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Asymmetric Effect of Real Exchange Rates on Import Expenditures

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Abstract

Research Originality: This study contributes to the literature by investigating the asymmetric effect of the real exchange rate on real import expenditures in Turkey.

Research Objectives: This study aims to investigate the short— and long-run symmetric/asymmetric effects of the exchange rate on import expenditures in the Turkish economy.

Research Methods: The study utilized both a linear Distributed Lag Autoregressive (ARDL) bounds testing approach and a nonlinear ARDL (NARDL) model, using a dataset from 1980 to 2022.

Empirical Result: The findings indicate that the real exchange rate has asymmetric effects on real import expenditures in the short run. The error correction model results reveal that short-run shocks among variables will lose their impact in the long run, and the co-movement of variables will correct itself in approximately 3 and 1.5 years.

Implications: These results shed light on policymakers shaping Turkey's import regime. In addition, adopting policies that provide macroeconomic balance based on real exchange rates is considered a crucial factor in reducing external dependency and eliminating Turkey's foreign trade deficits.

Keywords:

import expenditure; exchange rate; asymmetric effect; nonlinear ARDL

How to Cite:

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INTRODUCTION

In recent years, macroeconomic policies, notably exchange rate policy, have become increasingly important in many developing countries. However, these policies undergo significant changes over time, and countries, regardless of their level of development, strive to follow policies that will allow them to maximize their economic benefits in the international economic order. Recently, policymakers have been utilizing foreign trade policies and adjusting exchange rates to influence trade flows and, as a result, to enhance their economic development.

One of the most significant effects of real exchange rates is their influence on import expenditures. Just as there is a very high correlation between the real exchange rate and imports, the exchange rate strongly impacts a country's trade. It is a vital factor in determining a country's international competitiveness. Overvaluation of the exchange rate leads to an increase in the trade deficit and a decrease in reserves; this can often lead to increased use of exchange controls and trade barriers. In cases where tariff levels differ and non-tariff barriers decrease, the exchange rate can be crucial in affecting imports and, consequently, the foreign trade deficit. Furthermore, research indicates a dynamic relationship between the exchange rate and the trade balance (Chiu & Ren, 2019). Therefore, understanding the degree of the exchange rate's effect is crucial for effective import practices and the formulation of foreign trade policies.

Trade policy is crucial in shaping a country's trade dynamics. Import substitution policies may cause a decrease in imports. Conversely, if there is a foreign trade deficit, exports may be prevented in the short run, but exports may increase in the long run. A low level of imports may cause a decrease in exports due to a decrease in production, while a low level of exports may cause a decrease in imports due to insufficient foreign exchange. Therefore, it is essential to analyze the relationship between the real exchange rate and the imports of developing countries, such as Turkey.

The year 1980 marks a pivotal moment in Turkey's foreign trade policies. This is because while an import-based industrialization policy was implemented before 1980, an export-based industrialization policy began to be implemented after 1980. The situation that caused this policy change was the January 24 decision. Decisions such as the liberalization of international goods movements and the formation of prices, namely exchange rates, in these international goods and services, flows under market conditions have constituted important ideas regarding foreign trade policy within the January 24 decisions. As a result of these decisions, the import substitution policy has been abandoned, and an export-based growth policy has been adopted because of the implemented policies, which have led to serious increases in exports and import figures. The course of Turkey's exports, imports, and exchange rates from 1980 to 2022 are illustrated in Figure 1.

When reviewing the empirical literature on imports in Turkey, it is evident that most of the studies were conducted to determine the determinants of imports and some to investigate the effects of the exchange rate. Studies conducted to determine the

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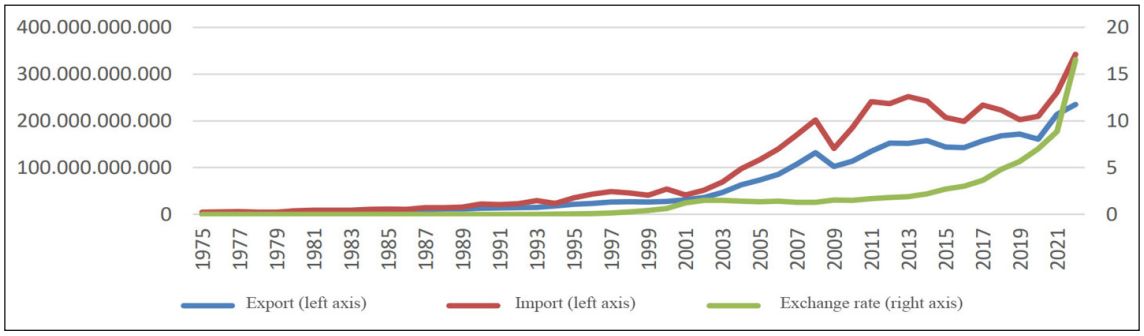
factors affecting imports, including different explanatory variables such as national income, exchange rate, and relative prices, were used in the model to determine whether these variables impacted imports. Generally, empirical studies indicate a negative relationship between exchange rates and imports. However, these studies implicitly assumed that the relationship between the two variables was symmetric. Besides, the exchange rate may have asymmetric effects on imports, and these effects may differ in the short and long run. For this reason, the preference for the NARDL model in analyzing the impact of exchange rates on import expenditures in this study is due to the advantages offered by this approach. The NARDL model provides simultaneous estimates for both short-run and long-run coefficients.

