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EXCHANGE RATE, EXPORT, AND IMPORT RELATIONS IN TÜRKİYE: DOES THE FLOATING EXCHANGE RATE REGIME MEET EXPECTATIONS?

Türkiye'de Döviz Kuru, İhracat ve İthalat İlişkileri: Dalgalı Döviz Kuru Rejimi Beklentileri Karşılıyor mu?

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Keywords:
Real Effective Exchange Rate, Export, Import, Türkiye, VAR Analysis

Jel Codes:
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Abstract

Türkiye has implemented different exchange rate regimes and foreign trade policies throughout its 100-year history. The foreign trade deficit has been a persistent issue since the establishment of the free-market economy and its opening to foreign capital and aid. Since 1980, export-oriented industrialization policies and the withdrawal of the fixed exchange rate regime have not effectively reduced the foreign trade deficit. This study used the VAR model to examine the relationship between the real effective exchange rate, exports, and imports from March 2001 to June 2023. To investigate the causality between variables, Granger causality test is performed; impulse response functions are used to establish the direction of the variables' reaction to shocks; and variance decomposition is used to evaluate the distribution of impact over periods. The study's findings contradict economic theory's predictions about exchange rate, export, and import linkages. The Granger causality test failed to identify a causal relationship between the real effective exchange rate and exports and imports, leading to the conclusion that the level of the exchange rate has no influence on exports and imports. The bidirectional causation between exports and imports, with import changes largely explained by exports, confirms Türkiye's export dependence on imports.

Anahtar Kelimeler:
Reel Efektif Döviz Kuru, İhracat, İthalat, Türkiye, VAR Analizi

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Öz

Türkiye 100 yıllık tarihi boyunca farklı döviz kuru rejimleri ve dış ticaret politikaları uygulamıştır. Dış ticaret açığı, serbest piyasa ekonomisinin belirlendiği, ekonominin yabancı sermaye ve dış yardımlara açıldığı dönemden itibaren ekonominin kronik bir sorunu haline gelmiştir. 1980 yılından itibaren uygulanan ihracata yönelik sanayileşme politikaları ve 2001 yılında sabit kur rejiminin terk edilmes dış ticaret açığının azalmasına katkı sağlayamamıştır. Çalışmada, Mart 2001 - Haziran 2023 döneminde reel efektif döviz kuru, ihracat ve ithalat ilişkileri VAR modeli ile incelenmiş, değişkenler arasındaki nedensellik ilişkileri Granger nedensellik testi ile sorgulanmış, etki tepki fonksiyonu ve varyans ayrıştırması ile uygulanan şoklara değişkenlerin tepkisinin yönü ve tepkinin dönem içerisindeki gelişimi analiz edilmiştir. Çalışma bulguları iktisat teorisinin öngördüğü döviz kuru, ihracat, ithalat ilişkileri ile çelişen bulgulara işaret etmektedir. Granger nedensellik testi ile reel efektif döviz kuru ile ihracat ve ithalat arasında nedensellik ilişkisi tespit edilememiş, döviz kuru düzeyinin ihracat ve ithalat üzerinde etkisinin olmadığı sonucuna ulaşılmıştır. Ancak ihracat ve ithalat arasında iki yönlü nedenselliğin tespiti, özellikle ithalattaki değişimin büyük ölçüde ihracatla açıklanıyor olması, Türkiye'de ihracatın ithalata bağımlılığı sorununu teyit etmektedir.

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1. Introduction

The Republic of Türkiye has pursued several economic strategies in accordance with global economic trends throughout its 100-year existence. Economic policy was decided during the foundation years by the conclusions of the Izmir Economic Congress and the stipulations of the Lausanne Peace Treaty. Although a liberal economic policy was adopted in the first decade following the foundation of the Republic, the encouragement of industrial output, monopolies established for trade in industrial products, and numerous privatizations, particularly in railways, indicate the government's strong role in the economy. It was conceivable to generate a foreign trade surplus with the authority to impose customs tariffs and regulate foreign trade in 1929. With the influence of the 1929 Depression and the Keynesian Revolution, the 1930s saw a shift to statist economic policy, with economic policies administered by development plans. The country had a strong period of foreign trade as a result of trade relations carried out through bilateral agreements. Between 1946 and 1960, the country transitioned to a free market economy and opened its doors to foreign capital and foreign aid. In order to adjust to the postwar free market economic conditions, Türkiye implemented the first devaluation in its history in 1946. The challenge of international payment difficulties in the years that followed necessitated the 1958 devaluation. Türkiye followed an import-substitution industrialization program from 1960 to 1980, and economic management was carried out within the framework of development plans. The import-substitution industrialization program limited domestic production and exports depending on imported inputs, and the 1973 oil crisis disrupted the country's balance of payments (Kepenek and Yenturk, 2001).

Türkiye, which was facing foreign payment difficulties and inflation concerns in the second half of the 1970s, took economic policy actions that may be described as a transformation. With the decisions of January 24, 1980, the value of the national currency was left to market forces, and an export-oriented industrialization policy was adopted (Kepenek and Yenturk, 2001). Following the abandonment of the fixed exchange rate regime in 1980 in favor of a flexible exchange rate regime, the national currency was depreciated by about 50%, limitations on foreign exchange movements were eliminated in 1989, and the Turkish lira's convertibility was ensured. The exchange rate was determined in the market, but the Central Bank intervened and guided the exchange rate during this period (Inan, 2002). From the beginning of 2000 until February 2001, the nominal exchange rate was used as an anchor; that is, the exchange rate was allowed to fluctuate within a certain band; however, when it became clear that the exchange rate could no longer be kept fixed due to the crisis in February 2001, the practice was discontinued, and the floating exchange rate regime was implemented (Atac, 2003).

