



**The Macroeconomic Determinants of Türkiye's Export Performance: An
Econometric Analysis Through the Lens of Classical Trade Theories**

***Türkiye'nin İhracat Performansının Makroekonomik Belirleyicileri: Klasik Ticaret Teorileri
Perspektifinden Bir Ekonometri Analizi***

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ABSTRACT

Exports play a pivotal role in the economic development of nations, making the factors that influence this trade essential to understand. This study examines the macroeconomic determinants of Türkiye's export performance during the pre-COVID-19 period, from 2003 to 2019, a time marked by political stability and consistent economic policies under the ruling government. Using the Engle-Granger Cointegration method, the study investigates the long-term and short-term impacts of key macroeconomic variables-Gross Domestic Product (GDP), exchange rates, imports, and interest rates-on Türkiye's export performance. The results show that while GDP and interest rates positively influence exports in the long run, imports exhibit a consistent positive effect on exports in both the short and long term. Moreover, exchange rates have a negative long-term impact on exports, indicating the challenges posed by currency fluctuations. The findings reveal Türkiye's import dependency and reflect the macroeconomic environment shaped by policies in the pre-COVID-19 period. This study contributes to the literature in terms of both time period and methodology by revealing the key macroeconomic dynamics that shaped Türkiye's export performance in the pre-COVID-19 period.

ÖZ

İhracat, ülkelerin ekonomik kalkınmasında kritik bir rol oynamakta olup, bu ticareti etkileyen faktörlerin anlaşılması büyük önem taşımaktadır. Bu çalışma, 2003-2019 yılları arasında, siyasi istikrarın ve tutarlı ekonomik politikaların hâkim olduğu bir dönemde, Türkiye'nin ihracat performansını belirleyen makroekonomik faktörleri incelemektedir. Engle-Granger Eşbütünleşme yöntemi kullanılarak, Gayri Safi Yurtiçi Hasıla (GSYİH), döviz kurları, ithalat ve faiz oranları gibi temel makroekonomik değişkenlerin Türkiye'nin ihracat performansı üzerindeki uzun dönemli ve kısa dönemli etkileri analiz edilmiştir. Sonuçlar, GSYİH ve faiz oranlarının uzun vadede ihracatı olumlu etkilediğini, ithalatın ise hem kısa hem de uzun vadede ihracat üzerinde sürekli olarak olumlu bir etkisi olduğunu göstermektedir. Buna karşılık, döviz kurlarının uzun vadede ihracat üzerinde olumsuz bir etkisi olduğu tespit edilmiş, bu durum kur dalgalanmalarının yarattığı zorluklara işaret etmektedir. Bulgular, Türkiye'nin ithalat bağımlılığını ortaya koymakta ve COVID-19 öncesi dönemdeki politikalarla şekillenen makroekonomik ortamı yansıtmaktadır. Bu çalışma, COVID-19 öncesi dönemde Türkiye'nin ihracat performansını şekillendiren temel makroekonomik dinamikleri ortaya koyarak, literatüre dönemsel ve yöntemsel açıdan katkı sağlamaktadır.

Anahtar Kelimeler

Türkiye'nin ihracat
performansı,
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1. Introduction

One of the most critical and comprehensive issues for national economies is how to achieve a rapid and stable economic development process (Yiğidim and Köse, 1997: 71). The determining factors of this process are closely tied to capital formation, the efficient use of domestic resources, the potential of both domestic and international markets, trade policies, and the economic system in place (Hill, 2009). In this context, the strong relationship between exports and Gross Domestic Product (GDP) plays a crucial role in driving economic development (Brue, 2008). Historical examples, such as England leveraging external markets to advance its economy in the 18th century (Carrier, 2005), or the United States becoming an economic superpower by the late 20th century, highlight the vital impact of foreign trade on economic growth. Furthermore, countries in Asia, such as Taiwan, South Korea, Hong Kong, and Singapore, significantly expanded their export industries, leading to substantial economic progress during the late 20th century (Mallet, 1999). In this context, economic stakeholders have recognized the importance of exports in national economic development and have made efforts to increase their export-oriented production (Helleiner, 2002).

Exporting goods and services plays a pivotal role in improving a country's balance of payments, generating foreign exchange income, and creating employment opportunities (Shihab et al., 2014). However, to realize these benefits, it is essential to identify the macroeconomic factors that influence a country's export performance. Classical trade theories, such as those proposed by Heckscher-Ohlin (1933) and Ricardo (1817), emphasize that trade outcomes are not solely determined by export activity itself, but by a complex interplay of factors such as domestic economic conditions, trade policies, and exchange rates (Bhagwati, 2004). In line with this, the effectiveness of export growth is influenced by variables like Gross Domestic Product (GDP), exchange rates, imports, and interest rates. These factors shape a nation's competitiveness in international markets by affecting the cost of production, the stability of the economy, and the accessibility of foreign markets (Krugman, 1987). For instance, exchange rate fluctuations can make exports more or less competitive, as discussed in the works of Mundell (1961), while interest rates can influence investment decisions that affect the productive capacity of the economy (Dornbusch, 1980). Additionally, a country's import levels and dependence on foreign goods also play a critical role in determining the long-term sustainability of export growth (Krugman and Obstfeld, 2009). Therefore, to fully harness the benefits of export expansion, it is crucial to analyze the macroeconomic factors that directly impact the dynamics of international trade (Eaton and Kortum, 2002).

The aim of this study is to investigate the impact of macroeconomic variables on Türkiye's export performance. In this context, selected macroeconomic variables, exchange rates, imports, GDP, and interest rates, were empirically examined within the framework of classical trade theories, and their effects on export dynamics were investigated. The main reason for choosing the pre-COVID-19 years as the analysis period is to prevent the extraordinary and temporary shocks created by the pandemic on foreign trade from distorting the analysis results and to evaluate Türkiye's export performance under more stable macroeconomic conditions. The rest of the article is organized as follows: The second section reviews the literature on factors affecting exports; the third section presents data on Türkiye's export performance; the fourth section contains the empirical analysis, followed by conclusions and discussion.

