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DETECTING ASYMMETRIC IMPACT OF EXCHANGE RATE ON INTERNATIONAL TRADE IN SERVICES: EVIDENCE FROM TÜRKİYE

DÖVİZ KURUNUN ULUSLARARASI HİZMET TİCARETİ ÜZERİNDEKİ ASİMETRİK ETKİSİNİN BELİRLENMESİ: TÜRKİYE'DEN BULGULAR

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ABSTRACT

While agricultural production constituted the basis of economies all over the world until the last centuries, industrial production has reached an important share with the Industrial Revolution. However, the rapid growth of the service sector in the last century has increased the share of the service sector in international trade. The relationship between international trade in goods and exchange rates has been the subject of many studies, and a certain empirical consensus has emerged on this issue. This study investigates whether imports and exports in the services sector have an asymmetric relationship with exchange rate fluctuations in the case of Turkish economy. The findings indicate that the appreciation of the domestic currency has a positive effect on services exports, while it has no significant effect on imports. Moreover, the estimations reveal that the Marshall-Lerner condition is not fully fulfilled for the services sector in Türkiye, and the J curve phenomenon is not valid.

Keywords: Service sector, exports, imports, time series analysis, NARDL model.

ÖZET

Son yüzyıllara kadar tüm dünyada ekonomilerin temelini tarımsal üretim oluşturmakta iken Sanayi Devrimi ile birlikte endüstriyel üretim de önemli bir paya ulaşmıştır. Ancak, son yüzyılda hizmet sektörünün hızla büyümesi uluslararası ticarette de hizmet sektörünün payını artırmıştır. Uluslararası mal ticaretinin döviz kuru ile ilişkisi birçok çalışmada ele alınmış, bu konuda belirli bir ampirik uzlaşı ortaya çıkmıştır. Bu çalışmada ise, hizmet sektöründe gerçekleştirilen ithalat ve ihracatın döviz kuru hareketleriyle ilişkisi Türkiye örneğinde, zaman serileri analizi kullanılarak araştırılmıştır. Elde edilen bulgular, yerli paradaki değerlenmenin hizmet ihracatını olumlu etkilediğine, ithalat üzerinde ise anlamlı bir etkide bulunmadığına işaret etmektedir. Ayrıca, tahminler Türkiye'de hizmet sektörü açısından Marshall-Lerner koşulunun tam olarak sağlanmadığını, J eğrisi olgusunun geçerli olmadığını ortaya koymaktadır.

Anahtar Kelimeler: Hizmet sektörü, ihracat, ithalat, zaman serileri analizi, NARDL modeli.

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1. INTRODUCTION

The rapid development of production and transport technologies has caused international trade to reach an unprecedented intensity in history. Nowadays, a larger variety and volume of goods can be delivered to much more distant markets in a much faster way. In a world where natural and human resources are not evenly distributed, trade contributes to production and development in both the seller and the buyer countries while reducing this imbalance, as it has been since time immemorial. While the development of international trade creates an important source of income for the exporting country, it also serves to increase welfare by meeting the needs of the importing country (Demir & Karagöz, 2024).

While the basis of economies all over the world was agricultural production until the twentieth century, the Industrial Revolution caused some European countries to switch to an industrial-oriented development model. Though the weight of industrial production increased in many other economies due to the spillover effect, it was observed that the service sector expanded rapidly all over the world in the 20th century, with the effect of the rising welfare level due to the increase in income. With the beginning of the second wave of globalisation in the world economy in the 1970s, the focus of global trade started to shift from manufactured goods to services. Substantial developments in the communication and transport sectors, as well as increases in capital accumulation and developments in asset market instruments, have been the factors fuelling the expansion in services trade (Yurttançıkmaz et al., 2017). As a natural consequence of these improvements, in the last century international trade in services has shown a great development in addition to the traditional trade in goods. Especially since the 2000s, the digitalisation caused by the development of communication and communication facilities with the widespread use of the internet worldwide has enabled the international trade in services to expand in scope and volume. According to World Bank (WB) statistics, international trade in services accounted for 14% of global GDP by 2023. According to World Trade Organisation (WTO) data, the volume of world trade in services, which was around USD 1 trillion in 2005, reached USD 3.9 trillion by 2023. More than half of this trade (56 per cent) is conducted through agencies in the country where the service is provided (Mode 3), while 34 per cent is conducted through cross-border transactions (Mode 1) (WTO, 2024).