The course of Türkiye's foreign trade in its 100-year history can be traced from the data in Table 1. Until 1930, Türkiye's foreign trade was in deficit, but with the statist policies implemented in the 1930s, Türkiye realized a foreign trade surplus in the period 1930-1946, except for 1938. Rapid increases in exports and imports were observed in the 1940s, and with the transition to a free market economy in 1946, foreign trade deficits started to accompany the increasing trade volume as of 1947. The transition to an import-substitution industrialization policy in the 1960-1980 period failed to ensure the domestic production of imported products as expected, serious increases in imports were experienced as of the second half of the 1970s, and the proportion of imports covered by exports decreased. With the 1980 transition to an export-oriented industrialization policy and the 1989 financial liberalization process, exports increased

significantly in the late 1980s and especially in the 1990s, but Türkiye's foreign trade deficit increased continuously as imports also increased. The 2001 crisis reduced the country's imports, and the foreign trade deficit declined. In February 2001, with the transition to a floating exchange rate regime, increases in trade volume were to the detriment of the country in terms of foreign trade balance. After contracting in 2009 due to the impact of the 2008 global crisis, trade volume recovered immediately in 2010, while trade volume increases in the 2010-2022 period resulted in a continuous foreign trade deficit. The foreign trade deficit has become a chronic problem for Türkiye since 1947.

Table 1. Foreign Trade by Years (in thousand dollars)

Years	Export	Import	Balance of Foreign Trade	Proportion of Imports Covered by Exports
1923	50,790	86,872	-36,082	58.5
1933	58,065	45,091	12,974	128.8
1943	196,734	155,340	41,394	126.6
1953	396,061	532,533	-136,472	74.4
1963	368,087	687,616	-319,529	53.5
1973	1,317,083	2,086,216	-769,133	63.1
1983	5,727,834	9,235,002	-3,507,168	62.0
1993	15,345,067	29,428,370	-14,083,303	52.1
2001	31,334,216	41,399,083	-10,064,867	75.7
2002	36,059,089	51,553,797	-15,494,708	69.9
2003	47,252,836	69,339,692	-22,086,856	68.1
2004	63,167,153	97,539,766	-34,372,613	64.8
2005	73,476,408	116,774,151	-43,297,743	62.9
2006	85,534,676	139,576,174	-54,041,499	61.3
2007	107,271,750	170,062,715	-62,790,965	63.1
2008	132,027,196	201,963,574	-69,936,378	65.4
2009	102,142,613	140,928,421	-38,785,809	72.5
2010	113,883,219	185,544,332	-71,661,113	61.4
2011	134,906,869	240,841,676	-105,934,807	56.0
2012	152,461,737	236,545,141	-84,083,404	64.5
2013	151,802,637	251,661,250	-99,858,613	60.3
2014	157,610,158	242,177,117	-84,566,959	65.1
2015	143,838,871	207,234,359	-63,395,487	69.4
2016	142,529,584	198,618,235	-56,088,651	71.8
2017	156,992,940	233,799,651	-76,806,711	67.1
2018	167,920,613	223,047,094	-55,126,481	75.3
2019	171,464,945	202,704,320	-31,239,375	84.6
2020	160,656,652	209,534,325	-48,877,673	76.7
2021	213,598,369	260,682,217	-47,083,848	82.0
2022	235,247,081	342,209,950	-106,962,869	68.8

Source: TURKSTAT (Turkish Statistical Institute), 2023.

The predicted structural transformation in Türkiye’s international trade was not achieved as a result of the export-oriented industrialization program. Although Türkiye’s international trade volume has risen, there has been no change in the nature of the goods traded. While exported commodities are often low-value-added items manufactured using labor-intensive manufacturing technologies, imported goods are predominantly capital-intensive goods. Furthermore, imports of intermediate and capital goods used in manufacturing have made production and exports reliant on imports, limiting high-value-added output (Karakas, 2017: 262).

The significant growth in trade volume and trade deficits associated with the transition to a floating exchange rate regime raises the question of whether exchange rates impact international trade. It is critical under the floating exchange rate regime to maintain the balance of payments without requiring administrative intervention by increasing the exchange rate in the case of a current account deficit and reducing the exchange rate in the opposite scenario. The floating exchange rate regime is not a system in which foreign exchange markets are never engaged; interventions in the foreign exchange market are undertaken for speculative or other motives (Atac, 2003). An appreciation of a country's national currency raises the relative price of exports while decreasing the relative price of imports. Depreciation, on the other hand, lowers the relative price of a country's exports while increasing the relative price of imports. The value of the exchange rate, like the value of other prices in the economy, is decided by the supply and demand of economic actors such as households, businesses, and financial institutions.

