnbwp, lnexc)	3.85243*	1%	3.29	4.37	H0 rejected
		5%	2.56	3.49	
		10%	2.2	3.09	
Diagnostic Tests: $\chi^2(1)_{S.C.}= 0.184$ –(0.7563), $\chi^2 (1)_{Het.}= 0.683$ (0.7487), $F_{Res}= 0.159$ (0.6912), J.-B.$_{Nor}= 1.499$ (0.4724)					

Note: * indicates significance at the 5% level. The UECM model was estimated with a maximum lag of „8", and based on the Schwarz Information Criterion, a model with lag components (3,0,3,8,1) was selected. Critical values represent the critical values derived from Pesaran et al. (2001). Diagnostic tests display the diagnostic test statistics for the chosen UECM model, with the values in parentheses representing probability values. Here, S.C. denotes the Breusch–Godfrey autocorrelation LM test, Het. the ARCH changing variance LM test, Res. Ramsey's RESET test, Nor. the Jarque–Bera normality test. Also CUSUM test results are stabilized.

After confirming the presence of a long-term relationship among the variables following the boundary test, the second stage of the ARDL procedure can be initiated. In this phase, the general ARDL model is estimated using the OLS technique to compute the long-term coefficients [Model (1)]. Accordingly, the general ARDL model was estimated with a maximum lag length of 8 based on the Schwarz information criterion. The most suitable model, with lag lengths of ARDL(3,0,3,8,1), was identified, and Model (1) was computed using the coefficients from this equation. Subsequently, to obtain the short-term dynamics related to the long-term model, an error correction model was estimated. The estimates of the coefficients for both the long and short terms are presented in Table 6 and Table 7.

Table 6. ARDL (3,0,3,8,1) Estimation Results with Long Run Coefficients

Variable	Coeffecient	Std. Error	t-statistic	Probability
C	8.026.896	3.080.787	2.605.470	0.0125
lnexp(-1)*	-0.557846	0.175782	-3.173.516	0.0027
lnrwp**	0.696004	0.462927	1.503.486	0.1399
lnuwp(-1)	-1.941.850	0.763622	-2.542.948	0.0146
lnbwp(-1)	0.538170	0.640923	0.839680	0.4056
lnexc(-1)	0.577258	0.185079	3.118.978	0.0032
d(lnexp(-1))	-0.597062	0.157226	-3.797.484	0.0004
d(lnexp(-2))	-0.289753	0.119571	-2.423.264	0.0196
d(lnuwp)	0.285215	0.523147	0.545190	0.5884
d(lnuwp(-1))	1.880.433	0.661128	2.844.278	0.0067
d(lnuwp(-2))	1.982.191	0.555310	3.569.521	0.0009
d(lnbwp)	-1.106.616	0.526083	-2.103.501	0.0412
d(lnbwp(-1))	-1.028.258	0.776665	-1.323.941	0.1924
d(lnbwp(-2))	-1.678.892	0.591130	-2.840.141	0.0068
d(lnbwp(-3))	-0.417869	0.391608	-1.067.059	0.2918

Variable	Coeffecient	Std. Error	t-statistic	Probability
d(lnbwp(-4))	0.826844	0.382548	2.161.416	0.0361
d(lnbwp(-5))	0.177388	0.409107	0.433599	0.6667
d(lnbwp(-6))	0.358109	0.454355	0.788169	0.4348
d(lnbwp(-7))	1.299.144	0.463824	2.800.940	0.0075
d(lnexc)	0.000488	0.261315	0.001869	0.9985
Variable	**Long Term**			
	Coeffecient	Std. Error	t-statistic	Probability
lnrwp	1.247.663	1.025.459	1.216.687	0.2302
lnuwp	-3.480.980	1.759.751	-1.978.109	0.0542
lnbwp	0.964729	1.143.444	0.843705	0.4034
lnexc	1.034.799	0.308430	3.355.052	0.0016
c	1.438.910	1.569.258	9.169.362	0.0000

According to the calculated long-term coefficients in Table 4, it's found that the lnrwp, lnuwp, and lnbwp do not have a significant impact on lnexp. However, an increase in the lnexc positively and significantly affects lnexp. Therefore, as the exchange rate rises, pasta exports also increase. This result is in line with international economic theories. In the third stage of the ARDL approach, short-term relationships are being investigated. Within this context, the short-term model is estimated by including lagged values of the error terms of the model estimated as ARDL (3,0,3,8,1). The estimation results can be seen in Table 7.