Imports and exports are important for all economies due to their consequences. On the one hand, increasing export volume and export revenues, and on the other hand, maintaining the foreign trade balance by reducing imports of consumer goods are among the main objectives of economic administrations. In this respect, trade in services is no different from trade in goods. At this point, determining the factors affecting foreign trade in services is important in terms of providing the expected benefits from foreign trade and managing the trade volume. In this regard, exchange rate control is an important policy instrument that provides governments with room for manoeuvre. Therefore, considering the increasing weight of services trade in the overall economy and international trade volume, examining the behaviour of international services trade against exchange rate movements may provide important insights into determining the effectiveness of exchange rate policies to be implemented. In this study, the issue is analysed in the case of the Turkish economy, in which the share of the services sector in GDP exceeds 60 per cent. In a recent research, Karagöz (2024) investigated the impact of exchange rate fluctuations on Türkiye's service trade via the linear ARDL model approach. This study tries to answer the question whether the exchange rate affects trade in services asymmetrically depending on the direction of changes.

2. FOREIGN TRADE - EXCHANGE RATE RELATIONSHIP: THE THEORY

A review of the literature on international economic theory reveals that exports are modeled as a function of foreign income level and relative prices (real exchange rate), while imports are modeled as a function of domestic income level and relative prices. Accordingly, the theoretical expectations regarding the effects of changes in the real exchange rate (REER) on the balance of trade are that increases in the REER will reduce the price competitiveness of the country's export products and increase imports by lowering the cost of imports, thus distorting the balance of trade. Naturally, decreases in REER can be expected to have the opposite effect on exports and imports (Denaux & Falks, 2013).

Since traditionally the domestic and foreign income level and the real exchange rate are the main determinants of the balance of trade, the effectiveness of foreign trade policies largely depends on the significance and magnitude of the income and price elasticities of export and import demand functions. The importance of price and income elasticities in foreign trade is analyzed within the framework of the elasticity approach. The elasticity approach is based on the Marshall-Lerner (ML) condition (Utkulu & Seymen, 2004).

In international economic theory, the long-run effects of a real depreciation of a country's national currency on the balance of trade are defined by the ML condition. The ML condition, which is analyzed as a long-run relationship, states that under the assumption that the supply elasticities of exports and imports are infinite, the sum of the price elasticities of demand for exports and imports must be greater than 1 (in absolute terms) for a fall in the value of a country's national currency to improve the trade balance. The ML condition can be explained by the positive quantity effect and the negative cost effect arising from a fall in the value of a country's national currency. Accordingly, when a country's national currency depreciates against other currencies, the price of imported goods in national currency increases on the one hand, while the price of export goods in foreign currency decreases on the other hand. The improvements in the trade balance due to the increase in the quantity of export goods and the decrease in the quantity of import goods due to these price changes are called the positive quantity effect. On the other hand, the deterioration in the trade balance due to price changes that make export goods cheaper and import goods more expensive than before is defined as the negative price effect (Hussain & Haque, 2014).

The short-term effects of real exchange rate depreciation on the balance of trade are analyzed under the J-curve concept. The J-curve hypothesis suggests that depreciation may worsen the trade balance in the short run but will improve it in the long run (Yazıcı & Islam, 2014). The J-curve effect is based on the ML condition that explains why the trade balance does not improve following a real depreciation of a country's national currency. The trade balance worsens in the short run because imports become more expensive, and exports become cheaper after the real depreciation of the national currency, while the quantities of exports and imports cannot be immediately adjusted to these changing conditions (the ML condition is not fulfilled). In the long run, it is stated that quantity effects will emerge (ML condition will be realized) and the trade balance will improve (Halıcıoğlu, 2008).

3. FOREIGN TRADE-EXCHANGE RATE RELATIONSHIP: THE EMPIRICAL LITERATURE

A review of the empirical literature on the relationship between exchange rates and foreign trade reveals that the issue is mainly analyzed in terms of aggregate trade in goods and services. A few studies have analyzed the relationship between the exchange rate and trade in services in

particular. Considering trade in goods and services in general, the issue has been the subject of many studies in Türkiye as in other countries. While some of these studies have analyzed the relationship in the context of ML condition, quite a lot of studies have focused on the validity of the J-curve phenomenon.

Dinçer and Kandil (2011) analysed the effects of exchange rate fluctuations on exports with disaggregated data covering 21 sub-sectors and throughout two sample periods, 1996-2002 and 2003-2008. Based on a theoretical model that divides exchange rate movements into expected and unexpected components, the empirical research traces the effects through demand and supply channels. Expected exchange rate appreciation, consistent with movements in the fundamentals, has significant negative effects by constraining export growth in many sectors. Random fluctuations in the exchange rate, deviations around the steady state equilibrium, have asymmetric effects on sectoral export growth. Evidence suggests that the contraction of export demand increases with currency appreciation over time. In contrast, the effect of depreciation in stimulating export growth has decelerated over time. While exchange rate fluctuations had a positive net effect on export growth before 2002, the net effect was negative for the period after 2003.