The real effective exchange rate is the most important determinant of a country's export and import demand. The nominal effective exchange rate is the weighted average value of the national currency compared to a basket of currencies representing nations that account for a major portion of a country's international trade. Adjusting the nominal effective exchange rate for relative price impacts yields the real effective exchange rate. The weighted geometric mean of a country's price level compared to the price level of the nations with which it trades is used to create real effective exchange rate indices. An increase in the real effective exchange rate indicates that the national currency appreciates in real terms, implying that the price of domestic goods in terms of foreign goods rises (CBRT, 2023).

In its 100-year history, Türkiye has been experiencing a chronic foreign trade deficit for most of its history. Different exchange rate regimes and different foreign trade policies have been implemented in Türkiye, but the problem still persists. In this study, the relationship between real effective exchange rates, exports, and imports during the period between March 2001 and June 2023, when the floating exchange rate regime was adopted, is analyzed with the Vector Autoregression (VAR) model. Despite the fact that the issue has been addressed in previous literature, this study has created a time series spanning more than twenty-two years from the implementation of this regime to the present. As a result, unlike other studies, the full duration of the floating exchange rate regime in Turkish economic history has been covered and evaluated. The causal relationship between the variables is investigated with the Granger causality test, the impact of a shock to one variable on other variables is analyzed with impulse response functions, and the duration of the impact of the shock on other variables is evaluated with variance decomposition results. The second section of the study summarizes the related literature, the third section introduces the data set used and presents the empirical findings, and the study concludes with a conclusion.

2. Literature Review

The exchange rate foreign trade relationship is still one of the most widely researched and debated topics in the literature. There are many studies on the subject in both national and international literature. In terms of their findings, the studies are presented in two groups: those that do not detect a relationship between exchange rates, exports, and imports and those that do.

In the first group, the findings of the studies that fail to detect a relationship between the variables are summarized. Ozçelik and Uslu (2020) used the VAR model to examine the relationship between the real exchange rate, exports, and imports in Türkiye from 2003 to 2016. The study discovered a weak relationship between imports and the real exchange rate, a weak relationship between the real exchange rate and exports, as well as a strong relationship between imports and exports, and the Granger causality test results revealed only a unidirectional causality from imports to exports. Hepaktan et al. (2011) used monthly data from 1982 to 2011 to investigate whether Türkiye's exchange rate policy is effective in achieving a foreign trade balance. According to the Johansen cointegration and Granger causality tests used in this study, the fact that the effect of exports and imports on the real effective exchange rate is larger than the effect of the real effective exchange rate on imports and exports indicates that the exchange rate policy is ineffective in achieving foreign trade balance. Another study, using the ARDL cointegration test, found that there is a long run relationship between exchange rates, imports, and exports in Türkiye, while the Granger causality test results show that there is no causal relationship between the variables (Bozdan et al., 2018). Aytekin and Ucan (2022) used the Johansen cointegration test and the Granger causality test with monthly data from 2004 to 2019 for Türkiye and concluded that there is a long run cointegration relationship between the series, bidirectional causality between exports and imports, and unidirectional causality from exchange rate to inflation and imports. Ugur (2021) analyzed the effect of the real effective exchange rate on exports and imports in the fragile five countries for the period 1994-2019 using panel cointegration analysis. The study concluded that the decline in the real effective exchange rate decreases imports but has no effect on exports. This result implies that the assumption that real effective exchange rate reductions, as indicated by the J curve, enhance exports while decreasing imports is exclusively true for imports in these nations. Nusair (2017) tested the validity of the J curve in sixteen European transition economies with linear and nonlinear ARDL models. The J curve phenomenon was not found in the linear model, but it was found in the nonlinear model in twelve of the sixteen countries, indicating that currency depreciation deteriorated the trade balance in the short run but improved it in the long run. The Johansen cointegration test was used by Onakaya et al. (2018) to determine the existence of the J curve phenomenon in the Nigerian economy. The authors claimed that while the appreciation of the national currency improved the trade balance in the short term, they were unable to discover a causal relationship between the variables in the long run. VAR analysis, Granger causality test, variance decomposition, and impulse response function approaches were utilized using the nominal exchange rate, export and import variables, and quarterly data for the Turkish economy from 1998 to 2015. While there was unidirectional causation from imports to exports, there was no causal link between the nominal exchange rate and exports and imports. According to the findings of variance decomposition and impulse response analysis, the exchange rate has no significant effect on exports and imports (Catalbas, 2016). Altin and Suslu (2017) used the Toda-Yamamoto approach to examine the relationship between the Turkish exchange rate, imports, and exports from 1989 to 2016 and found no statistically significant relationship. Oluyemi and Isaac (2017) determined, using monthly data from 1996 to 2015, that the real effective exchange rate in Nigeria has no effect on the volume of imports and exports and is unaffected by export and import operations. In this study, which results contrary to economic theory, the relationship between variables was explored using impulse response functions. According to impulse response functions, exchange rates respond positively to imports and negatively to exports.