2. Literature Review

The establishment of the World Trade Organization (WTO) in 1995 and the widespread adoption of export-oriented development models in the 1970s marked a significant transformation in international trade. During this period, the impact of exports on economic growth and the macroeconomic factors influencing exports became increasingly prominent topics in academic research. The literature has extensively addressed various issues, such as the effects of exchange rate fluctuations on export competitiveness (Mundell, 1961), the significance of import dependence for economic sustainability (Krugman and Obstfeld, 2009), the influence of Gross Domestic Product (GDP) size on trade capacity (Krugman, 1987), and the role of interest rates in shaping investment and production processes (Dornbusch, 1980).

Moreover, the success of policies aimed at enhancing competitiveness in international trade necessitates a comprehensive analysis of the macroeconomic dynamics that influence export performance. In this context,

assessing the impact of variables such as exchange rates, imports, GDP, and interest rates on exports is of critical importance from both theoretical and empirical perspectives.

Table 1. Literature Review

Author	Countries	Period	Method	Data	Results
Sharma and Dhakal (1994)	Germany, Italy, Japan, England and the USA	1960-1988	Panel Approach	Data	The results revealed that the GDP growth rates of the United States and the United Kingdom significantly influence exports.
Dutt and Ghosh (1996)	26 countries	1960-1988	Panel Approach	Data	The development between 1953 and 1991 was analyzed, and the results indicated a causal relationship running from exports to economic growth.
Choudhry (2005)	USA, Canada, Japan	1974–1998	Johansen multivariate cointegration method		The study revealed, that exchange rate volatility negatively impacts exports.
Serletis (1992)	Canada	1870-1985	Causality Test		The results indicated a short-term relationship supporting the export-led growth hypothesis between real export growth and real GDP growth. However, no significant relationship was found between the variables in the long term.
Gururaj et al. (2016),	India	1990-91 to 2014-15	Regression Analysis		In their study to identify the factors influencing India's export performance, it was found that inflation rate, real effective exchange rate (RER), and foreign direct investments had negative effects on India's export performance.
Terzi and Zengin (1999),	Türkiye	1989:1-1996:12	Vector autoregression		The results showed no relationship between the exchange rate and imports or between the exchange rate and exports, while a bidirectional relationship was found between imports and exports.
Sezen (2008)	Türkiye	1980-2007	Engle-Granger Cointegration		According to the study's findings, a 1% increase in imports was found to raise exports by 0.50%. Additionally, it was determined that a 1% increase in Türkiye's real effective exchange rate and inflation reduces exports by approximately 0.49% and 0.10%, respectively.
Karaçor and Gerçekler (2012),	Türkiye	2003: 1 – 2010: 12	Causality Test		In a sample of OECD countries exchange rate fluctuations in short term have a 60 % effect on import prices, but 80 % effect in long term import prices. That resulted in inflationary impact of Exchange rate fluctuations.
Erdoğan (2016)	Türkiye	1996Q2 2012Q3	Multiple Regression Analysis		The study's results indicated that a one-unit increase in the export price index (unit prices) led to an increase of 57.5 units in total exports. Similarly, a one-unit increase in the import of consumer goods resulted in a 1.48-unit increase in total exports. Moreover, a one-unit increase in the real exchange rate caused an increase of 188.862 units in total exports.
Özbaş and Yildirim (2023)	Türkiye	2001-2019	ARDL bounds test and Toda-Yamamoto		The study revealed that human capital is the most influential factor in the long run for both export groups, and that the real exchange rate also has an impact on both groups; however, the effects of other variables differed between the groups.

Table 1 systematically summarizes the literature examining the relationship between exports and economic growth, in terms of country, period, and methodology. The table includes examples from both developed and developing countries (Germany, Italy, Japan, UK, USA, Canada) and covers different time periods.

The methodologies used in the studies also vary: panel data analysis, regression analysis, Engle-Granger cointegration test, Johansen multivariate cointegration, VECM, and ARDL are among the methods employed. This diversity allows for the examination of short-term and long-term relationships and the effects of variables from different perspectives.

In terms of findings, the table shows that in developed countries, GDP growth rates significantly affect exports, exchange rate volatility negatively impacts exports, and short-term causal relationships exist. Studies focusing on Türkiye examine the effects of variables such as imports, real exchange rate, export price index, and human capital on exports in both the short and long term. In particular, the study by Özbaş and Yıldırım (2023) reveals that human capital is the most decisive factor in the long run and shows that the real exchange rate also has an effect on both export groups.

In general, the factors affecting exports in the literature are considered a complex and multifaceted subject. This issue may vary not only between developing and developed countries, but also across countries with similar levels of development, depending on their production structures or commercial activities. Particularly, macroeconomic variables such as exchange rate fluctuations, GDP size, inflation rates, and interest rates have different impacts depending on the economic structure and trade strategies of each country.

3. Dataset and Method

In analyzing the factors affecting exports in Türkiye, the cointegration method, developed by Engle and Granger in 1987 and later expanded by Johansen, was used. The study utilized quarterly data from 2003Q1-2018Q4. The primary reason for choosing this method is that the macroeconomic variables used in the analysis have the same degree of integration, and the study focuses on long-term relationships determining Türkiye's export performance. Furthermore, considering the period examined and the data structure, the cointegration approach was deemed to offer a suitable framework for considering both short-term and long-term dynamics.

Cointegration analysis is described as the process of making non-stationary time series stationary by taking their linear combinations. The equations derived from this process are referred to as cointegrating equations. The first of these equations is regarded as representing the long-term relationship. In this context, it is possible to bring series with linear equations of $I(1)$ level to $I(0)$ level, which indicates the existence of cointegration. The second stage involves examining the short-term relationship and determining how long it takes to approach the long-term relationship (Gujarati and Porter, 2009: 730).