Güler (2021) analyzed the asymmetric short- and long-term effects of the real effective exchange rate and selected macroeconomic indicators on exports and foreign trade balance in Türkiye for the period 2013-2020 with the NARDL approach. According to the findings, positive real exchange rate shocks (real appreciation of the TL) increase exports to some extent in the very short term and decrease in the following periods. Negative real exchange rate shocks (real depreciation of the TL) also increase exports gradually. On the other hand, a positive real exchange rate shock leads to an improvement in the trade balance in the first three months and then to deterioration, while a negative real exchange rate shock leads to a gradual improvement in the trade balance. However, in the long run, the response of the trade balance to the depreciation of the TL is twice the response to the appreciation of the TL.

Bal et al. (2023) investigated the effect of exchange rate movements on Türkiye's trade with EU countries for the period of 1997-2016. In the analysis based on the ARDL model, a cointegration relationship was found between the exchange rate and imports, while no evidence was found for the existence of a cointegration relationship for exports. The estimation of the import equation reveals that there is a positive connection between the exchange rate and imports from EU countries.

The causality relationship between the real exchange rate and foreign trade has also been examined in various studies, and different findings have been obtained. In studies applying the Granger causality test, Yurtoğlu (2017) finds bidirectional causality between real exchange rate and exports, while Tapşın and Karabulut (2013), Değer and Demir (2015), and Aytekin and Uçan (2022) report a unidirectional causality relationship from real exchange rate to exports.

In one of the few studies examining the effect of exchange rate on trade in services, Karagöz (2024) investigated the issue based on the ARDL model. The findings indicate that there is a long-run relationship (cointegration) between the real exchange rate and trade in services. In line with the theoretical expectations, FMOLS estimates indicate that the appreciation of the domestic currency decreases services exports and increases imports. Moreover, the estimates also reveal that the Marshall-Lerner condition is not fully fulfilled for the services sector in Türkiye.

Batbaylı and Ertürk (2024), on the other hand, investigated the effect of exchange rate on health services exports with the help of a multivariate model and found that changes in the real effective exchange rate negatively affect health services exports. Accordingly, it can be expected that foreign patients will prefer treatment in Türkiye more due to the relative price/cost advantage of the depreciation of the Turkish lira.

According to the results of the Granger causality test based on the Toda-Yamamoto method conducted by Koca and Yıldırım (2021), there is a causality relationship from GDP, foreign direct investments, and real effective exchange rate to services export revenues in the short run in Türkiye. Koca and Sevinç (2023) investigated the effect of exchange rate and exchange rate volatility on services trade for 9 developing countries, including Türkiye. They concluded that exchange rate volatility has a positive effect on services imports and exports, while exchange rate hurts services imports and exports, which means that exchange rate volatility weakens trade in services, but an increase in the exchange rate strengthens it. Özkul and Öztürk (2019) did not find any causality relationship between the services sector and the exchange rate as a result of the Granger causality test based on the Toda-Yamamoto method.

The effect of exchange rate on trade in services has been analysed in many studies for other countries. In his analysis for Ethiopia, Chigeto (2024) finds that the exchange rate has no significant effect on trade in goods and services other than services exports. Some researchers conclude that the effect of the exchange rate on trade in services may differ depending on the type of service. Eichengreen and Gupta (2012) find that the exchange rate influences the export of services rather than the export of goods, and this effect is even greater for modern services. Cheng (2020, 2021) also analysed the effect of devaluations on the US trade in services and found that this effect manifests itself in the long run and differs by service type.

There are also studies suggesting that the effect of exchange rate on trade in services may be asymmetric depending on the direction of exchange rate changes. Bahmani-Oskooee and Karamelikli (2021) claim that the findings of Cheng (2021) may differ when asymmetry is considered. They show that changes in the real bilateral exchange rate have significant short-run and long-run effects on U.S. payments to and receipts from most of its partners in most of the non-linear models in their analysis of asymmetric interaction for the same sample. Bahmani-Oskooee and Baek (2023) assessed the symmetric and asymmetric effects of changes in the real effective exchange rate of the Korean won on Korea's trade with the rest of the world in 10 categories of services. They find short-run effects on imports and exports in almost all 10 service sectors. In slightly more than 50 per cent of the sectors, the effect is also valid in the long run. These findings do not change significantly when real trade in services is considered against nominal trade. However, it should be noted that the findings are sector-specific.