Figure 1. Turkey's Annual Export ($), Import ($) and Exchange Rate between 1980 and 2022



Source: International Financial Statistics (2023).

Studies investigating the relationship between exchange rates and import expenditures began in the 1980s in the applied literature. Since then, numerous studies have focused on various countries' economies. Despite the extensive literature on this topic, relatively few studies examine the relationship between import expenditures and exchange rates in an asymmetric manner. For instance, Alpha and Pingfeng (2015) found no relationship between the exchange rate and the import of goods and services during periods of inflation in the short run in Sierra Leone. In another study, Ardiyanti (2015) explored the effect of the real exchange rate on bilateral trade performance between Indonesia and the USA from 1990 to 2012. The results of the ARDL analyses indicated that exchange rate volatility negatively affected Indonesia's imports from the USA. Oluyemi and Isaac (2017) used monthly data from 1996 to 2015 to determine that Nigeria's real effective exchange rate had no impact on the volume of imports and exports. Bahmani-Oskooee and Halicioglu (2017) found that depreciations could improve Turkey's trade balance with five countries but not with four others. Dehraj et al. (2017) show a positive relationship between exchange rate volatility and exports and imports in the Pakistani economy from 1985-2015. Thorbecke (2018) investigated the effect of the exchange rate on imports and exports in the US economy from 1992 to 2017. The dynamic OLS estimation results show that the effect of the exchange rate on import value is positive and significant.

Bostan et al. (2018) investigated the Romanian economy and found that the exchange rate negatively affected exports and imports. In his analysis of South Africa,

Habanabakize (2020) detected a long-run relationship between the exchange rate and growth, as well as export and import variables, using the ARDL model. The findings reveal bidirectional causality between the exchange rate and imports, growth and imports, and exchange rate and growth. 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. They discovered a unidirectional relationship between the exchange rate for exports and imports in the short run. Nuhu and Bukari (2021) found that exports had a negative effect on the real effective exchange rate, while imports had a positive effect. Keho (2021), who examined the relationship between the real exchange rate and foreign trade in the Ivory Coast sample during the period 1975-2017, reveals in his study using the ARDL bounds test approach that a depreciation in the real exchange rate provides an improvement in the foreign trade balance in both the short and long-run. Iqbal et al. (2021) researched Pakistan using a non-linear ARDL model from 1980-2017 and found empirical evidence that the exchange rate affects imports. Usman et al. (2021) examined 21 trading sectors between Pakistan and China from 1980-2018 using linear and non-linear ARDL models. According to the empirical results, only six sectors support the symmetric J curve, while 13 sectors support the asymmetric J curve. Xu et al. (2022) evaluated the symmetric and asymmetric effects of exchange rate volatility on China's bilateral trade with each of its 21 trading partners. The asymmetric analysis, which utilized non-linear models, revealed short-run asymmetric effects in almost all export and import demand models and logarithm-significant asymmetric effects in 50% of the models.

Ho et al. (2023) examined the asymmetric and symmetric effects of the real exchange rate on the bilateral trade balance between the United States and Vietnam using ARDL and NARDL models at the industry level. It was found that only the symmetric real exchange rate was statistically significant in explaining the total trade balance between the USA and Vietnam in the long run. According to Truong and Van Vo (2023) study, the exchange rate has an asymmetric effect on Vietnam's trade balance in both the short and long run. It also confirmed that an increase in the exchange rate decreases the trade balance, while the appreciation of the exchange rate of the same size as the depreciation does not affect the trade balance in the short run. Nga et al. (2024) studied the impact of exchange rate changes on Vietnam's export-import dynamics. The findings of the ARDL model reveal that the real effective exchange rate and money supply significantly affect import patterns. The NARDL analysis findings further indicate the long-run asymmetric effects of the real exchange rate on trade. Dissimilarly, the empirical research by Felipe et al. (2024) finds no relationship between the real exchange rate and the trade balance in European countries from 1995 to 2019.

In the case of Turkey's economy, in their study, Doğan and Kurt (2016), in their analysis of monthly data in the 2003-2015 period, determined a causality relationship between exchange rates and investment and consumption goods imports as a result of Granger causality, impact-response analysis, and variance decomposition. Cergibozan and Ari (2018) examined the trade balance results of the exchange rate regimes implemented

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in Turkey between 1987 and 2015. As a result of the study, a long-run relationship was found between the real effective exchange rate and the trade balance. Ari et al. (2019) aim to provide more evidence on the recent developments of J curve literature by using NARDL approaches for Turkey's bilateral trade data for 18 European Union member states from 1990 to 2017. The findings from the non-linear ARDL model provide more support for the J curve phenomenon than the linear model. Ayhan (2019) examined the Turkey economy for the period 2005-2014 and found that imports have been positively affected by the real exchange rate and industrial production in the short and long-run; it has been found that exchange rate volatility is negatively affected in both the short and long-run.