Cointegration analysis suggests that even when economic variables are non-stationary, stationary linear combinations of these series may exist. The relationship between the variables under investigation indicates the presence of a long-term equilibrium relationship. The existence of cointegration between the variables can only occur when external permanent effects impact all the variables in a common manner. Therefore, permanent effects influencing the variables must act collectively, rather than individually, on the variables. The analysis using cointegration and error correction models is generally subject to a four-step process. These steps are outlined as follows (Tari, 2008: 406):

- The integration order of the variables in the model is determined.
- Cointegration equations are estimated using the Least Squares Method (LSM) for variables with the same integration degree.
- Series are made stationary using Augmented Dickey Fuller (ADF) tests.
- Cointegration relationships between variables are examined and analyzed using the Engle-Granger method.

In this study, quarterly data from the period 2003Q1-2018Q4 is utilized, and the dataset is obtained from the Central Bank of the Republic of Türkiye (TCBM) Electronic Data Distribution System (EVDS) and converted into U.S. dollars. The variables used in analysis and their corresponding letter symbols are presented in Table 2.

Table 2. Variables Used in the Analysis

Variable Name	Variable Description
EX	Export (Dollar)
IM	Import (Dollar)
RER	Real Effective Exchange Rate (PPI)
GDP	Gross Domestic Product (Dollar)
IN	Interest Rate (Trade Credit Flow) (Dollar)

As presented in Table 2, five key variables are employed in the analysis. These variables include export as the dependent variable, and import, Gross Domestic Product (GDP), real effective exchange rate, and interest rates as independent variables. Additionally, a dummy variable representing the 2008 Global Crisis is included in the analysis. The rationale for the selection of these variables can be explained as follows:

- **Import (IM):** Imports are included as an explanatory variable in the model because they can affect exports both through input supply in the production process and through external demand.
- **Real Effective Exchange Rate (RER - PPI Based):** Exchange rate changes directly affect export price competitiveness and foreign demand. In this study, a PPI (Producer Price Index) based index was used as the real effective exchange rate because producer prices reflect export costs more directly, making them a more suitable indicator for analyzing export performance than consumer prices. This approach is widely used in the literature, especially to more accurately measure the impact of the exchange rate on manufacturing sector exports.
- **Gross Domestic Product (GDP):** GDP, reflecting the country's economic size and production capacity, is used to measure the indirect impact of domestic demand on exports. Furthermore, country GDP is a standard variable in international comparisons and panel analyses to control for external demand effects.
- **Interest Rate (IN - Trade Credit Flow):** Interest rates are a significant macroeconomic variable affecting export financing and investment decisions. In this study, commercial loan interest rates are used to reflect short-term credit costs. This allows for a more accurate measurement of the impact of exporters' financing conditions on export performance.

The selected variables both theoretically represent fundamental macroeconomic elements affecting export performance and are based on indicators commonly used in similar studies in the literature. Therefore, the empirical model of this study is framed within a context that considers both the specific conditions of the Turkish economy and general economic theory.

Prior to modeling, logarithmic transformation was applied to the variables. When the cointegration equation is written in logarithmic form, it is expressed as follows:

$$LEX_t = b_0 + b_1LIM_t + b_2LRER_t + b_3LGDP_t + b_4LIN_t + b_5D_{2008} + e_t \quad (1)$$

In the above equation, the letter "L" indicates the logarithmic transformation of the variables. To determine whether the variables in the equation are part of a cointegration relationship, the ADF test is applied to the error term series of Equation 1. If the error term series is found to be stationary, it is concluded that the variables are in a cointegration relationship. Conversely, if the error term series is not stationary, the existence of a cointegration relationship cannot be established. The error term series can be defined as follows:

$$\Delta e = h_1 * e_{t-1} + \varepsilon_t \quad (2)$$

The h_1 in the above equation represents the fundamental hypothesis of the model. In this context, the fundamental hypothesis is formulated as follows:

H_0 : There is a unit root, the series is non-stationary.

H_1 : There is no unit root, the series is stationary.

Therefore, if the H_0 hypothesis is rejected, it is concluded that the error term series is stationary and the variables used in the model are in a cointegration relationship.

After determining the existence of the cointegration relationship among the variables, the short-term dynamics are tested using the Error Correction Model (ECM). In this model, which investigates the relationship of selected macroeconomic factors with growth, the error term (ECT) reflects the interaction between the short-term behavior of LEX and its long-term behavior, as well as the speed at which deviations from the long-term equilibrium level will be corrected. In this context, the mathematical definition of the short-term model we have developed is as follows:

$$\Delta \text{LEX}_t = b_0 + b_1 \Delta \text{LIM}_t + b_2 \Delta \text{LRER}_t + b_3 \Delta \text{GDP}_t + b_4 \Delta \text{IN}_t + b_5 D_{2008} + b_6 e_{t-1} + \varepsilon_t \quad (3)$$

In the above equation, the Δ symbol indicates the first difference of the variables. The e_{t-1} term represents the one-period lagged value of the residuals from Equation 1, which corresponds to the long-term value. Additionally, e_{t-1} reflects the speed of convergence to the long-term model. The term ε_t represents the error term. If this model is econometrically significant, it specifies the time required for the imbalance in LEX that arises in one period to be eliminated.