Mahmood and Alkhateeb (2017) investigated the impact of devaluation and appreciation (negative and positive movements in the exchange rate) on trade in the services sector by applying the non-linear autoregressive lagged distributed (NARDL) model technique. Their findings show that there are asymmetric effects for all sectors in the short run and that the long-run effects can improve the trade balance of all sectors. General devaluation confirms the existence of the J-curve after some lag.

Bahmani-Oskooee and Karamelikli (2023) consider US trade in insurance and financial services with each of its nine trading partners. While the estimates from a linear model provide limited support for the J-curve effect, the estimation of a non-linear model provides much more support for the hypothesis. Bahmani-Oskooee et al. (2024), after estimating linear and non-linear ARDL

models using Singapore's imports and exports of insurance and financial services trade, conclude that changes in the real effective value of the Singapore dollar have both short-run and long-run effects on both services trade.

Bahmani-Oskooee and Saha (2024) follow symmetric (linear) and asymmetric (non-linear) forecasting methods in their analysis for India and find that outward and inward payments of all eight sectors respond to changes in the effective exchange rate of the Indian Rupee in the short run, given that the two approaches complement each other. However, only six categories of services are affected in the long run. The two unaffected sectors are insurance and travel. On the other hand, Sahoo (2018), in his analysis for India, showed that real exchange rate changes do not have a significant asymmetric effect on services exports from India in both the short and long run according to the results of the non-linear ARDL model extended with various variables. This means that the J-curve effect between the real exchange rate and services exports does not exist in the Indian context.

Considering the studies analysing the exchange rate-foreign trade relationship in the Turkish case, it is observed that the issue is either handled in terms of total trade in goods and services or the possible asymmetric nature of the relationship is ignored. Looking at the issue in terms of Granger non-causality analysis does not provide enough insight into the cause-and-effect relationship between the variables. In this respect, it can be said that the current study will fill an important gap in the literature on Türkiye in terms of scope and methodology.

4. METHOD AND MODEL

There is plenty of evidence that exchange rate changes can have asymmetric effects on trade (Bahmani-Oskooee and Karamelikli, 2021). First, as noted by Bussiere (2013), prices of traded goods respond asymmetrically to exchange rate changes. Since prices determine the volume of trade (exports and imports of goods or services), the response of trade flows to exchange rate changes can also possible to be asymmetric. Second, Bahmani-Oskooee and Fariditavana (2016) argued that traders' expectations may change according to the depreciation and appreciation of the currency in use, and therefore they may respond asymmetrically to exchange rate changes. Finally, Arize et al. (2017) suggested that firms' entry and exit strategies may be affected by exchange rate changes. Those entering the market when a currency depreciates may be at a different rate than those exiting the market when a currency appreciates. This may cause trade flows to respond asymmetrically to exchange rate changes.

The classical ARDL approach assumes that the cointegration relationship, indicating the long-run relationship, is a symmetric linear combination of regressors. This general approach does not fit with the approach of modelling nonlinearity and asymmetry in behavioural finance and economic theory. Shin et al. (2014) propose a nonlinear ARDL (NARDL) framework in which short- and long-run nonlinearities are modelled as positive and negative partial sum decompositions of explanatory variables. Therefore, in the econometric analysis where the import and export quantities of the service sector are taken as dependent variables separately, the relationship between the variables is investigated via the NARDL approach. A generic NARDL model that can be used to investigate the relationship between two variables can be expressed as follows:

$$\Delta Y_t = \mu + \sum_{j=1}^{k1} \beta_j \Delta Y_{t-j} + \sum_{j=0}^{k2} \delta_j \Delta X_{t-j}^{+} + \sum_{j=0}^{k3} \theta_j \Delta X_{t-j}^{-} + \gamma Y_{t-1} + \pi X_{t-1}^{+} + \omega X_{t-1}^{-} + u_t$$

In each model, the real exchange rate (REER) is decomposed into positive (increase) and negative (decrease) components and included in the model as a separate variable. The cointegration relationship is tested with the F test conducted for the hypothesis $\gamma = \pi = \omega$, and the validity of the symmetric relationship is tested with the Wald test conducted for the hypothesis $-\pi/\gamma = -\omega/\gamma$.