The second group, the summaries of the studies in which a relationship between the variables was found, is also presented. Sahin and Durmus (2019) used monthly data from 2003 to 2018 to examine the relationship between Türkiye's real effective exchange rate, exports, and imports. The structural break co-integration test revealed that the variables were related in the long run in the study, and causality tests revealed a unidirectional causality relationship from the real effective exchange rate to imports and from exports to the real effective exchange rate. Gerni et al. (2018) discovered a long run relationship between Türkiye’s exports, imports, and the real effective exchange rate using ARDL and NARDL methodologies with quarterly data from 2003 to 2017. Although the study failed to identify an asymmetric relationship in the long run, it did reveal an asymmetric relationship in the short run in which decreases in the exchange rate and imports impact exports. Balcilar et al. (2014) used the ARDL model to examine the determinants of export performance in Türkiye using quarterly data from 1995 to 2012 and studied the causal relationships among variables based on the findings. The study discovered that productivity is the main determinant of exports in the short and long run, low exchange rates increase exports in the long run, real wage increases negatively affect exports in the short and long run, and foreign income is the most important determinant of exports in the long run. Iossifov and Fei (2019) addressed the arguments in the literature that trade flows are disconnected from real effective exchange rate movements by using data from the Turkish economy and using quarterly data for the period 1998–2017. The real effective exchange rate was discovered to be a significant predictor of real trade balances throughout this period. The study emphasizes that the effect of the real effective exchange rate on appreciation and depreciation periods is not symmetric. During the period of real effective exchange rate appreciation until the third quarter of 2008, the transmission channel operated to raise imports while exports continued to grow. The depreciation of the real effective exchange rate encouraged exports while suppressing imports in the post-2008 crisis era. Cergibozan and Ari (2018) studied the trade balance consequences of exchange rate regimes implemented in Türkiye between 1987 and 2015. They find no evidence of the J curve hypothesis despite finding a long run relationship between the real effective exchange rate and the trade balance under fixed and floating exchange rate regimes. In a study that used linear and nonlinear ARDL models to examine the effect of the real effective exchange rate on the bilateral trade balance between the United States and Vietnam, it turned out that the real exchange rate affected the trade balance in the long run in the linear model and that while the effects on trade at the industry level varied by product category, asymmetric effects were found in most of the total industries in the short and long run in the nonlinear model (Ho et al., 2023). Nuhu and Bukari (2021) examined the effect of Ghana's exports and imports of products on the real effective exchange rate using VAR analysis with monthly data from 2005 to 2019. They discovered that exports had a negative effect on the real effective exchange rate, whereas imports had a positive effect, with import shocks having a greater impact. In their analysis of the post-2008 crisis period in South Africa, Habanabakize (2020) found a long run relationship between exchange rate, growth, export, and import variables with the ARDL model. Their findings indicate the beneficial effects of economic growth on exports and imports, as well as currency appreciation, which boosts imports and decreases exports, consistent with the theory. Furthermore, the Granger causality test results reveal bidirectional causality between the exchange rate and imports, growth and imports, and the exchange rate and growth. According to a study that examined the short and long run effects of the real effective exchange rate and income on Greece's trade between 1995 and 2018, the long run income elasticities of trade decreased

throughout the period; the effect of the change in the real effective exchange rate on exports was realized in the post-crisis period, while the effect on imports was realized throughout the period, contrary to what was expected (Lazarou and Zervas, 2022). In their study on the influence of exchange rate fluctuations on the balance of payments in Nigeria for the period 2010-2019, Irmiya et al. (2023) indicated that unstable exchange rates create deterioration in the balance of payments. The study highlighted that exchange rate instability reduces the value of the national currency, harms exports, and raises the cost of imported products, and that the overall performance of the economy is dependent on exchange rate stability. Rahim et al. (2020) used VAR analysis and Granger causality tests to examine the causality relationship between exports, imports, and exchange rate variables in the Indonesian economy and discovered a unidirectional relationship from exchange rate to exports and to imports in the short run; in other words, strengthening the national currency increases exports and imports. Berument et al. (2015) used VAR analysis to examine the impact of real effective exchange rate shocks on Türkiye's exports to fifteen important trading partners and discovered that a depreciation of the aggregate real exchange rate increases exports by three-quarters and that the response of exports to bilateral real exchange rate shocks varies across countries.

As mentioned earlier, the floating exchange rate regime was introduced in Türkiye in February 2001, and although the issue has been addressed in the previous literature, this study has created a time series of more than twenty-two years from the implementation of this regime to the present day; thus, unlike other studies, the entire period of the floating exchange rate regime in the history of the Turkish economy has been covered and analyzed. It is hoped that this "full period" analysis will contribute to future studies on the subject to some extent.

3. Data and Estimation Results

The relationship between the real effective exchange rate, exports, and imports under the floating exchange rate regime in Türkiye is analyzed with the VAR model. Monthly data covering the period between March 2001 and June 2023 is used in the study. Real effective exchange rate data are obtained from the CBRT (Central Bank of the Republic of Türkiye), while exports and imports data are obtained from the TURKSTAT (Turkish Statistical Institute).

Table 2. Unit Root Test Results

	lnEX	dlnEX	lnIM	dlnIM	lnRER	dlnRER
ADF Test Statistics	-2.789443	-5.040604*	-2.949341	-4.290533*	-1.768865	-10.13567*
PP Test Statistics	-2.165782	-44.55877*	-3.009914	-27.40382*	-1.326430	-14.55061*
KPSS Test Statistics	0.389443	0.118294*	0.386079	0.073424*	0.500904	0.031469*

Note: *significance level at 1%

The stationarity of the series was determined using the ADF (Augmented Dickey-Fuller), PP (Phillips-Perron), and KPSS (Kwiatkowski-Phillips-Schmidt-Shin) unit root tests. The logarithmically converted export, import, and real effective exchange rate series were shown to be non-stationary using unit root tests. The unit root test was applied again, this time using the series' first differences, and the first differenced series were determined to be stationary according to all three unit root tests. The results of the unit root test are shown in Table 2. The

abbreviation lnEX is used for the logarithmic transformation of the export series, lnIM for the logarithmic transformation of the import series, and lnRER for the logarithmic transformation of the real effective exchange rate series; d denotes the first difference of the series.