Çatalbaş (2021), who examined the long and short-run relationship between the real exchange rate, imports, and exports in Turkey with data for the period 1990:01-2019:03, concluded that the changes in the exchange rate did not affect imports in the short and long run. Yıldırım and Saraç (2022) investigated the asymmetric effect of exchange rate changes on Turkey's bilateral trade with Germany in the period 2002:1-2020:2 using the Markov Regime Switching model. As a result, they found evidence that changes in the real exchange rate positively affected the bilateral trade balance during the expansion period and that the J curve was valid. Güngör, Gürsoy, and Doğan (2022) examined Turkey and 8 EU member countries for the period 2005:01-2021:12. Trade balance, real exchange rate, and industrial production index variables were tested with the Markov Regime Switching Approach. The study proved that the J curve effect is not valid in the trade between the relevant EU countries and Turkey. Gohar et al. (2023) studied the relationship between exchange rate and household consumption in the case of developing economies in Africa. They used the non-linear ARDL model that includes negative and positive shocks in the exchange rate. The results show that exchange rate movements have asymmetric effects on household consumption in all the developing economies except Nigeria. In their study, Thorbecke and Şengönül (2023) investigated how exchange rates affect Turkey's imports and exports. Non-linear autoregressive distributed lag results show that appreciations in periods of appreciation increase imports and exports, but exchange rate changes in periods of depreciation often do not affect trade. Türk (2024) analyzed the relationship between real effective exchange rate, real exports, and real imports in the Turkish economy for 2013 and 2023. According to the asymmetric causality test results, it was determined that there was a causality relationship between the positive component of the real effective exchange rate and the positive component of actual export.

Although the relationship between exchange rate and import expenditures has received significant attention in the economic literature, studies have generally focused on the symmetric relationship between these variables. On the other hand, developing countries such as Turkey face chronic foreign trade deficits. However, the literature generally does not deal with the possibility of an asymmetric relationship between exchange rates and import expenditures. This study attempts to fill this gap in the literature specific to Turkey. Specifically, it attempts to differentiate the analysis from other studies by analyzing this possible two-way relationship and revealing how it affects

import policies. Examining the effects of exchange rates on import expenditures is of primary importance in open economies. Indeed, exchange rates can significantly affect import expenditures, especially in countries with fragile economic structures and floating exchange rate regimes, such as Turkey. This condition demonstrates the importance of the study. From this perspective, the current study aims to investigate the symmetrical/ asymmetrical effect of the exchange rate on import expenditure in the short and long run in the case of Turkey between 1980 and 2022. For this purpose, the empirical literature on import expenditure-exchange rates is included in the introduction section of the study. Then, information about the dataset and econometric method used in the research is provided, the results are presented, and in the last section, the study is concluded by evaluating the findings.

METHODS

In this study, the functional relationship in equation (1) was estimated using time series analysis to investigate the effect of the real exchange rate on real import expenditure. Real Gross Domestic Product (LRGDP) is a key economic indicator of the overall economy. As such, this variable was included in the model as a control variable, representing all variables that may affect import expenditure. The real dollar exchange rate (LREX) was used as the exchange rate in the econometric analysis. Data on imports (LRM) were received from the CBRT in nominal values and converted to real using the USD exchange rate series.

The data set used in the study is annual and covers the period 1980-2022. Since Turkey's economy went through a major transformation (structural transformations) process after 1980, and based on the assumption that the data could yield more accurate results, the period between 1980 and 2022 was analyzed in the study. Series regarding the variables used in the analysis were obtained from the CBRT Electronic Data Distribution System. All series are seasonally adjusted using the Census X-12 method. Abbreviations and definitions of the variables used in the study are given in Table 1. The letter "L" in front of the symbols representing the variables indicates that the logarithm of the relevant variable is taken.

Table 1. Abbreviations and Definitions for Variables

Variable Abbreviation	Variable Description
LRM	Real Import Expenditure
LREX	Real Exchange Rate
LRGDP	Real Gross Domestic Product

In this study, a two-stage process was followed to investigate the effect of exchange rates on import expenditure in the short and long-run. First of all, symmetric short and long-run relationships were analyzed with the help of the linear Autoregressive Distributed Lag (ARDL) model developed by Pesaran and Shin (1999). Following this,

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a non-linear (asymmetric) ARDL analysis was carried out, considering that the effect of the exchange rate on import expenditure may be asymmetric. The ARDL method has significant advantages over its alternatives. Its most important advantage is that it allows the effects of short-run and long-run shocks between series to be examined in the same model. Another important advantage is that it does not require the series to be stationary at the same level or different. Provided that the dependent variable is stationary in I(1), the independent variables can be stationary in I(0) or I(1). However, no series should be stationary in I(2). In addition, the ARDL method provides reliable and unbiased results, especially in models consisting of small samples, and prevents diagnostic problems such as heteroskedasticity, multicollinearity, endogeneity, and autocorrelation in the model. For that, the use of ARDL models was preferred in the study.

According to the ARDL model, it is possible to investigate whether there is a cointegration relationship between the variables, regardless of whether the series is stationary at the level of first order differences. However, this method is not applicable if the stationarity level of the series is greater than 1. Therefore, in the study, first of all, the stationarity properties of the variables were determined with the Extended Dickey-Fuller (ADF) test developed by Dickey & Fuller and the Phillips-Perron (PP) unit root tests introduced by Phillips and Perron, Brooks (2019).