In the analysis of the effect of the real exchange rate on services trade, the modelling approach used by Cheng (2020, 2021) was adopted:

$$SER\_X_t = \alpha_0 + \alpha_1 REER_t + \alpha_2 IPI_t^W + u_t$$

$$SER\_M_t = \beta_0 + \beta_1 REER_t + \beta_2 IPI_t^{TR} + v_t$$

where, *SER_X* represents the value of service exports from Türkiye, and SER_M represents the value of service imports from Türkiye. *REER* is the real exchange rate, and IPI is the industrial production index, which represents the income level in the equation. The factor affecting Türkiye's export demand for services is the world income level (IPI_t^W), and the factor affecting Türkiye's demand for foreign (imported) services is the domestic income level (IPI_t^{TR}).

The service sectors considered in the analysis are limited by data availability and include information and communication, publishing, cinema-TV-music publishing, architecture and engineering services, culture-art-entertainment-sports, performing arts, librarianship, professional scientific and technical activities, and other professional scientific and technical activities.

In the analysis, the CPI-based real effective exchange rate index, which allows regional analysis and enables the distinction of competition composition in domestic-foreign market classification, was used as the exchange rate indicator. The exchange rate data consists of the CPI-based real effective exchange rate values, with 2003=100. The CPI-based real effective exchange rate is calculated by taking the weighted average of the ratio of the price level in Türkiye to the price levels of 36 countries with which foreign trade is conducted. The Central Bank of the Republic of Türkiye (CBRT) determines the weights according to the volume of bilateral trade flows. The real effective exchange rate (REER) is obtained by eliminating the relative price effects in the nominal effective exchange rate (NEER). Real effective exchange rate indices calculated by the Central Bank of the Republic of Türkiye are calculated by taking the weighted geometric average of the ratio of Türkiye's price level to the price levels of the countries with which it trades (Saygılı et al., 2010).

A really effective exchange rate index below 100 indicates that the Turkish lira has lost value, while a real effective exchange rate index above 100 indicates that it has gained value. Theoretically, since the depreciation of the domestic currency (TL) will increase the export revenues in foreign currency (foreign exchange) and the competitiveness in foreign trade, an inverse relationship ($\alpha_1 < 0$) is expected between REER and exports, and on the contrary, since it will increase the import cost, a positive relationship ($\beta_1 > 0$) is expected between REER and imports. Since the increase in income will increase purchasing power and demand for imported goods and services, the coefficient of the income variable is expected to be positive in both equations ($\alpha_2, \beta_2 > 0$).

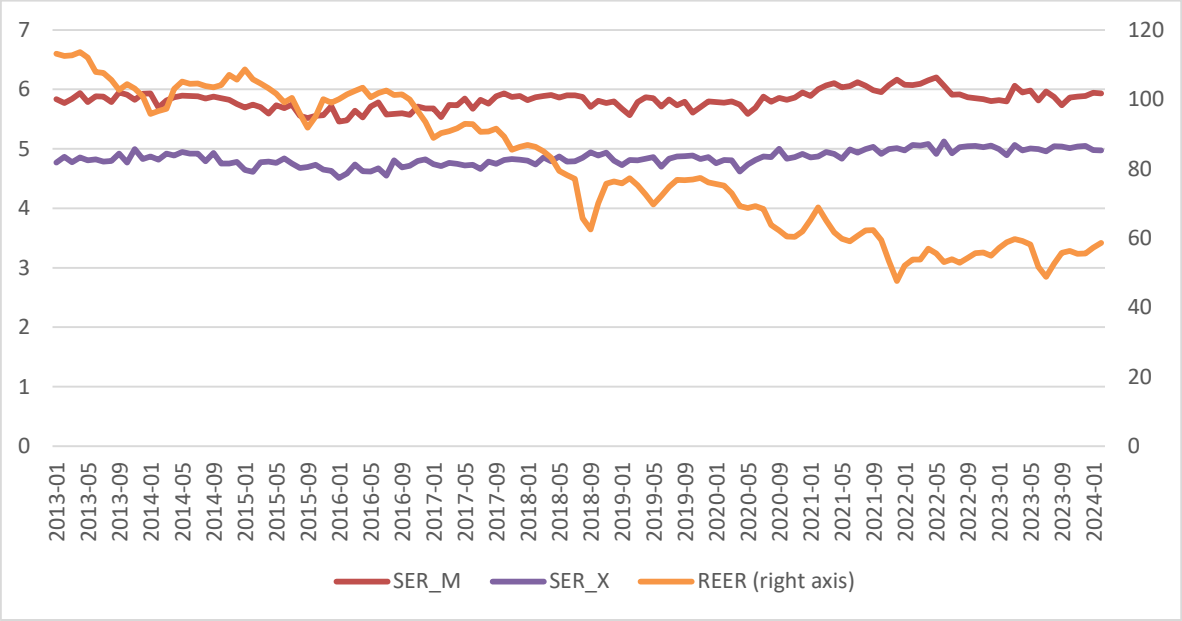
Import and export series have been subjected to logarithmic transformation to smooth out the changes in their variances to some extent. The real exchange rate and industrial production

variables in index form were used as percentage scales. Industrial production index data for OECD countries are obtained from OECD statistics, all other data are obtained from CBRT's Electronic Data Delivery System (EDDS). Data for the period January 2013 - February 2024 are used in the analysis, which is currently available in the EDDS. Since this period contains significant and typical exchange rate movements, and 144 monthly observations are considered sufficient to understand the nature of the relationship, we do not expand the data volume.