The VAR model employs series that are made stationary by taking the difference. The appropriate number of lags should be determined first before estimating the model. Table 3 shows the lag selection criteria that were utilized to calculate the appropriate number of lags. While the Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ) consider two lags to be adequate for the model, the Akaike information criterion (AIC), sequential modified likelihood ratio test static (LR), and final prediction error (FPE) criterion all agree that five lags are appropriate. The number of lags for the VAR model is set to 5 based on the criteria in the Table 3.

Table 3. VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	933.8684	NA	1.52e-07	-7.188173	-7.146974	-7.171609
1	998.1403	126.5585	9.90e-08	-7.614983	-7.450188	-7.548725
2	1041.674	84.71373	7.58e-08	-7.881650	-7.593259*	-7.765700*
3	1056.402	28.31902	7.25e-08	-7.925883	-7.513895	-7.760240
4	1071.784	29.22061	6.90e-08	-7.975168	-7.439584	-7.759832
5	1085.157	25.09378*	6.68e-08*	-8.008937*	-7.349756	-7.743907
6	1091.666	12.06251	6.81e-08	-7.989699	-7.206922	-7.674977
7	1100.015	15.27952	6.85e-08	-7.984671	-7.078298	-7.620256
8	1104.562	8.217162	7.09e-08	-7.950290	-6.920320	-7.536181

The model with the appropriate number of lags satisfies the conditions of stability, absence of serial correlation and constant variance, which are confirmed by the relevant tests and the results are presented in the appendix. Table 4 shows the estimated 48 coefficients, standard errors, and t statistics for the VAR model that meets the stability criteria. The footnote below the table indicates whether the coefficients in the table are statistically significant.

Table 4. VAR Estimates

	DLNEX	DLNRER	DLNIM
	-0.595838*	0.015306	0.045535
DLNEX(-1)	(0.09052)	(0.02920)	(0.08937)
	[-6.58221]	[0.52414]	[0.50950]
	-0.239654**	0.007331	0.282359*
DLNEX(-2)	(0.10572)	(0.03411)	(0.10438)
	[-2.26688]	[0.21495]	[2.70520]
	-0.426382*	0.054281	-0.135011
DLNEX(-3)	(0.10970)	(0.03539)	(0.10830)
	[-3.88691]	[1.53384]	[-1.24661]
	-0.411829*	0.074967**	-0.358728*
DLNEX(-4)	(0.10512)	(0.03391)	(0.10378)
	[-3.91775]	[2.21062]	[-3.45652]
	-0.261164*	0.046330	-0.057959
DLNEX(-5)	(0.09183)	(0.02963)	(0.09066)
	[-2.84396]	[1.56387]	[-0.63927]
	0.335901*	0.355798*	0.434937**
DLNRER(-1)	(0.19996)	(0.06451)	(0.19742)
	[1.67980]	[5.51541]	[2.20307]

Table 4. Continued

	DLNEX	DLNRER	DLNIM
	0.015741	-0.258037*	-0.001129
DLNRER(-2)	(0.21141)	(0.06820)	(0.20872)
	[0.07446]	[-3.78344]	[-0.00541]
	-0.117828	0.034927	0.015959
DLNRER(-3)	(0.21250)	(0.06856)	(0.20980)
	[-0.55447]	[0.50948]	[0.07607]
	-0.010316	-0.136867**	0.111600
DLNRER(-4)	(0.19824)	(0.06395)	(0.19572)
	[-0.05204]	[-2.14012]	[0.57021]
	0.024688	-0.146483**	0.121792
DLNRER(-5)	(0.18305)	(0.05905)	(0.18072)
	[0.13487]	[-2.48056]	[0.67392]
	-0.032267	-0.001397	-0.487088*
DLNIM(-1)	(0.09335)	(0.03012)	(0.09216)
	[-0.34566]	[-0.04638]	[-5.28506]
	-0.125926	-0.029785	-0.319706*
DLNIM(-2)	(0.10129)	(0.03268)	(0.10000)
	[-1.24321]	[-0.91149]	[-3.19694]
	0.348017*	-0.064456***	0.201098**
DLNIM(-3)	(0.10199)	(0.03290)	(0.10069)
	[3.41241]	[-1.95907]	[1.99720]
	0.324490*	-0.026204	0.250932*
DLNIM(-4)	(0.09800)	(0.03162)	(0.09675)
	[3.31114]	[-0.82883]	[2.59350]
	0.046575	-0.020369	-0.080109
DLNIM(-5)	(0.09144)	(0.02950)	(0.09028)
	[0.50934]	[-0.69048]	[-0.88733]
	0.017757*	-0.002086	0.013489**
C	(0.00665)	(0.00215)	(0.00657)
	[2.66970]	[-0.97200]	[2.05423]

Note: Standard errors in ( ), t statistics in [ ]. *Significant at 1% level of significance. ** Significant at 5% level of significance. *** Significant at 10% level of significance.