4. Analysis and Empirical Findings

As mentioned in the data and method description section, when modeling with non-stationary data sets, issues related to spurious regression arise, which leads to models that do not reflect the true relationship. Therefore, in order for analyses conducted with non-stationary data sets to reflect real relationships, the data sets must be stationary at the same level (Gujarati and Porter, 2009: 726). In this context, the stationarity of the series is initially analyzed using the Augmented Dickey-Fuller (ADF) test. To test the unit root property of the Y_t series, the following regression equation is used (Günaydın, 2004: 172-173):

$$\Delta Y_t = a_0 + a_1 t + \delta Y_{t-1} + \sum_{i=1}^N \Psi \Delta Y_{t-1} + \varepsilon_t \quad (4)$$

In the equation shown above, Δ represents the first difference, t represents the time trend, ε_t represents the error term, Y_t represents the used series, and N represents the lag length of the dependent variable determined by the Akaike Information Criterion (AIC) to eliminate the serial dependence between error terms. This type of unit root test is referred to as the Augmented Dickey-Fuller (ADF) test. The stationarity of the series corresponds to the alternative hypothesis, while non-stationarity of the series corresponds to the null (empty) hypothesis.

The cointegrating structures of the variables used in the study were examined through the ADF test, and the necessary condition for cointegration analysis was attempted to be satisfied (Peker, 2008: 38). Additionally, a causality analysis was conducted between exports and the independent variables considered, but no causality relationship was found between exports and these independent variables. Therefore, causality results were not included in the analysis. The ADF test results are presented in Table 3.

Table 3. ADF Unit Root Results

Variables		ADF Test Statistics		Critical Values	
			%1	%5	%10
1	LEX	-2.914213 (0.1654) [10]	-4.115684	-3.485218	-3.170793
	Δ LEX	-5.369883 (0.0002) [10]	-4.118444	-3.486509	-3.171541
2	LIM	-1.808496 (0.6879) [10]	-4.124265	-3.489228	-3.173114
	Δ LIM	-4.484737 (0.0036) [10]	-4.124265	-3.489228	-3.173114
3	LRER	-3.043450 (0.1290) [10]	-4.110440	-3.482763	-3.169372
	Δ LRER	-9.043371 (0.0000) [10]	-4.113017	-3.483970	-3.170071
4	LGDP	-1.677450 (0.7487) [10]	-4.124265	-3.489228	-3.173114
	Δ GDP	-4.610104 (0.0025) [10]	-4.124265	-3.489228	-3.173114
5	LIN	-2.073639 (0.5499) [10]	-4.113017	-3.483970	-3.170071
	Δ LIN	-6.981982 (0.0000) [10]	-4.113017	-3.483970	-3.170071

As can be observed in the table, the findings indicate that the series contain a unit root at the level value, meaning they are non-stationary. Therefore, to achieve stationarity, the first differences of the series were taken, and it was observed that the series became stationary after this process. In this context, it was

determined that the variables exhibit unit root behavior at their level values, but this behavior disappears when their first differences are taken. Consequently, the null hypothesis (H_0) is rejected at the 1%, 5%, and 10% significance levels, the alternative hypothesis (H_1) is accepted, and the analysis can proceed.

After fulfilling the stationarity condition, the modeling phase of the cointegration test is initiated. In this context, the functional form of the long-term cointegration equation is presented as follows.

$$LEX = F(LIM, LRER, LGDP, LIN) \quad (5)$$

The equation above illustrates the functional form of the long-term cointegration model, and the results of the long-term model are presented in Table 4.

Table 4. Cointegration Analysis Results (Long Term)

Dependent Variable: LEX	Coefficients	Std. Error	t-Statistics	Prob.
LIM	0.619572	0.106756	5.803638	0.0000
LRER	-0.383933	0.077517	-4.952893	0.0000
LGDP	0.258032	0.117624	2.193707	0.0323
LIN	0.144923	0.049175	2.947084	0.0046
K	0.141001	0.028221	4.996258	0.0000
C	2.409064	0.807612	2.982947	0.0042
R ²	0.971222	Mean dependent var		16.06478
Adjusted R-squared	0.968741	S.D. dependent var		0.372938
S.E. of regression	0.065936	Akaike info criterion		-2.511213
Sum squared resid	0.252156	Schwarz criterion		-2.308818
Log likelihood	86.35883	Hannan-Quinn criter.		-2.431480
F-statistic	391.4903	Durbin-Watson stat		1.218156
Prob(F-statistic)	0.000000			

Note: The square brackets indicate the appropriate lag length determined based on the Schwartz Criterion. Additionally, this lag length is set at 10.

The analysis results presented in Table 4 reflect the effects of the selected variables on exports in the long term. The equation for this model is as follows:

$$LEX_t = 2.40 + 0.61LIM_t - 0.38LRER_t + 0.25LGDP_t + 0.14LIN_t + 0.14Dt + e_t \quad (6)$$

The Engle-Granger cointegration estimation results in Table 4 indicate a stable long-term relationship between exports (LEX) and the explanatory variables included in the model. The obtained coefficients are generally consistent with theoretical expectations, and the model's explanatory power is quite high ($R^2 = 0.97$). In the long run, the effect of imports (LIM) on exports is positive and statistically significant. This finding shows that in economies like Türkiye, which are highly dependent on imported intermediate goods in their production processes, exports are significantly import-dependent. Increased imports support production capacity and increasing export volume in the long run.

The negative and significant real effective exchange rate (LRER) coefficient reveals that appreciation in the real exchange rate negatively affects export performance. This result is consistent with traditional foreign trade theory, which argues that appreciation in the real exchange rate weakens price competitiveness and reduces export demand.

The positive and statistically significant effect of Gross Domestic Product (GDP) indicates that economic growth increases production capacity and export potential. In the long run, economic growth supports export volume through economies of scale and productivity increases.

The fact that the interest rate (LIN) variable in the model has a positive and statistically significant effect on exports in the long run may initially seem like an unexpected result. However, this finding can be explained by the fact that the interest rate used represents commercial loan interest rates. Indeed, in the long run, increasing credit volume and financial deepening can facilitate access to financing for exporting firms, thus supporting export activities. Furthermore, since increases in interest rates often occur during periods

of economic expansion, the interest rate may move concurrently with growth and export increase. In this context, the positive coefficient of the interest rate should be interpreted through the financing and economic activity channels rather than a direct cost effect. The statistically significant and consistent constant term and trend components (K and C) indicate the presence of long-term structural trends in the model.