Table 7. Error Correction Model Estimation Results for lnexp

Variable	Short Term			
	Coeffecient	Std. Error	t-statistic	Prob.
d(lnexp(-1))	-0.597062	0.122159	-4.887.576	0.0000
d(lnexp(-2))	-0.289753	0.104373	-2.776.133	0.0080
d(lnuwp)	0.285215	0.442762	0.644171	0.5228
d(lnuwp(-1))	1.880.433	0.514834	3.652.504	0.0007
d(lnuwp(-2))	1.982.191	0.487012	4.070.104	0.0002
d(lnbwp)	-1.106.616	0.474261	-2.333.349	0.0243
d(lnbwp(-1))	-1.028.258	0.526935	-1.951.392	0.0574
d(lnbwp(-2))	-1.678.892	0.469658	-3.574.715	0.0009
d(lnbwp(-3))	-0.417869	0.349538	-1.195.490	0.2383
d(lnbwp(-4))	0.826844	0.333052	2.482.628	0.0169
d(lnbwp(-5))	0.177388	0.357356	0.496391	0.6221
d(lnbwp(-6))	0.358109	0.372532	0.961283	0.3417
d(lnbwp(-7))	1.299.144	0.374517	3.468.849	0.0012
d(lnexc)	0.000488	0.220901	0.002210	0.9982
ECM (t-1)	-0.557846	0.109951	-5.073.582	0.0000

According to the results obtained, it is observed that lagged values related to lnexp have a significant negative impact at a 5% significance level in the short term. This effect continues for two months. While the changes in lnuwp do not have any significant effect on lnexp at a 5% significance level in the first month, it is observed that despite the increase in wheat prices in the following two months, Türkiye's pasta exports have increased. There is no apparent effect of lnrwp. Regarding lnbwp, there is no significant effect in the short term in the first two months; however, in subsequent months, it is observed that sometimes price increases negatively affect lnexp, and sometimes they have a positive impact. Exchange rate changes do not seem to have any short-term effects. To strengthen the validity of these findings, a robustness check was also conducted using the Fully Modified Ordinary Least Squares (FMOLS)and Dynamic Ordinary Least Squares (DOLS) method.

3.4. Robustness Check

In the initial model of the study, cointegration relationships among the series were identified using the ARDL method. In this section, to enhance the reliability and validity of the findings, the robustness of the results was tested using two separate models. The first of these methods is the FMOLS approach. This approach helps validate the results obtained from cointegration tests (Zimon et al., 2023). The formula for this approach, as utilized by Hansen and Phillips (1990) to amalgamate the most precise cointegration measures, is presented below:

$$\Delta lnexp_{2t} = \theta_0 + \sum_{i=1}^{t} \theta_1 \Delta lnexp_{2t-1} + \sum_{i=1}^{t} \theta_2 \Delta lnrwp_{t-i} + \sum_{i=1}^{t} \theta_3 \Delta lnuwp_{t-i}$$
$$+ \sum_{i=1}^{t} \theta_4 \Delta lnbwp_{t-i} + \sum_{i=1}^{t} \theta_5 \Delta lnexc_{t-i} + \lambda_1 \, lnexp_{2t-1}$$
$$+ \lambda_2 \, lnrwp_{t-1} + \lambda_3 \, lnuwp_{t-1} + \lambda_4 \, lnbwp_{t-1} + \lambda_5 \, lnexc_{t-1} + \varepsilon_t \quad (5)$$

As a second robustness test, the DOLS approach was utilized. The DOLS procedure involves incorporating exogenous variables along with their first-difference expressions to address endogeneity and calculate standard errors using a covariance matrix of errors that is robust to autocorrelation. DOLS estimators provide a reliable measure of statistical significance. Assessing the impact of the endogenous indicator on exogenous indicators in levels, leads, and lags is an effective method for dealing with various integration orders (Pattak et al., 2023). This approach enables the integration of different factors into the cointegrated framework (Dogan and Seker, 2016). The calculation for the DOLS method can also be considered based on Formula 5 above. The results for both approaches are presented in the table below.

When examining the results of the analysis conducted for robustness checking, it is observed that the long-term findings of the ARDL model align with the same conclusions. Accordingly, while no significant effects of imported wheat prices are observed, a 1% increase in the exchange rate is found to increase Türkiye's pasta exports by approximately 0.6454% according to the FMOLS model and by approximately 0.6658% according to the DOLS model.