3.1. VAR Granger Causality Test Results

Since the VAR model meets the stability criteria, the Granger causality test was used to assess the causality between the variables, and the results are shown in Table 5. The null hypothesis in the Granger causality test asserts that there is no causality between the variables. The null hypothesis that there is no causality from the real effective exchange rate to exports is accepted in the model with exports as the dependent variable, whereas the null hypothesis that there is no causality from imports to exports is rejected. In other words, while no causality exists from the real effective exchange rate to exports, there is a causality from imports to exports. Because the model contains two explanatory variables, the probability value of the chi-square test statistic in the "All" row is used to assess if all independent variables affect the dependent variable. Since the probability value is 0.00070<0.10, it can be concluded that the independent variables in this model (real effective exchange rate and import) are the cause of the dependent variable (export).

In the model where the real effective exchange rate is the dependent variable, no causal relationship was found from exports to the real effective exchange rate or from imports to the

real effective exchange rate. Considering all variables in the model, no causal relationships were found from independent variables to the dependent variable, the real effective exchange rate.

A causal relationship from exports to imports was found in the model with imports as the dependent variable. However, no causal relationship was detected from the real effective exchange rate to imports. Considering the joint effects of two independent variables in this model, it is possible to conclude that there is a causal relationship between independent variables and imports.

Table 5. VAR Granger Causality / Block Exogeneity Wald Test Results

Dependent variable DLNEX	**Chi-sq**	**df**	**Prob.**
DLNRER	4.217071	5	0.5186
DLNIM	28.67991	5	0.0000
All	30.62439	10	0.0007
Dependent variable DLNRER	**Chi-sq**	**df**	**Prob.**
DLNEX	6.721355	5	0.2422
DLNIM	4.091703	5	0.5363
All	12.11486	10	0.2774
Dependent variable DLNIM	**Chi-sq**	**df**	**Prob.**
DLNEX	36.65914	5	0.0000
DLNRER	6.071304	5	0.2993
All	42.23847	10	0.0000

3.2. Impulse Response Functions

Graphs of impulse response functions show how other series are affected when a shock is given to one of the series. In the graphs, the horizontal axis shows the periods, also called the zero line, and the vertical axis shows the severity of the response. Responses above the zero line indicate positive responses, while those below it indicates negative responses. The red dashed lines represent the boundaries of the 95% confidence interval bounds, while the blue line is called the response curve. When the zero line is within the confidence interval, it implies that the reaction is meaningless (Mert and Caglar, 2019).

The impulse response functions of the variables in the model are presented in Figure 1. The top panel of the figure shows the response of exports to shocks to exports, the real effective exchange rate, and imports. The shock to export has a positive response in the first month, turns negative in the second month, and becomes statistically insignificant in the middle of the third month. The response of exports to the real effective exchange rate is negative in the first month, and positive in the second month, but this response is not statistically significant. The response of exports to a shock to imports is positive in the first month, negative in the second month, and this effect persists until the middle of the third month.

The middle panel of the figure shows the responses of the real effective exchange rate. The response of the real effective exchange rate to the shock in exports is negative and then positive, but this response is not statistically significant. The response of the real effective exchange rate to shocks originating from itself was quite high and positive until the middle of the third month. The response of the real effective exchange rate to imports induced shocks is statistically insignificant, as is the response to shocks to exports.

The bottom panel of the figure shows the response of imports to shocks. As in other variables, import responds the most to self-induced shocks. While this response is positive until the beginning of the second period, it is negative until the middle of the third period. The response of imports to the shock of exports is positive until the beginning of the second period and negative until the third period. The response of imports to the shock to the real exchange rate appears to be quite limited and is not statistically significant.