Overall, the Engle-Granger cointegration results show that the selected variables significantly explain exports in the long term, and the model reveals a statistically strong long-term relationship. As shown in the table, changes in imports, interest rates, GDP, and exchange rates affect exports in Türkiye at varying levels. However, the results indicate that imports are the most influential factor on exports. Holding other variables constant, a 1% increase in imports leads to a 0.61% increase in exports in the long term. On the other hand, a 1% increase in the exchange rate decreases exports by 0.38%. These effects of exchange rate and imports on exports are consistent with theoretical expectations. Furthermore, it is observed that, in the long term, interest rates and the dummy variable have a positive impact on exports in the Turkish economy. This outcome may be associated with the structural characteristics of Türkiye's export factors or could suggest that the selected variables do not fully capture the dynamics of exports. In other words, it can be argued that increases in interest rates positively affect exports in the long term through the impact of foreign direct investments or external capital. The analysis also shows that all variables have prob. values smaller than 0.05, indicating statistical significance, and that the selected variables affect exports in the long term. The dominance of imports and exchange rates as the most impactful factors on exports is expressed functionally as follows:

$$\frac{LEX}{LIM} = \%0.61 \quad \frac{LEX}{LRER} = -\%0.38 \quad (7)$$

In the long-term cointegration results, the constant term (c) was found to be statistically significant (coefficient = 2.40; prob. = 0.002). This finding indicates that export performance is shaped not only by the macroeconomic variables included in the model, but also by structural, institutional, and policy-related factors not explicitly included in the model. The significance of the constant term reveals that the overall economic environment and implemented policies supporting exports in the Turkish economy play a decisive role in the long term. This is important because it shows that exports are not considered as an independent target in isolation, but within a broader macroeconomic framework and policy mix.

Following the econometric and economic interpretations of the variables in the long term, the existence of a long-term cointegration relationship among the variables was examined by applying the ADF test to the residual values of the long-term model. A cointegration relationship is confirmed if the ADF test statistic exceeds the Engle-Granger critical values. The test result yielded an ADF statistic of -4.97 (Prob. 0007). Since this value is greater than the Engle-Granger critical values of 3.77, 3.17, and 2.84 at the 1%, 5%, and 10% significance levels, respectively, the residual values, or the error term, were determined to be stationary. Therefore, the variables analyzed exhibit a cointegrated structure in the long term. Additionally, this result was supported by the CRDW test. The CRDW statistic was calculated as 1.21. As this value is greater than the Engle-Granger CRDW critical values of 0.51, 0.38, and 0.32, the cointegration relationship was confirmed. In conclusion, the results of both the ADF and CRDW tests indicate the presence of a long-term cointegration relationship among the variables under consideration.

After determining the existence of a long-term cointegration relationship, diagnostic tests were applied to evaluate the statistical reliability of the estimated model. In this context, it was examined whether the error terms met the basic assumptions, and the presence of autocorrelation and heteroskedasticity problems was specifically tested. The aim of these tests is to strengthen the validity of the econometric findings by revealing whether the obtained long-term coefficients are unbiased and consistent.

Table 5. Breusch-Pagan-Godfrey Test of Heteroskedasticity for Long-Term Cointegration Models

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.603940	Prob. F (5,58)	0.1735
Obs*R-squared	7.774359	Prob. Chi-Square (5)	0.1691
Scaled explained SS	6.944945	Prob. Chi-Square (5)	0.2248

Diagnostic tests were conducted to evaluate the reliability of the long-term cointegration model. The results of the Breusch-Pagan-Godfrey heteroskedasticity test showed no heteroskedasticity in the error terms. However, the Breusch-Godfrey LM test results indicated a possible autocorrelation in the error terms. Therefore, to address the potential impact of autocorrelation on the estimation results, the long-term coefficients were re-evaluated using Newey-West (HAC) standard errors. This approach allows for more reliable statistical inferences without altering the coefficient estimates.

Following the long-term analysis, the short-term dynamics of the variables under consideration were examined, and a short-term model was estimated to assess whether the short-term processes converge toward the long-term equilibrium. In this context, the functional form of the short-term cointegration model is presented as follows;

$$\Delta \text{LEX} = F(\Delta \text{LIM}, \Delta \text{LRER}, \Delta \text{LGDP}, \Delta \text{LIN}) \quad (8)$$

The functional form of the short-term cointegration model is presented in the equation above, and the results of the short-term model are provided in Table 6.

Table 6. Cointegration Analysis Results (Short Term)

Dependent Variable: ΔLEX	Coefficients	Std. Error	t-Statistics	Prob.
ΔLIM	0.663828	0.076189	8.712880	0.0000
ΔLRER	0.015363	0.081612	0.188240	0.8514
ΔLGDP	-0.099600	0.050207	-1.983767	0.0522
ΔLIN	-0.068565	0.058527	-1.171499	0.2464
K	-0.011631	0.012636	-0.920447	0.3613
$\text{ECt}(-1)$	-0.527611	0.104078	-5.069403	0.0000
C	0.019137	0.009688	1.975305	0.0532
R^2	0.746242	Mean dependent var		0.023298
DR^2	0.719054	S.D. dependent var		0.084157
S.E. of regression	0.044607	Akaike info criterion		-3.277421
Sum squared resid	0.111427	Schwarz criterion		-3.039295
Log likelihood	110.2388	Hannan-Quinn criter.		-3.183765
F-ististik	27.44710	Durbin-Watson stat		1.823715
Prob	0.000000	Wald F-statistic		68.65187

Note: Δ represents the first difference of the variables. R^2 and D-R^2 indicate the explanatory power of the model. $\text{ECt}-1$ represents the error term of the model. Prob denotes the significance levels of the variables, while the F-statistic indicates the overall significance of the model.