5. FINDINGS

Figure 1 shows the course of service imports, service exports, and real exchange rate index in Türkiye over the last 11 years. It is noticeable that service exports and imports showed a cyclical fluctuation during the sample period. Three cyclical waves can be distinguished as of 2013-2015, 2016-2019, and 2020-2024. It is noteworthy that exports and imports followed a parallel course during the period and that there was a foreign trade deficit in service trade as in goods trade. The pandemic, which has been effective in Türkiye as well as all over the world following the beginning of 2020, had a significant effect on service trade. However, it is seen that the pandemic has had a greater effect on Türkiye's service imports.

Figure 1. The course of service imports, exports, and real exchange rates index during the sample period



In accordance with the standard practice in time series analysis, firstly, the stationarity of the series was investigated with the unit-root test. The results obtained from the Augmented Dickey-Fuller (ADF) test are reported in Table 1. According to the findings, at the 5% significance level, the Turkish industrial production index series exhibits a stationary behaviour in terms of level values. The other series appear to be non-stationary in their level values but become stationary after first differencing.

Table 1. Results of ADF unit root tests

	Level		First difference		
	Intercept	**Intercept + Trend**	**Intercept**	**Intercept + Trend**	**Decision**
REER	− 1.2527 0.6501	*− 2.8300* 0.1894	*− 9.1573* < 0.001	− 9.1530 < 0.001	I(1)
IPI_TR	− 1.2517 0.6505	*− 4.1674* < 0.001	*− 13.1348* < 0.001	− 13.0873 < 0.001	I(0)
IPI_W	*− 2.7495* 0.0686	− 3.5062 0.0428	*− 9.5963* < 0.001	− 9.5613 < 0.001	I(1)
SER_X	− 1.6976 0.4302	*− 3.3493* < 0.0630	*− 12.6986* < 0.001	− 12.6614 < 0.001	I(1)
SER_M	*− 2.7901* 0.0624	− 3.2307 0.0830	*− 16.2420* < 0.001	− 9.5392 < 0.001	I(1)

Notes: The appropriate lag length in the test process was determined by the elimination method according to the SBC criterion. In each cell, the first value represents the test statistic, and the second value represents the p-value. The appropriate specification according to the SBC criterion is indicated in italics. The decision on the stationarity of the variable was made at a 5% significance level.

The estimation of the export equation in the form of the NARDL model is shown in Table 2. As a result of the elimination made according to the SBC, the appropriate specification was determined to be the NARDL (2,0,0,1) model. The bounds test's F-value (3.420) reveals the validity of a cointegration relationship between the variables at the 10% significance level. The coefficient of the error correction term (ECM) (-0.303) is within acceptable limits and significant. This indicates that short-term imbalances are compensated, albeit slowly, and the long-term equilibrium relationship is maintained. According to the estimates, both the positive and negative changes in the real exchange rate index increase Türkiye's service exports statistically significantly in the short and the long run. This indicates that the expansion in service exports is fed by the appreciation of the TL. However, the Wald symmetry test reported at the bottom of the table reveals that service exports do not show an asymmetric response depending on the direction of the changes in the exchange rate. It is observed that the average industrial production index of OECD countries, which is included in the equation representing the world income level, does not have a statistically significant effect on Türkiye's service exports in the long run.

The diagnostic control indicators given in the table (J-B, χ^2_{B-G}, χ^2_W statistics) indicate that the error term is normally distributed, non-autocorrelated, and has a constant variance, and therefore the model is reliable and sufficient. Ramsey's RESET test statistic indicates no misspecification error, and CUSUM and CUSUM-square statistics indicate stable coefficients.