In the ARDL model, an unrestricted error correction model (UECM) is initially constructed to determine whether there is a cointegration relationship between the variables. This model is adapted as in equation (2) to test the existence of a long-run relationship between the import expenditure indicator and the real exchange rate and real gross domestic product.

$$\Delta LRM_t = \beta_0 + \sum_{i=1}^{m} \beta_{1i} \Delta LRM_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta LREX_{t-i} + \sum_{i=0}^{m} \beta_{3i} \Delta LRGDP_{t-i} + \beta_4 LRM_{t-1} + \beta_5 LREX_{t-1} + \beta_6 LRGDP_{t-1} + u_t \quad (1)$$

In equation (1), β_{1i}, β_{2i}, β_{3i} coefficients are short-run dynamics; β_4, β_5, β_6 coefficients, long- run relationships; u_t, error term; Δ, difference operator; m indicates the optimal delay lengths. In the study, the optimal lag length was determined with the help of Akaike information criterion (AIC). The following hypothesis is established to test for a cointegration relationship among the variables related to equation 1).

$$H_0: \beta_1 = \beta_2 = \beta_3 = 0$$
$$H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq 0 \quad (2)$$

The F-statistic calculated for hypothesis (2) is compared with the lower and upper critical values of the table of Pesaran, Shin & Smith (2001). If the H_0 hypothesis is rejected, it is decided that there is a cointegration relationship between the variables. After determining the existence of a cointegration relationship, the ARDL model was developed to determine the short and long-run relationships between the variables. To examine the long-run relationship between real import expenditure, real exchange rate, and real gross domestic product, the ARDL model was formulated as shown in equation (3).

$$\Delta LRM_t = \beta_0 + \sum_{i=1}^{m} \beta_{1i} \Delta LRM_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta LREX_{t-i} + \sum_{i=0}^{m} \beta_{3i} \Delta LRGDP_{t-i} + u_t \quad (3)$$

After estimating the long-run coefficients, the error correction model (ECM) is used to examine the short-run relationship between the variables. In order to investigate the short-run effect of real exchange rate and real gross domestic product on real import expenditure, the ECM model was found in equation (4).

$$\Delta LRM_t = \beta_0 + \tau EC_{t-1} + \sum_{i=1}^{m} \beta_{1i} \Delta LRM_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta LREX_{t-i} + \sum_{i=0}^{m} \beta_{3i} \Delta LRGDP_{t-i} + u_t \quad (4)$$

The coefficient of the EC_{t-1} variable (error correction term) in equation (4) is expected to be negative and statistically significant. In ARDL models, serial correlation is assessed using diagnostic tests, which are the LM test for serial correlation, normality test for normality, autoregressive conditional heteroskedasticity test and White heteroskedasticity test for heteroskedasticity, and Ramsey RESET test for functional form. Stability tests (cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) are also used to test the goodness of fit of the ARDL model.

The non-linear ARDL model developed by Shin et al. (2014) uses the sums of positive and negative partial decompositions of independent variables to test short and long-run asymmetric relationships of variables. The LREX variable was split into positive and negative to test the asymmetric effect of the real exchange rate on real import expenditure. $LREX_t^+$ and $LREX_t^-$, in the equation are the cumulative sums of the positive and negative changes in the real exchange rate, respectively, and are calculated using equation (5).

$$LREX_t^+ = \sum_{j=1}^{t} \Delta LREX_j^+ = \sum_{j=1}^{t} \max(\Delta LREX_j, 0)$$
$$LREX_t^- = \sum_{j=1}^{t} \Delta LREX_j^- = \sum_{j=1}^{t} \min(\Delta LREX_j, 0) \quad (5)$$

After dividing the LREX variable into positive and negative parts, the linear UECM model in equation (1) was rearranged as shown in equation (6).

$$\Delta LRM_t = \beta_0 + \sum_{i=1}^{n1} \delta_{0i} \Delta LRM_{t-i} + \sum_{i=0}^{n2} \delta_{1i} \Delta LREX_{t-i}^+ + \sum_{i=0}^{n3} \delta_{2i} \Delta LREX_{t-i}^- + \sum_{i=0}^{n4} \delta_{3i} \Delta LRGDP_{t-i} +$$
$$\theta_1 LRM_{t-1} + \theta_2 \Delta LREX_{t-1}^+ + \theta_3 \Delta LREX_{t-1}^- + \theta_4 LRGDP_{t-1} + e_t \quad (6)$$

In equation (6), whether there is a cointegration relationship between the variables is determined by testing the H0 hypothesis where the lagged level coefficients of the variables are collectively equal to zero, as in the linear ARDL model. The table critical values of Pesaran et al. (2001) are also valid for the equation in question. The long-run coefficients in equation (6) are, respectively, $L_{LREX}^+ = -\theta_2/\theta_1$, $L_{LREX}^- = -\theta_3/\theta_1$, $L_{LRGDP} = -\theta_4/\theta_1$. It is calculated using formulas. L_{LREX}^+ and L_{LREX} indicate positive and negative exchange rate changes, respectively, and L_{LRGDP} indicates the long-run coefficients of the LRGDP variable.