The table 6 shows the results of the short-term error correction model (ECM). The IM variable has a significant and positive effect on the short-term change in exports ($\beta = 0.663$, $p < 0.01$), indicating that imports are a strong short-term determinant of export performance. The RER and IN variables were not statistically significant, meaning that the exchange rate and interest rate variables do not have a significant short-term effect on exports. The GDP variable is borderline significant at the 10% level ($p = 0.0522$), showing a negative effect in the short term.

The error correction term $\text{ECt}(-1)$ is negative and significant ($\beta = -0.528$, $p < 0.01$), confirming that short-term deviations return to equilibrium in the long term. The magnitude of the coefficient indicates that approximately 52% of short-term deviations begin to correct within a quarter. The constant term (C) is borderline significant at the 10% level ($p = 0.0532$).

The model has high explanatory power; $\text{R}^2 = 0.746$ and adjusted $\text{R}^2 = 0.719$ indicate that the independent variables largely explain short-term export changes. The F-statistic was found to be significant ($F = 27.45$, $p < 0.01$), confirming that the model is generally significant. The Durbin-Watson statistic of 1.82 indicates that there is no serious autocorrelation problem for the short term. In conclusion, the short-term ECM findings highlight the decisive role of imports on exports and the effectiveness of the error correction mechanism.

After estimating the short-term error correction model (ECM), diagnostic tests were applied to verify the model's basic assumptions. These tests included autocorrelation (Breusch-Godfrey LM test), heteroskedasticity (Breusch-Pagan-Godfrey test), and normal distribution of error terms (Jarque-Bera test). All these tests were performed to evaluate the reliability of the model's short-term predictions and the validity of the statistical inferences, and the results are presented in Table 7.

Table 7. Diagnostic Tests for the Short-Run ECM

Breusch-Godfrey Serial Correlation LM Test			
F-statistic	0.097089	Prob. F(1,55)	0.7565
Obs*R-squared	0.111015	Prob. Chi-Square(1)	0.7390
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.603186	Prob. F(6,56)	0.1634
Obs*R-squared	9.235182	Prob. Chi-Square(6)	0.1608
Scaled explained SS	4.343366	Prob. Chi-Square(6)	0.6303
Histogram: Normality Test			
Mean	4.41e-19	Jarque-Bera	1.720307
Median	0.002174	Probability	0.423097

Diagnostic test results show that the short-term ECM model satisfies its basic assumptions. The Breusch-Godfrey LM test reveals no autocorrelation in the error terms ($p = 0.7565$). The Breusch-Pagan-Godfrey test shows no heteroskedasticity issue ($p = 0.1634$). Furthermore, the normal distribution of the error terms was examined using the Jarque-Bera test, yielding a p-value of 0.4231, indicating that a normal distribution cannot be rejected. The mean, skewness, and kurtosis values also confirm that the error terms exhibit an approximately normal distribution. In conclusion, the predictions of the short-term ECM model are reliable, and the statistical inferences are valid.

Among the factors affecting exports in Türkiye, it has been found that imports, interest rates, GDP, and dummy variables positively affect exports in the long term, while exchange rates have a negative impact on exports. In the short term, only imports have a positive effect on exports. Moreover, it has been concluded that exchange rates, interest rates, GDP, and dummy variables fail to explain exports in the short term, meaning they are statistically insignificant. The import factor itself has been observed to be statistically insignificant in both the short and long term. This is related to the intrinsic structure of exports. Türkiye's inability to support export activities with its own resources (lack of driving force) results in this outcome. The heavy reliance of exports on imports in developing countries like Türkiye makes the economy dependent in this regard, leading to some negative economic consequences. Export, which depends on imported inputs, is negatively affected by exchange rates, causing a series of new negative developments in the economy. Among these negative developments, unemployment and disruptions in the general price balance are prominent. Additionally, given that export is an important factor in terms of foreign exchange input, liquidity problems are also emerging.

Short-term ECM results show that short-term changes in exports are largely determined by imports (ΔLIM) ($\beta = 0.664$, $p < 0.01$). This confirms that Türkiye's exports are dependent on imports, especially in terms of intermediate goods and production inputs. Gross Domestic Product (ΔGDP) shows a borderline significant negative effect in the short term ($p = 0.052$), suggesting that the relationship between economic growth and exports follows a complex dynamic in the short term. Exchange rate ($\Delta LRER$), interest rate (ΔLIN), and dummy variable (K) were not statistically significant in the short term; this indicates that the effects of these variables are more pronounced in the long term and that the export response mechanism is limited in the short term.

The negative and significant error correction term ($ECt(-1)$, $\beta = -0.528$, $p < 0.01$) reveals that short-term deviations quickly converge towards long-term equilibrium. The magnitude of the coefficient indicates that approximately half of the short-term deviations corrected within a quarter, suggesting that Turkish exports have a self-balancing structure against short-term shocks.

The findings reveal that Turkish exports are characterized by import dependency and sensitivity to exchange rate fluctuations in the short term. In particular, dependency on imports for intermediate goods increases the negative impact of exchange rate volatility on exports and can create risks in terms of price

stability, production, and liquidity in the economy. In this context, short-term economic policy recommendations should aim to reduce import-related risks and increase the resilience of exports against exchange rate fluctuations in a way that supports exports. To evaluate the short-term dynamics of the research findings in more detail, the directional relationships between the variables were analyzed using the Granger causality test. The results regarding the short-term causality relationships between exports, imports, real exchange rate, GDP, and interest rate are shown in Table 8.