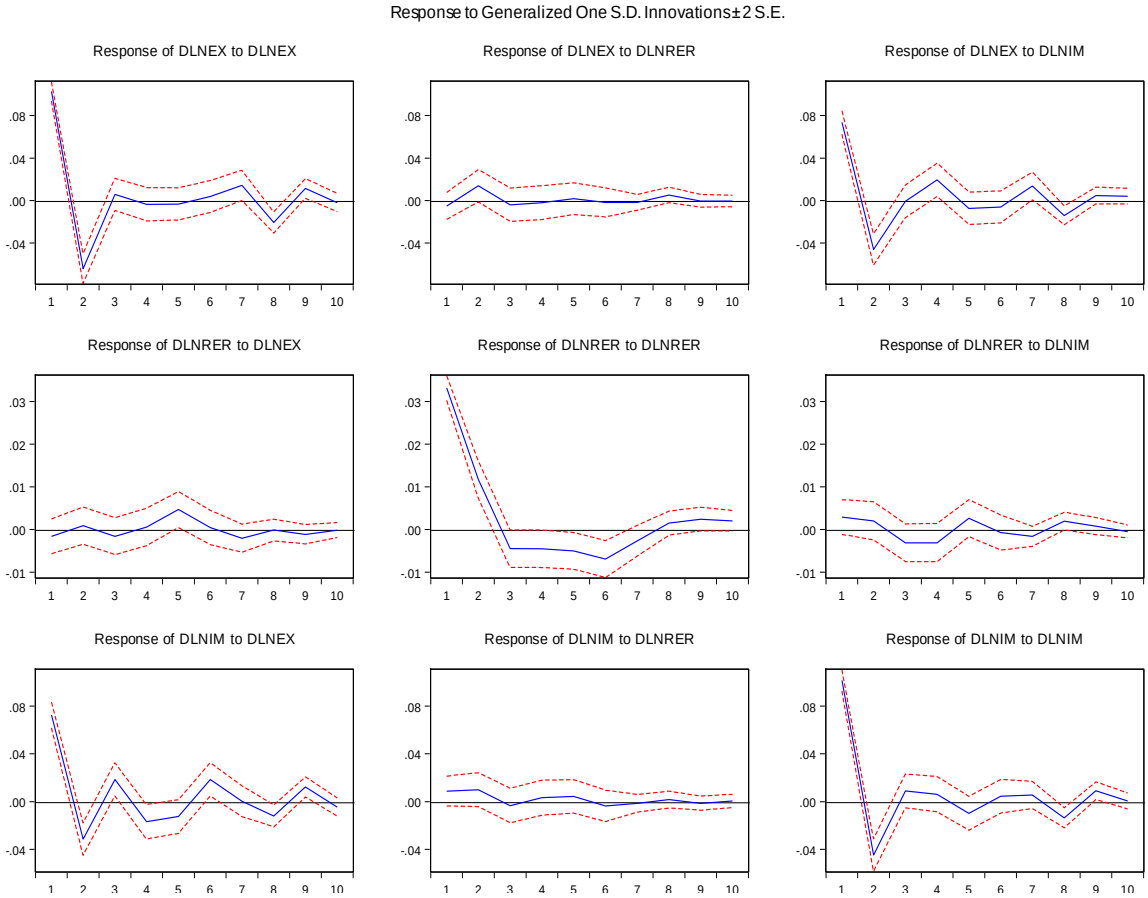

Figure 1. Impulse Response Functions

3.3. Variance Decomposition

Impulse response analysis was used to determine the direction of the response of a variable to the shocks applied to the series. Variance decomposition gives the distribution of the total change among the variables over the periods.

Table 6, which presents the variance decomposition results for the export variable, shows that in the first period, all of the change in exports was explained by itself; in the second period, 0.7% of the change in exports was explained by the real effective exchange rate; and in the other periods the explanatory power of the real effective exchange rate for exports remained at very low levels of 0.8% and 0.9%. The proportion of the change in exports affected by its own shocks decreased considerably in the fourth period, and by this period, imports explained about 7% of the change in exports. In the fourth period and thereafter, the effect of the change in the real effective exchange rate on exports remained at very limited levels (below 1%) until the end

of the tenth period, while the ratio of the change in exports to the change in imports was around 8% on average.

Table 6. Variance Decomposition of Export

Period	S.E.	DLNEX	DLNRER	DLNIM
1	0.102863	100.0000	0.000000	0.000000
2	0.121739	99.18840	0.777257	0.034347
3	0.122099	98.82455	0.867030	0.308415
4	0.126411	92.27965	0.840637	6.879709
5	0.126690	91.94180	0.851207	7.206996
6	0.127378	91.04247	0.858385	8.099142
7	0.128290	90.99163	0.854791	8.153583
8	0.130007	91.12460	0.935308	7.940097
9	0.130598	91.05500	0.927089	8.017913
10	0.130866	90.70518	0.925160	8.369661

According to the variance decomposition results of the real effective exchange rate in Table 7, imports had no effect on the real effective exchange rate in the first period, while the effect of exports was 0.2%, meaning that 99.7% of the change in the real effective exchange rate was explained by its own lagged values. The sensitivity of the real effective exchange rate to its own lagged values started to decrease after the third period, and changes in imports and exports started to affect the real effective exchange rate. At the end of the tenth period, 95% of the change in the real effective exchange rate is explained by itself, while 2.3% is explained by exports and 2.4% by imports.

Table 7. Variance Decomposition of Real Effective Exchange Rate

Period	S.E.	DLNEX	DLNRER	DLNIM
1	0.033184	0.242566	99.75743	0.000000
2	0.035223	0.279368	99.71986	0.000769
3	0.035618	0.476985	99.17322	0.349794
4	0.036169	0.487486	97.74535	1.767169
5	0.036789	2.088003	96.20182	1.710179
6	0.037445	2.028855	96.31301	1.658135
7	0.037605	2.311804	96.03934	1.648856
8	0.037731	2.297835	95.55004	2.152126
9	0.037872	2.374545	95.23061	2.394848
10	0.037937	2.368248	95.18323	2.448518

The variance decomposition results of the import variable in Table 8 are quite different from the other two variables. While only 47% of the change in imports is explained by itself, 51% is explained by exports. In subsequent periods, the interaction between these two variables has not changed significantly. The sensitivity of the change in imports to its own lagged values declined to 47% in the tenth period, while the portion of the change in imports explained by exports was realized as 51% in the tenth period, although it decreased by one or two points from time to time. The effect of the real effective exchange rate on the change in imports hovered in the 1.5%-1.8% band throughout the whole period.