Finally, in the non-linear ARDL model, symmetric and asymmetric relationships are tested using the Wald statistic. Whether the exchange rate causes an asymmetric effect on import expenditures has been tested within the framework of three different

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hypotheses. The first two of these hypotheses detect an asymmetric relationship in the short-run, and the third in the long- run.

The first hypothesis that tests the asymmetric effect in the short-run examines whether the sum of the current and past period values of each positive and negative exchange rate change is significant. In equation (7), for positive changes $\sum_{i=0}^{n2} \delta_{1i}=0$, for negative changes $\sum_{i=0}^{n3} \delta_{2i}=0$ if one of the H_0 hypotheses formed as in this case is rejected and the other is accepted, and it is decided that exchange rate changes cause an asymmetric effect on import expenditures. The second hypothesis was created to test the asymmetric effect in the short-run tests whether the sum of the current and past period values of positive and negative exchange rate changes are equal to each other. Indicating that there is short-run symmetry, $\sum_{i=0}^{n2} \delta_{1i}= \sum_{i=0}^{n3} \delta_{2i}$ if the H_0 hypothesis formed as follows is rejected, it is decided that the effect of exchange rate changes on import expenditures is asymmetric. Finally, the H_0 hypothesis, which states that there is long-run symmetry, is formed as $L^{+}_{LREX} = L^{-}_{LREX}$ and if the null hypothesis is rejected, it is decided that there is an asymmetric effect in the long-run (Kurtović et al., 2023).

RESULTS AND DISCUSSION

This study aims to determine whether the real exchange rate has a symmetric/ asymmetric effect on import expenditures in Turkey. In this section, descriptive statistics of the variables used are given. The mean, maximum, minimum, and standard deviation values of the real import expenditure (RM), real exchange rate (REX), and real gross domestic product (RGDP) variables before logarithmic transformation are presented in Table 2.

Table 2. Descriptive Statistics

Series	RM	REX	RGDP
Mean	210.016	70.991	21.265
Maximum	437.780	178.145	69.329
Minimum	86.373	16.711	5.090
Std. Dev.	80.115	46.081	16.006

When examining Table 2, the average value of RM from 1980-2022 is approximately 210. The period average of the real exchange rate in the relevant period is 70.991. The standard deviation of the real exchange rate (REX) in the said period was measured as 46.08. It is observed from Table 2 that the average, maximum, minimum, and standard deviation values of the real gross domestic product (RGDP) series are lower than the RM and REX variables.

Before testing the effect of the exchange rates on import expenditures in the study, the annual changes in the variables from 1980 to 2022 are illustrated in Figures 2, 3, and 4, respectively. Figure 2 and Figure 3 show the course of real import expenditure and real gross domestic product over time, respectively, for the period under consideration.

As seen in Figure 2 and Figure 3, LRM and LRGDP are constantly increasing. The real exchange rate increased continuously until the early 1990s. After 2015, a decrease was observed in the real exchange rate, which followed a fluctuating course from 1990 to 2015.

Figure 2. LRM Time Course (1980-2022)

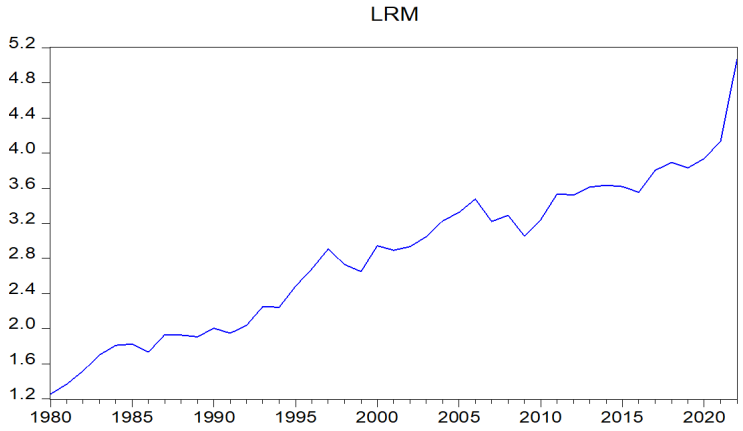


Figure 3. LRGDP Time Course (1980-2022)