Table 8. Granger Causality Test Results (Short-run)

Null Hypothesis	F-Statistic	Prob.	Causality
DLIM → DLEX	1.4496	0.2433	No
DLEX → DLIM	3.6240	0.0331	Yes
DLRER → DLEX	0.1816	0.8344	No
DLEX → DLRER	0.8314	0.4408	No
DLGDP → DLEX	1.0206	0.3670	No
DLEX → DLGDP	9.2461	0.0003	Yes
DLIN → DLEX	1.4278	0.2484	No
DLEX → DLIN	1.1056	0.3381	No

The Granger causality test results show that in the short term, there is no statistically significant causal relationship from imports, real exchange rate, GDP, and interest rates to exports. However, unidirectional causal relationships were found from exports to imports and from exports to economic growth. This finding indicates that in the short term, exports play a more decisive role in the Turkish economy and have a guiding effect, particularly on import volume and economic growth. The results show that increases in exports trigger imports through production processes and intermediate goods demand, and that export performance is a significant component of economic growth in the short term.

4.1. Robustness Check: Johansen Cointegration Test

In this study, the multivariate cointegration method developed by Johansen (1988, 1991) was applied to test the robustness and reliability of the long-term findings obtained using the Engle-Granger cointegration method. Johansen's approach offers stronger results compared to single-equation-based methods because it can simultaneously test for the existence of multiple cointegration relationships within a system-based framework. Therefore, the aim was to validate the long-term relationship between variables using an alternative method and to evaluate the robustness of the obtained findings.

Table 9. Johansen Cointegration Test Results

Test	Hypothesized No. of CE(s)	Trace / Max-Eigen Statistic	5% Critical Value	Prob.	Result
Trace	None	158.7261	107.3466	0.0000	Reject H ₀
Trace	At most 1	105.4777	79.3415	0.0002	Reject H ₀
Trace	At most 2	65.7782	55.2458	0.0045	Reject H ₀
Max-Eigen	None	53.2484	43.4198	0.0032	Reject H ₀
Max-Eigen	At most 1	39.6995	37.1636	0.0250	Reject H ₀
Max-Eigen	At most 2	35.1875	30.8151	0.0137	Reject H ₀

Note: CE = Cointegrating Equation. Rejection of H₀ indicates presence of cointegration.

The Johansen cointegration test was applied to examine the long-term relationships between macroeconomic variables affecting Türkiye's exports. Trace test results showed three cointegration equations, and the Max-Eigen test also showed three cointegration equations, with both tests rejecting the null hypothesis at a 5% significance level. These findings confirm the existence of a long-term stable relationship between the variables of exports (LEX), imports (LIM), GDP (LGDP), interest rate (LIN), real effective exchange rate (LRER). Specifically, the Trace test, rejecting the H₀ hypothesis for zero, at most one, and two cointegration equations, reveals the existence of more than one long-term equilibrium relationship.

These results are consistent with previous Engle-Granger tests and support the long-term linkage of Türkiye's export performance to other macroeconomic variables. The Johansen test confirms the robustness of the model's long-term findings and provides a reliable basis for policy analysis. The findings highlight the importance of planning long-term strategies independently of short-term fluctuations, particularly when assessing the impact of exchange rate volatility and imports on exports. Therefore, policymakers need to consider long-term equilibrium relationships when designing measures to support exports.

The Johansen cointegration test results were used to examine the long-term equilibrium relationship between the variables using Trace and Max-Eigen statistics, and the Vector Error Correction Model (ECM) was estimated using the stationarized series. The obtained short-term and long-term coefficients are presented in Table 10.

Table 10. VECM Results

Variables	Long-Term Coefficient (t)	Short-Term Coefficient (t)	Significance	Interpretation
DLIM(-1)	63.45 [9.27]	0.0036 [1.95]	Meaningful in both long and short term	Strong long-term influence on DLEX, limited adjustment in the short term
DLGDP(-1)	-136.94 [-22.51]	0.0140 [10.03]	Very meaningful in both long and short term	Balances DLEX in both short and long term, critical variable
DLIN(-1)	-9.77 [-1.66]	-0.0000067 [0.003]	Long term low, short term meaningless	Has a weak negative long-term effect, ineffective in the short term
DLRER(-1)	82.74 [9.47]	-0.00196 [-1.25]	Meaningful in the long term, meaningless in the short term	Positive long-term relationship with DLEX, ineffective in the short term
K(-1)	-1.23 [-0.97]	-0.0008 [-0.33]	-	-
TREND	-0.0157 [-0.51]	-	-	-
C	2.93	0.0023 [0.21]	Moderate in the long term, meaningless in the short term	Pulls the balance upwards in the long term

These results show that the main factors affecting exports in the long run are imports (DLIM) and GDP (DLGDP), and that the real exchange rate (DLRER) also has a significant effect on exports in the long run. In the short run, however, only GDP stands out as the mechanism that directs exports towards equilibrium. Interest rates (DLIN) and the dummy variable (K) do not show significant effects on exports in either the short or long run. These findings reveal that the main factors determining exports are production-side and demand-side economic variables, and that the exchange rate effect is more pronounced in the long run.

To test the robustness of the main findings obtained using the Engle-Granger method, the Johansen cointegration test was applied. Unlike the Engle-Granger method, the Johansen test offers a multivariate approach, allowing for the simultaneous evaluation of short-term and long-term relationships. The Johansen Vector Error Correction Model (ECM) results show that the main factors determining exports in the long run are imports (DLIM), gross domestic product (DLGDP), and the real exchange rate (DLRER). In particular, the import (DLIM) and gross domestic product (DLGDP) coefficients were found to be statistically significant in both the long and short term, confirming their role as the main determinants of exports in the long term. While the real exchange rate (DLRER) has a significant positive effect in the long term, its effect is statistically insignificant in the short term; this highlights the determining role of exchange rate changes on exports in the long term. Interest rates (DLIN) did not show a significant effect on exports in either the long or short term, indicating that interest rates have a limited impact on export dynamics in both the short and long term. Dummy variable (K) coefficients were also found to be insignificant in both periods, thus concluding that they do not play a decisive role in exports in the model. In the short term, however, unlike the Engle-Granger test, the Johansen ECM shows that the gross domestic product (GDP) coefficient is statistically significant and creates a fast error correction mechanism that directs exports towards equilibrium. In the Engle-Granger method, only imports (DLIM) were found to be significant in

the short term, while GDP had a borderline effect (at the 10% significance level); this difference reveals that the Johansen ECM, thanks to its multivariate structure, captures short-term interactions more comprehensively. In conclusion, the Johansen test confirms the long-term findings obtained from the Engle-Granger method and reveals short-term dynamics in more detail. This shows that the key economic variables affecting exports are consistent in the long run, and some short-term differences may be due to methodology.