Table 2. Estimation of export function

Variables	**Coefficient**	**St. error**	**t-statistic**	**p-value**
Short-run				
SER_X (-1)	– 0.3027	0.0759	– 3.9881	0.0001
REER_P	– 0.1983	0.1085	– 1.8288	0.0698
REER_N	– 0.1633	0.0711	– 2.2956	0.0234
IPI_W (-1)	0.1200	0.2134	0.5623	0.5749
ΔSER_X (-1)	– 0.3889	0.0766	– 5.0734	< 0.010

ΔIPI_W	1.2408	0.3622	3.4259	< 0.010
Intercept	0.8730	0.9839	0.8873	0.3766
Long-run				
REER_P	– 0.6552	0.3608	– 1.8157	0.0717
REER_N	– 0.5395	0.2297	– 2.3477	0.0204
IPI_W (-1)	0.3965	0.6947	0.5707	0.5691
Intercept	2.8834	3.1923	0.9032	0.3681
F_{bounds}	3.4200	Bounds values	I(0)	I(1)
J-B	0.2817 (0.8686)	%10	2.370	3.200
χ^2_{BG}	5.1785 (0.0751)	%5	2.790	3.670
χ^2_{BPG}	7.1745 (0.3050)	%1	3.650	4.660
F_{RESET}	0.6674 (0.4155)	Wald (symmetry)	0.7209	0.3959
CUSUM	Stable	CUSUM_square	Stable	

Table 3 shows the estimates of the import equation. When SBC is taken into account, it is determined that the most appropriate specification is the NARDL (1,0,0,0) model. The bounds test F-value is high (4.606) and reveals that the variables are in a cointegration relationship at the 5% significance level. The coefficient of the error correction term (ECM) (-0.262) is within acceptable limits and statistically significant. Accordingly, short-term imbalances are compensated for by 26% in the following period. According to the estimates, as in the export equation, both positive and negative changes in the real exchange rate index increase Türkiye's service imports. However, the effects of both positive and negative changes are not statistically significant. Accordingly, exchange rate movements do not have a significant effect on services imports in Türkiye. The Wald test statistic also confirms that service imports do not respond asymmetrically to changes in the exchange rate. It is seen that Türkiye's industrial production index, which is included in the equation representing the domestic income level, which is an important factor affecting import demand, also has a statistically significant effect on Türkiye's service imports. Accordingly, the increase in the domestic income level increases the demand for imported services.

The Breusch-Godfrey and Breusch-Pagan-Godfrey tests statistics (χ^2_{B-G}, χ^2_{BPG}, respectively) conducted to test the hypotheses state that the error terms are not autocorrelated and have constant variance indicate that the hypotheses in question cannot be rejected, thus the model is reliable and sufficient. The CUSUM and CUSUM-square statistics indicate that the coefficients are stable over time.

Table 3. Estimation of the import function

Variable	Coefficient	St. error	t-statistic	p-value
Short-run				
SER_M (-1)	– 0.2620	0.0713	– 3.6741	0.0004
REER_P	– 0.1386	0.1544	– 0.8976	0.3711
REER_N	– 0.0375	0.1035	– 0.3618	0.7181
IPI_TR	0.3435	0.1319	2.6037	0.0103
ΔSER_M (-1)	– 0.2163	0.0864	– 2.5037	0.0136
Intercept	0.0499	0.6552	– 0.6860	0.9378
Long-run				
REER_P	– 0.5290	0.5384	– 0.9825	0.3277
REER_N	– 0.1430	0.3788	– 0.3773	0.7066
IPI_TR	1.3109	0.5692	2.3030	0.0229
Intercept	0.1905	2.3986	0.0794	0.9368
F_{bounds}	4.6059	Bounds values	I(0)	I(1)
J-B	2.5875 (0.2742)	%10	2.720	3.770
χ^2_{BG}	4.2627 (0.1187)	%5	3.230	4.350
χ^2_W	3.0546 (0.6916)	%1	4.290	5.610
F_{RESET}	1.4088 (0.2375)	Wald (symmetry)	2.4598	0.1168
CUSUM	Stable	CUSUM_square	Stable	

The asymmetric relationship between REER and service exports and imports can also be traced on the cumulative dynamic multipliers graph (see the appendix at the end of the paper). As can be seen in the graph, service exports respond increasingly negatively to positive and negative shocks in the real exchange rate over 15 periods (left panel). It is seen that the response to positive shocks is larger in absolute value. It is noteworthy that only cumulative positive shocks have a significant negative effect on service imports, but the effect becomes stable from the seventh period onwards (right panel).

6. CONCLUSION

Today, there is an intense trade relationship between countries. Tens of thousands of products, whether final, raw, or intermediate, are moving across borders. The transportation and communication technologies that have developed in recent decades have increasingly made services, in addition to traditional goods trade, the subject of international trade. One of the key factors that has the potential to affect foreign trade volume in terms of both export and import is the exchange rate. It is also possible that the trade of service products, which has a different structure than tangible goods, may be affected by exchange rate movements.