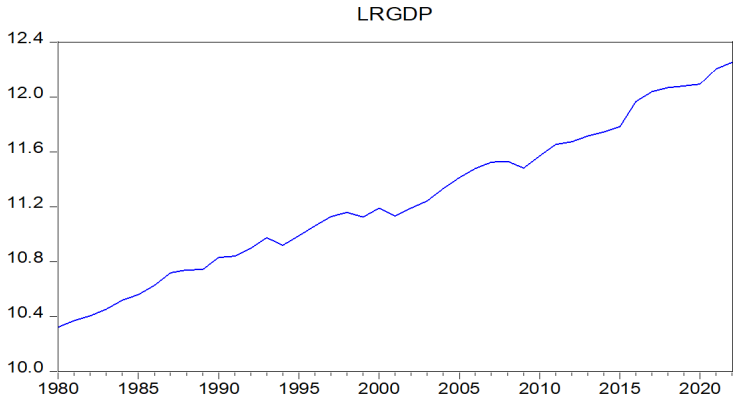
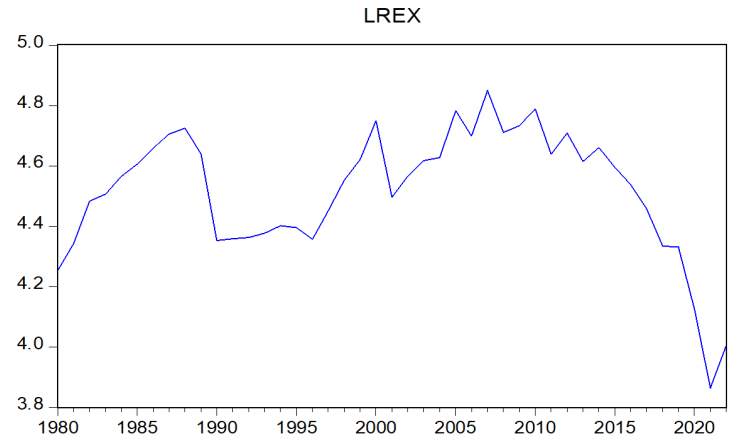


Figure 4. LREX Time Course (1980-2022)



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In the study, the stationarity levels of the variables were first determined. The degree of stationarity of the variables was analyzed using ADF and PP unit root tests, and the results are summarized in Table 3. As seen in Table 3, according to both ADF-t and PP-t statistics, it was determined that all series were stationary at the first cyclical difference in both constant and constant-trend form; in other words, they did not contain unit roots. Therefore, the findings obtained from unit root tests show that selecting the ARDL model as the analysis method is appropriate.

Table 3. ADF and PP Unit-Root Test Statistics of Series ADF Unit-Root Test Statistics

	Level		First Difference	
Variables	**Constant**	**Constant+ Trend**	**Constant**	**Constant+ Trend**
LRM	0.563 (0)	-2.138 (0)	-4.413*** (0)	-4.355*** (0)
LRGDP	0.212 (0)	-2.398 (0)	-6.709 ***(0)	-4.859 ***(3)
LREX	-1.142 (0)	-1.125 (0)	-6.487*** (0)	-7.012 ***(0)

Note: Values in parentheses indicate the delay length. Optimal lag lengths were determined according to the Schwarz information criterion. *** indicates that the calculated t-statistics are significant at the 1% level.

Phillips-Perron Unit-Root Test Statistics

	Level		First Difference	
Variables	**Constant**	**Constant+ Trend**	**Constant**	**Constant+ Trend**
LRM	0.736 (4)	-2.341 (2)	-4.189*** (3)	-4.120** (3)
LRGDP	0.700 (10)	-2.480 (1)	-5.752*** (10)	-8.812*** (10)
LREX	-1.470 (3)	-1.339 (3)	-6.498*** (3)	-7.005***(2)

Note: Values in parentheses indicate the window width. *** and ** indicate that the calculated t-statistics are significant at the 1% and 5% levels, respectively.

After the stationarity properties of the series were determined, the LRM=f(LRGDP, LREX) model was created and tested to test the existence of the cointegration relationship between import expenditure, exchange rate, and gross domestic product. Linear ARDL bound test results for the model in question are presented in Table 4. In the table, short-run coefficients are given in panel A, long-run coefficients are provided in panel B, and diagnostic statistics for the models are reported in panel C.

Table 4 shows the model results testing the effect of exchange rate changes on import expenditures. According to the ARDL model estimation results, the F statistic was calculated as 5.120. It was greater than the upper critical value of the table at the 1% significance level. In this case, the H0 hypothesis, which states no cointegration relationship between the variables, was rejected at the 1% level. Thus, according to the bounds test result, the existence of cointegration, in other words, a long-run relationship between LRM, LRGDP, and LREX variables, was determined. This relationship was found to be statistically very strong.

Table 4. ARDL Estimation Results (Dependent Variable: LRM)

Panel A: Short Run	ARDL (1, 4, 2)	
	Coefficient	t-statistic
$\Delta LRGDP_t$	1.089	2.445**
$\Delta LRGDP_{t-1}$	0.024	0.053
$\Delta LRGDP_{t-2}$	-1.074	2.329**
$\Delta LRGDP_{t-3}$	-1.192	2.466**
$\Delta LREX_t$	0.298	1.352**
$\Delta LREX_{t-1}$	0.627	2.279**
Panel B: Long Run		
C	-3.600	-1.179
$LRGDP_t$	0.590	2.081**
$LREX_t$	-0.437	-2.616**
Panel C: Diagnostic Statistics		
F-statistic	5.120***	
ECM_{t-1}	-0.322	-4.753***
LM	0.783	
CUSUM	Stable	
R^2	0.97	
Ramsey-Reset	0.49 (0.62)	
Heteroskedasticity	0.52 (0.88)	

Note: ***,** and * indicate the significance level of 1%, 5% and 10%, respectively.