Table 8. Robustness Check Results

Variable	FMOLS				DOLS			
	Coefficient	Std. Error	t-Statistic	Prob.	Coefficient	Std. Error	t-Statistic	Prob.
lnrwp	-0.3601	0.4306	-0.8363	0.4060	-0.7350	0.6287	-1.1690	0.2477
lnuwp	-0.2347	0.5294	-0.4434	0.6589	-0.0559	0.9649	-0.0579	0.9540
lnbwp	0.0803	0.4504	0.1783	0.8591	0.2929	0.7193	0.4072	0.6856
lnexc	0.6454	0.1120	5.7617	**0.0000**	0.6658	0.1642	4.0551	**0.0002**
C	16.5059	0.5855	28.1917	**0.0000**	16.5165	0.8194	20.1561	**0.0000**
R- Squared	0.571442				0.65487			

4. Discussions

In today's context, where food supply is of utmost importance, this research, recognizing the significance of wheat as a raw material in the production of some of the most fundamental food products, highlights the need for a multifaceted examination. The study aims to determine whether Türkiye's pasta exports, which are based on wheat, are related to the prices of imported wheat. According to the factor endowment theory, countries export based on the production factors they possess. This study reveals that in the long term, Türkiye's possession of wheat, whether domestic or imported, serves as a crucial factor in pasta production, contributing to averting crises in exports. It's evident that short-term crises based on occasional fluctuations in imported product prices do not have lasting effects, and Türkiye's pasta exports successfully navigate through these short-lived shocks. Even with an increase in the imported wheat price, Türkiye manages to increase its pasta exports by utilizing the purchased wheat. This study shows some similarities with the studies in literature review. Studies explaining the relationship between raw material prices and exports of commodity such as (Nikonenko et al., 2020; McGregor, 2017; Jawaid and Waheed, 2011) have similar results like this research.

As of 2022, Türkiye stands fourth in global pasta exports and similarly holds the fourth position in global wheat imports. Despite this balance between production capabilities and exports, Türkiye does engage in wheat exports, albeit in small quantities, as observed from statistical data. Some studies mentioned in the introduction section of this research suggest that raw material prices influence product exports across various industries (Schmitt-Grohe & Uribe, 2018). However, this study focused on Türkiye indicates that imported wheat prices don't significantly affect pasta exports in the long term. Still, it aligns with similar short-term shock scenarios documented in literature. When considering the wheat supply for pasta exports highlighted in past studies, the occurrence of short-term shocks becomes an explanatory aspect. Evidently, Türkiye's pasta exports exhibit a dependence on imported wheat. Hence, despite price fluctuations, wheat procurement continues to support pasta exports. In this context, one of the most critical aspects for Türkiye is the necessity to increase wheat production and, when insufficient, supplement it with imported wheat to sustain exports. Because as Tiess (2010) mentioned price of raw material does not always fit to competition.

Another finding of this study is the effect of exchange rates on pasta exports. The studies that found that the exchange rate increases exports (Kasman & Kasman, 2005; Kılıç and Yıldırım, 2015; Nazlıoğlu, 2013; Karakaş & Erdal, 2017) have reached a similar conclusion to this research. On the other hand, studies that have observed the negative impact of the exchange rate on exports (Baak et al., 2007; Cheung & Sengupta, 2023; Uysal & Doğru, 2013) have yielded contradictory results thus far. The comparison with the results obtained from this study and the past studies in literature are briefly summarized in the table below.

Table 9. Brief Summary of Comparison Between Past Studies in Literature

Research	Findings	Similarity Assestment with this Study	
		Short Run	Long Run
Kasman & Kasman, 2005	Exchange rate increase -> exports (+)	Contradictory	Similar
Baak et al., 2007	Exchange rate volatility -> foreign trade (-)	Contradictory	Contradictory
Tiess, 2010	Price increases -> international competition (-)	Similar	Contradictory
Cheung & Sengupta, 2013	Exchange rate volatility -> foreign trade (-)	Contradictory	Contradictory
Uysal & Doğru, 2013	Exchange rate increase -> exports (-)	Contradictory	Contradictory
Kılıç & Yıldırım, 2015	Exchange rate increase -> exports (+)	Contradictory	Similar
Khalifa, 2016	Raw material prices -> commodity exports (-)	Similar	Contradictory
Karakaş & Erdal, 2017	Exchange rate increase -> exports (+)	Contradictory	Similar
Niemi, 2018	price increases -> commodity export (-)	Similar	Contradictory
Golikova et al., 2020	Raw material prices -> commodity exports (-)	Similar	Contradictory
Nikonenko et al., 2020	Raw material prices -> commodity exports (-)	Similar	Contradictory

In addition to the results of these studies, it is also possible to discuss the findings in terms of the factor endowment theory and the Marshall-Lerner condition. Accordingly, based on theories from previous years, it is possible to say that Türkiye's pasta exports are not affected by imported input prices in the long run, due to the strength derived from the current factor conditions. On the other hand, it is observed that an increase in the exchange rate also boosts pasta exports, almost as if fulfilling a classic economic prophecy.