In this study, whether exchange rate fluctuations have an asymmetric relationship with service exports and imports has been empirically examined in the case of Türkiye. The analysis results based on the NARDL model show that, in line with theoretical expectations, the real exchange rate index negatively affects Türkiye's service exports in the long term. The effect of exchange

rate changes on service imports is negative, contrary to expectations. However, the changes on both sides do not affect imports. The level of income abroad does not seem to have a significant effect on the export function. This may be due to the low relative prices of services exported from Türkiye. The fact that the short-run coefficients and the long-run coefficients of exchange rate variables are close to each other in both export and import equations shows that the response of trade in services to exchange rate movements does not change much from the short-run to the long-run. Considering the magnitudes and signs of the coefficients of the exchange rate variable in the export and import equations in the short and long run, it can be said that neither the Marshall-Lerner condition nor the J curve behaviour is valid for Türkiye's trade in services. On the other hand, the fact that the income level of Türkiye has a significant and positive effect on service imports makes the previous inference more meaningful when the high relative prices of imported services are considered.

Overall, the evidence of NARDL models supports the findings by Karagöz (2024) obtained from the linear ARDL model. This similarity between the two model structures can be interpreted as the absence of a non-linear adjustment in the response of trade in services to the exchange rate. In this respect, it can be said that the two approaches are substitutes rather than complementary. The partial validity or complete invalidity of the relationship between trade in services and positive and negative exchange rate movements is also confirmed by analyses conducted for other country samples. Bahmani-Oskooee and Saha (2024), in their analysis for India, find that total trade in services is not affected by positive and negative changes in the exchange rate, but significant interactions by sub-sectors are valid. The analyses by Bahmani-Oskooee and Baek (2023), Sahoo et al (2019), and Mahmood and Alkhateeb (2017) also reveal that this relationship varies according to economic structure and sectoral characteristics.

To investigate the sensitivity of international trade in services to exchange rates, this study uses high-frequency series for a relatively short period. Analysing the effects of different economic conditions and policy differences on this relationship in the long run with data from a longer period may provide useful information. In addition, if sufficient data are available, the exchange rate sensitivity of service sectors by sub-categories can be investigated.

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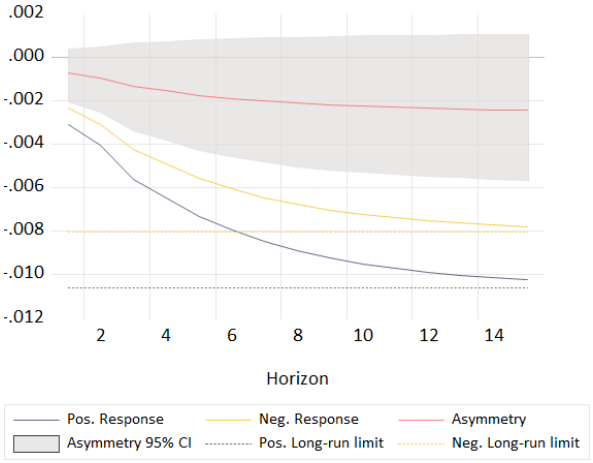
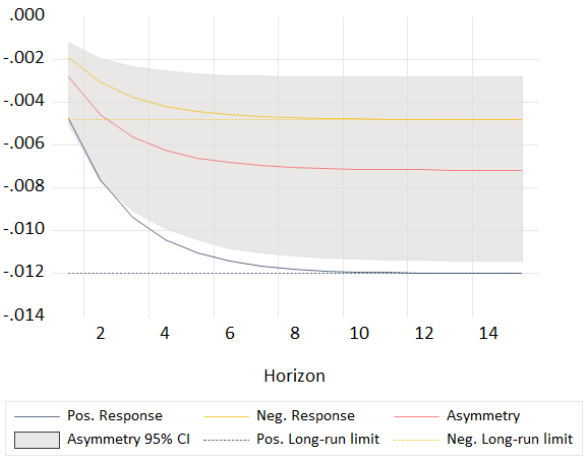
Ethical aspects of the research: In this study, all the rules specified in the "Higher Education Institutions Scientific Research and Publication Ethics Directive" were followed. None of the actions specified in the second section of the directive, "Actions Contrary to Scientific Research and Publication Ethics", were carried out. I declare that this research does not require ethics committee approval.

Author contribution rate: All stages of the study were designed and prepared by the author.

Appendix: Graphs of the cumulative dynamic multipliers



Cumulative Dynamic Multiplier: *REER* on *SER_X*



Cumulative Dynamic Multiplier: *REER* on *SER_M*