Looking at the long-run elasticity coefficients estimated as a result of the ARDL model, the coefficient of the LRGDP variable is calculated as 0.590. According to this coefficient, a 10% increase in the LRGDP variable causes a 5.90% increase in the LRM variable. In other words, a 10% increase in gross domestic product causes a 5.90% increase in import expenditures. As expected, income growth positively affects import expenditures. The elasticity coefficient of the LREX variable was calculated as -0.437. The coefficient of the LREX variable was found to be statistically significant. There was a negative relationship between the LREX variable and the LRM variables. This result indicates that a 10% change (increase) in the LREX variable causes a 4.37% change in the LRM variable in a different direction (decrease). This situation indicates that the real exchange rate is a long-run determinant of real import expenditures in the period 1980-2022, specific to Turkey. This significant effect of the exchange rate on import expenditures is probably due to the exchange rate policy exercised by the government. The result is also consistent with Tran (2019), Hidayat et al. (2024), Bahmani-Oskooee and Arize (2020), Peştere Akçay and Akçay (2023), and Tarasenko (2021). Moreover, this finding meets the theoretical expectation that, if the real exchange rate increases, goods' competitiveness in international markets and imports decreases.

According to the results of the short-run model, a positive and statistically significant relationship was found between the ΔLRGDP variable and the ΔLRM variable at the 5% significance level. This coefficient is smaller in absolute value than in the long-run and is estimated as 1.089. Accordingly, a 10% increase in the ΔLRGDP variable causes a 1.08% increase in the ΔLRM variable. The coefficient of the ΔLREX variable

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was estimated at 0.298. The coefficient of ΔLREX was determined to be statistically significant at the 5% level. This means that a 10% increase in the ΔLREX variable causes a 2.98% increase in the ΔLRM variable. These findings are supported by Meniago and Eita (2017), and Asteriou et al. (2016). The sign of the error correction term (ECM_{t-1}) coefficient was negative as expected. This indicates that deviations from equilibrium in the short-run reach equilibrium in the long-run. The value of the estimated error correction term coefficient is -0.322, which shows that 32.2% of the deviations occurring in the short-run are corrected in the next period, approaching the long-run balance. In other words, short-run imbalances disappear in about three years and long-run balance returns.

Upon examining the diagnostic test results of the ARDL model, it is evident that there is no issue with autocorrelation. The χ^2 statistic calculated as a result of the Breusch-Godfrey LM test performed to detect the autocorrelation problem was greater than the table's critical value, and therefore the H_0 hypothesis, which states that there is no autocorrelation between the error terms, was rejected at the 5% significance level. As a result of the CUSUM test, examining the stability of the parameters in the estimated ARDL model, it was seen that the CUSUM statistics remained within the critical limits at the 5% significance level, and the H_0 hypothesis, which states that the coefficients in the model were stable, was not rejected at the 5% level. Therefore, the CUSUM test chart demonstrates that the residuals of the model remain within the limits, the parameters are stable, and there is no structural change. It is concluded that the ARDL [1,4,2] model in Table 4 does not have any problem in terms of diagnostic statistics (autocorrelation, heteroskedasticity, and functional form misspecification). Various previous studies also found consistent findings such as Irmiya et al. (2023) and Habanabakize (2020).

The results of the NARDL model [LRM=f(LRGDP, $LREX^+$ $LREX^-$)] applied to explain the non-linear aspect of the effect of exchange rate changes on import expenditures are given in Table 5. The F-statistic value for the non-linear ARDL bounds test approach is shown in Table 5. According to the results presented in Table 5, it can be seen that the F-statistic calculated for the bounds test has a value of 7.10. It was determined that the F-statistic value obtained was statistically significant at the 1% level. In this regard, the existence of a non-linear cointegration relationship between real import expenditure, a real exchange rate ($LREX^+$ and $LREX^-$), and real gross domestic product (LRGDP) has been determined.

The long-run equation result for the non-linear ARDL model is shown in Table 5. According to these results, all long-run coefficients, except for LRGDP, were not statistically significant. When long-run coefficients are examined, it is seen that increases and decreases in the real exchange rate adversely affect import expenditures. In other words, import expenditures respond to positive changes (increases) in the exchange rate by decreasing, while they respond to negative changes (decreases) by decreasing. However, according to the findings, there is no asymmetry in the magnitude of the effect of increases and decreases in the real exchange rate on import expenditures.

Table 5. NARDL Estimation Results (Dependent Variable: LRM)

Panel A: Short Run	NARDL (1, 0, 1, 3)	
	Coefficient	t-statistic
$\Delta LREX^{+}$	-0.251	-0.937
$\Delta LREX^{-}$	-0.621	-1.233
$\Delta LREX_{t-1}^{-}$	-2.467	-4.988***
$\Delta LREX_{t-2}^{-}$	-1.352	-2.486***
Panel B: Long Run		
C	-7.564	-1.909*
$LRGDP_t$	0.829	2.125**
$LREX_t^{+}$	-0.251	-0.693
$LREX_t^{-}$	-0.621	-0.882
Panel C: Diagnostic Statistics		
F-statistic	7.100***	
ECM_{t-1}	-0.738	-6.331***
LM	0.541	
CUSUM	Stable	
R^2	0.97	
Ramsey-Reset	1.10 (0.25)	
Heteroskedasticity	0.79 (0.66)	
Panel D: Wald Tests		
Long Run Wald Test	F-statistic =1.119	
Short Run Wald Test	F-statistic =11.341**	

Note: ***,** and * indicate the significance level of 1%, 5% and 10%, respectively.