Table 8. Variance Decomposition of Import

Period	S.E.	DLNEX	DLNRER	DLNIM
1	0.101556	51.10379	1.492620	47.40359
2	0.111933	49.93187	1.788139	48.27999
3	0.113647	51.11294	1.781918	47.10514
4	0.117822	49.61074	1.699561	48.68970
5	0.118559	50.10876	1.777188	48.11405
6	0.120663	50.74383	1.765909	47.49026
7	0.120935	50.51605	1.772758	47.71119
8	0.121778	50.80759	1.756461	47.43595
9	0.122398	51.29784	1.742588	46.95957
10	0.122618	51.26457	1.736658	46.99877

4. Conclusion

Türkiye switched to an export-oriented industrialization strategy in 1980 and a financial liberalization process in 1989, reduced interventions in exchange rates over time, and adopted the floating exchange rate regime with the crisis in February 2001. In this study, the exchange rate, export and import relations for the period 2001:3 to 2023:6 are analyzed with the VAR model; causality relations between the variables are determined with the Granger test; how the shocks applied to the variables affect other variables is analyzed with the impulse response functions; and finally, the duration of the shock applied to other variables is analyzed with variance decomposition.

The Granger causality test, which is applied after the VAR model is found to satisfy the stability conditions, shows that there is a causal relationship from imports to exports and from exports to imports. However, no causality was found between the exchange rate and export and import variables. The impulse response functions indicate that the responses of exports and imports to exchange rate shocks are statistically insignificant, consistent with the Granger causality test results. The response of exports to an import shock is positive in the first period, and negative in the second period, but disappears in the middle of the third month. The response of imports to an exports shock is positive until the beginning of the second period, and then turns negative. While the direction of the variables' responses to shocks is determined by impulse response, variance decomposition is used to determine the share of the total change among the variables over the period. The explanatory power of the exchange rate for the changes in exports and imports is found to be quite limited. The rate at which the change in exports is affected by its own shocks decreased considerably in the fourth period and by this period, imports started to explain about 7% of the change in exports. The variance decomposition results for imports are quite different from the other variables' results. In the first period, 51% of the change in imports was explained by exports, and this ratio has not changed much over the ten periods. While the changes in the other variables in the model are largely explained by themselves, the situation is quite different for imports. This result indicates that the problem of exports dependence on imports persists in Türkiye.

The findings of the study are generally inconsistent with the theoretically foreseen exchange rate-foreign trade relationship; the exchange rate does not affect exports or imports. The strong relationship between imports and exports confirms the imported input dependence of export-oriented production. Domestic production of imported raw materials and intermediate goods will reduce the dependence of exports on imports and have a positive impact on the

foreign trade deficit by reducing imports. In this way, the export-led growth strategy will also yield successful results. Another problem with Türkiye's exports is related to the quality of the export goods. The orientation of production towards capital intensive areas, ensuring high value-added production, and increasing competitiveness in the international market will contribute to the reduction of the foreign trade deficit and the development of the country.

Declaration of Research and Publication Ethics
This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

Researcher’s Contribution Rate Statement
I am a single author of this paper. My contribution is 100%.

Declaration of Researcher’s Conflict of Interest
There are no potential conflicts of interest in this study.

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Appendix

AR characteristic polynomial reverse roots are utilized to determine if the VAR model meets the stability criteria. The fact that the absolute values of the autoregressive characteristic roots of the VAR equation system are smaller than one indicates that the system is constituted by stationary variables and fulfills the stability criterion. The inverse roots of the AR characteristic polynomial are shown in Figure 1 to be within the unit circle, implying that the system meets the stability criteria.

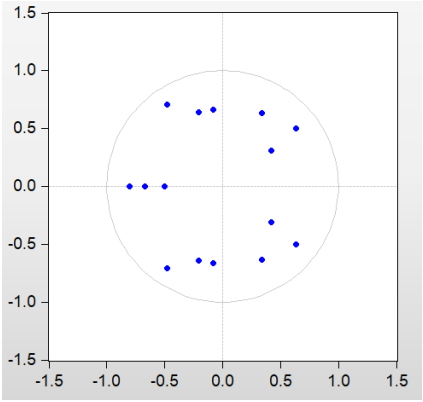

Figure A1: Inverse Roots of AR Characteristic Polynomial

The Autocorrelation Langrange Multiplier (LM) test is applied for 10 lags to verify whether the VAR model meets the criterion of no serial correlation. Since all the p-values in Table 1 are greater than 0.01, the LM test null hypothesis "No serial correlation at lag h" cannot be rejected. The absence of autocorrelation of the residuals up to 10 lags is ensured at a bias level of 0.01.

Table A1: Autocorrelation LM Test

Lag	LRE stat	Rao F-stat	Prob.
1	12.85642	1.435599	0.1692
2	10.59222	1.180496	0.3047
3	2.420752	0.267926	0.9829
4	11.43345	1.275161	0.2472
5	11.28148	1.258049	0.2569
6	14.65395	1.638822	0.1009
7	8.271451	0.920032	0.5071
8	9.538240	1.062079	0.3892
9	7.900281	0.878470	0.5442
10	12.52908	1.398658	0.1851

To evaluate if the error terms in the VAR model fulfill the constant variance constraint, the white heteroskedasticity test was used. The table's test findings demonstrate that the null hypothesis that the variance of the error term is constant cannot be rejected ($p>0.01$) and that the constant variance condition is fulfilled at the 0.01 error level.

Table A2: White Heteroskedasticity Test

Chi-sq	df	Prob.
207.3044	180	0.0797