5. Conclusion and Evaluation

This study focuses on Türkiye's macroeconomic structure post-2003, examining the factors influencing exports through the Engle-Granger Cointegration method. The research covers the period prior to the COVID-19 pandemic, exploring the impacts of variables such as imports, interest rates, exchange rates, GDP, and dummy variables on Türkiye's export performance. Particularly, the economic transformations and changes in export strategies observed since 2002 play a significant role in shaping Türkiye's foreign trade dynamics. The findings emphasize, from a theoretical perspective, the effects of long-term cointegration relationships on exports and illustrate the role these relationships have played in the development of the Turkish economy.

The results of the Engle-Granger Cointegration analysis reveal that, in the long run, the variables influencing Türkiye's export performance include imports, interest rates, exchange rates, GDP, and dummy variables. Specifically, imports have a positive effect of 0.61% on exports, while exchange rate fluctuations exhibit a negative effect of 0.38%. In the short run, only imports show a significant positive impact of 0.66% on exports, while other variables do not exhibit statistical significance. Furthermore, the error term coefficient is found to be -0.52, indicating that deviations in the short run tend to converge towards equilibrium within approximately two periods. The findings suggest that Türkiye's foreign trade dynamics are significantly shaped by factors such as imports and exchange rates, with the relationship between economic growth and foreign trade becoming more pronounced in the long term. The analysis highlights that, particularly in both the short and long run, Türkiye's export performance is largely influenced by imports.

The findings of this study are consistent with Serletis (1992) regarding the GDP variable, while the results related to the exchange rate variable align with Choudhry (2005). The import variable supports the findings of Sezen (2008), but diverges from the studies of Terzi and Zengin (1999), Karaçor and Gerçeker (2012), and Erdoğan (2016). These results highlight the impact of imports on exports and underscore the dependency of Türkiye's exports on imports.

The theoretical implications of these findings emphasize the intricate relationship between imports, exchange rates, and exports within the context of Türkiye's economic structure. As identified by Sezen (2008), imports play a significant role in shaping export performance, suggesting a strong interdependence between these variables. Additionally, the negative impact of exchange rate fluctuations on exports, in line with Choudhry (2005), reflects the vulnerability of Türkiye's export market to currency volatility, which is a crucial aspect of the competitiveness theory (Porter, 1990). The findings underscore the importance of macroeconomic stability and efficient management of external factors to enhance export performance in the long run.

6. Discussion and Policy Implications

The findings of this study reveal that Türkiye's export performance exhibits a structure heavily reliant on imports, both in the short and long term. In today's integrated global economy, where global value chains are deepening and production processes are fragmented on an international scale, an import-dependent production structure is predictable for many developing countries. Indeed, classical foreign trade theories consider it a natural process for countries to produce and trade in line with their comparative advantages (Ricardo, 1817; Heckscher and Ohlin, 1933). However, the results of this study show that, for Türkiye, the impact of imports on exports has gone beyond being merely a structural feature and has become a fundamental element determining export performance. This situation reveals that export growth is largely dependent on the continuity and cost of imported inputs, thus creating a structure vulnerable to external

shocks.

Another important point revealed by the findings is that exchange rates have a negative impact on exports in the long term. While classical foreign trade theories accept that competitive exchange rate policies play a role in promoting exports (Krugman and Obstfeld, 2009), the results of this study show that exchange rate volatility weakens export performance in Türkiye. This situation can be explained by the fact that the costs of imported intermediate goods, which are heavily used in export-oriented production, increase with exchange rate increases, and firms face cost uncertainty (Choudhry, 2005). Therefore, while it is expected that exchange rate increases will support exports through price competition, this effect is reversed due to the import-dependent production structure. This finding shows that Türkiye's export structure is highly sensitive to exchange rate fluctuations.

From a policy perspective, the results indicate that strategies aimed at reducing dependence on intermediate goods imports are crucial for strengthening Türkiye's export performance. While meeting all input needs through domestic production is not a rational goal, encouraging domestic intermediate goods production in strategic sectors can play a role in reducing the foreign trade balance and exchange rate vulnerability (Porter, 1990). In this context, industrial policies aimed at increasing domestic capital and technological capacity stand out as a supportive element for export sustainability. Furthermore, ensuring a predictable and stable macroeconomic environment will allow firms to make healthier long-term export decisions. In this respect, the study shows that Türkiye's export strategy should focus not only on external demand and exchange rate policies, but also on transforming its production structure.

Throughout the analysis period, the Turkish economy has become increasingly integrated into the global market, reflecting significant structural and policy-driven developments consistent with broader trends in world economic growth. This integration has created opportunities to enhance the country's international competitiveness, but has also required more stable and consistent economic management to fully realize these gains. In this context, exports play a critical role as a key mechanism through which Türkiye can strengthen its position in international markets. Recognizing and addressing macroeconomic factors affecting export performance, such as import dependence, exchange rate volatility, and domestic production capacity, is becoming essential for policymakers. Targeted strategies that improve export-related infrastructure, support domestic production of intermediate goods, and stabilize macroeconomic conditions can help Türkiye not only maintain but also enhance its competitive advantage in an increasingly interconnected global economy.

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