5. Limitations

In the literature review section of the study, it is observed that the quality of wheat concerning pasta exports is a topic of interest. The research can be considered limited due to the absence of a variable indicating quality among the variables used in this study. Additionally, since the study is conducted specifically for Türkiye, the three neighboring countries with the highest exports have been selected. For studies involving different countries, wheat prices from additional importing countries could also be considered. From a theoretical perspective, the inability to measure the effect of price elasticity on the

relationship between exchange rates and exports within the context of the Marshall-Lerner condition can also be considered as another limitation of the study.

The data set used in the study was selected based on common and up-to-date time intervals. Access to longer-term and broader data sets could be achieved if all countries had complete data entries in the ITC Trademap database. The dataset for the 72-month time series used in the research can also be considered a constraint in this context. The exclusion of data, such as monthly wheat and pasta consumption, among the study variables has hindered the establishment of a more comprehensive model. However, it is worth noting that such data could not be included in the model due to their unavailability on a monthly basis.

6. Conclusion

Findings of this study suggest that Türkiye's pasta export is not significantly influenced by the price of the imported wheat in the long term. In the short term, while there seems to be no effect observed from Russia's wheat export prices, the occasional increase in Ukraine's wheat price appears to increase pasta exports, potentially due to Türkiye being both a producer and importer of wheat from various countries. Similarly, examining the effects of Bulgaria's wheat prices on Turkish pasta exports reveals that price increases sometimes reduce pasta exports and sometimes increase them. However, research findings indicate that all these effects are short-lived. In the long term, it has been observed that Türkiye's pasta exports are positively affected only by increases in the exchange rate. The fact that Türkiye's pasta exports are not significantly affected in the long term by the wheat prices from the countries it primarily sources wheat from can be considered a significant opportunity.

It has been determined that increases in the exchange rate lead to an increase in Türkiye's pasta exports in the long run. Considering Türkiye's status as a developing country, it is natural for businesses to focus on exports to take advantage of the rising exchange rate. Indeed, as can be seen in the relevant figure, the exchange rate has been consistently increasing in Türkiye in recent years. Additionally, given that Türkiye's trade deficit is a chronic issue, it can be argued that generating foreign currency income is a valid motive for all businesses capable of exporting. In other words, in a developing country where exports cannot meet imports, businesses also seek to position themselves advantageously under the assumption that the exchange rate increase will be persistent. Furthermore, another aspect of the increase in the exchange rate is that businesses exporting from Türkiye may have a price advantage in global competition compared to their international competitors.

7. Theoretical Implications

The findings obtained with the model established in this study are significant for international trade, economics, agricultural economics, and macroeconomics research. Particularly noteworthy is the scarcity of studies that examine international trade at the product and

product group levels, as well as the limited research that presents the impact of supply and raw material variables at the macro level on exported products. In this context, the research findings suggest that delayed effects may be present, especially in the short term. Therefore, it is recommended to conduct similar studies in various countries and with different product groups. Especially within the framework of factor endowment theory, it is observed that traditional international trade theories still hold explanatory power for today's trade. Additionally price elasticity variables could be used in future studies if available. Therefore, researchers are encouraged to focus on studies that integrate historical theories (such as Factor Endowment Theory and Marshall-Lerner Condition) with contemporary approaches. Particularly, it is believed that research on the export products of developing countries to various countries, goods, and time periods, tested with diverse methods, should be encouraged to enhance the understanding of international trade. In addition to all this, it is recommended not to overlook the exchange rate variable in export studies, considering that the classic economic view, which suggests that exports also increase with an increase in the exchange rate is once again proven correct.

8. Practical Implications

The research results suggest that there is not only a responsibility for pasta producers but also for policymakers. Although not included in the model of this study, it can be said that considering the emphasized quality of raw materials in the literature, imported wheat should also be carefully selected for the country in this regard. It is accurate to say that the price of wheat to be imported into the country need to be inspected, and tariff measures should be taken to ensure that local wheat producers can compete without being harmed. Furthermore, considering Türkiye's consumption of wheat-based products from a health perspective, wheat imports should be shaped according to the health certificate requirements of leading countries in the world.

In addition, considering the long-term impact of the exchange rate on pasta exports, Türkiye's monetary and fiscal policies regarding the exchange rate are noteworthy. Indeed, although the sudden increases seen in recent years may present a positive picture in terms of foreign currency earnings for exporters, it can be said that proper decisions need to be made considering the possibility of increased costs being covered with foreign currency. Since the competitive performance of exporters in the international market will also depend on the balance of income and expenses, effective management of the exchange rate is crucial for both governments and companies to minimize risks.

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