Additionally, when the Wald test result of long-run symmetry is examined in Table 5, it is determined that the calculated F-statistic is 1.119 and is not statistically significant. In this regard, the H0 hypothesis, which was established to show that the positive real exchange rate coefficient is equal to the negative real exchange rate coefficient, could not be rejected. Consequently, the analysis does not support an asymmetric relationship between the real exchange rate and import expenditures in the long run.

In the long run, the positive real exchange rate coefficient is -0.251, while the negative real exchange rate coefficient is -0.621. In line with this result, it has been determined that a 1 unit increase in the real exchange rate will cause an approximately 0.251 unit decrease in import expenditures. In comparison, a 1 unit decrease in the real exchange rate will cause an approximately 0.621 unit decrease in import expenditures. However, the relationships in question were not statistically significant. Because in developing countries like Turkey, the response of imports and all activities that generate foreign exchange outflows to exchange rate changes depends on different factors. These factors include the price and cost structures of the countries involved, domestic demand, production capacity, productivity, and the structure of import markets. Additionally, as shown in Table 5, a 1 unit increase in real gross domestic product (GDP) is associated with an approximately 0.829 unit increase in import expenditures. This result is similar to Sulaiman et al. (2018) research on Egypt, a developing country like Turkey.

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Upon examining the findings of the error correction model, it is observed that the error correction coefficient is approximately -0.738. In addition, it was determined that the error correction coefficient was statistically significant at the 1% level and was negative in the direction of expectation. When investigating short-run asymmetric effects, the analysis reveals that increases and decreases in the real exchange rate lead to reduced import expenditures. While the findings obtained from the study are consistent with the results in the studies of Yaşar (2024) and Dada (2021), Nusair (2017), Nguyen et al. (2021), Bhat and Bhat (2021), they do not support the empirical evidence reached by Bahmani-Oskooee et al. (2018), Bahmani-Oskooee and Arize, A.C. (2020) and Arize et al., (2017). Examined diagnostic test results of the NARDL model; it is seen that there is no autocorrelation problem in the model. As a result of the CUSUM test, which examined the stability of the parameters in the estimated ARDL model, it is seen that the CUSUM statistics remained within critical limits at the 5% significance level. According to the results shown in Table 5, the NARDL [1,0,1,3] model has no problem in diagnostic statistics (autocorrelation, heteroskedasticity, and functional form misspecification).

In the last panel of Table 5, Wald test results for both short-run and long-run symmetry in the NARDL model are presented. It is possible to say that the effect of the real exchange rate on import expenditures is asymmetric in the short run, but this effect is not in the long run. The results are not consistent with the findings in various previous studies by Abegaz (2024), Jiang and Liu (2023), and Apanisile and Oloba (2020). The differences in the findings may be due to the economic structures of the countries, the data set, and the econometric method used.

CONCLUSION

In most empirical studies on the impact of changes in the exchange rate on import expenditures, it is implicitly assumed that exchange rate changes create a symmetric effect. However, this assumption is not very valid in practice for many reasons. These factors can lead to asymmetric effects, meaning that import expenditures respond differently to increases and decreases in the exchange rate. In this study, the impact of the real exchange rate on real import expenditures in Turkey from the 1980-2022 period is investigated in the short and long run. According to the linear ARDL and non-linear ARDL bounds test results, cointegration, the existence of a long-run relationship, was determined between import expenditures, real gross domestic product, and real exchange rate. As a result of the ARDL model, the short and long-run elasticity coefficients of the real exchange rate variable were estimated as positive. This result indicates a direct relationship between the real exchange rate and import expenditures, with increases in the exchange rate leading to a rise in import expenditures. According to the NARDL model results, it was determined that positive changes in the real exchange rate caused a decrease in import expenditures in the long run. At the same time, negative changes also caused a reduction. However, the coefficients showed that the effect of increasing changes in the exchange rate on import expenditures was smaller than decreasing changes.

According to the Wald test results regarding long and short-term symmetry in the NARDL model, it has been determined that the effect of the real exchange rate on import expenditures is symmetrical in the long run and asymmetrical in the short run. In the short run, both positive real exchange rates and negative real exchange rates have an impact on import expenditures.

As a result, determining the real exchange rate effect is important in making growth forecasts and determining the import policies to be implemented. For this reason, as an open economy country, the asymmetric effect of the real exchange rate on import expenditures, especially in the short run, should be considered when establishing import policies in Turkey. Based on empirical findings, policymakers should implement a moderate exchange rate policy and strengthen the domestic product market to enhance competitiveness in foreign trade. Therefore, policymakers should focus on the activities that increase the productivity of the sectors where the exporting enterprises are located to increase the competitiveness of the national products in the global market. If the focus is on strengthening domestic production and increasing export revenues, the country's import dependency will decrease over time. Finally, it can be stated that for Turkey to remain competitive in the global market and to improve its foreign trade balance, which has been negative for a long time, the political power should also address the actual and potential threats to foreign trade with appropriate policies. Moreover, this study, which considers the symmetric and asymmetric behaviors of real exchange rates and import expenditures, has aspects open to development.

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