

Dynamic Impacts of Exchange Rates, Trade Openness, and GDP Growth on Turkiye’s Service Imports: A NARDL Approach

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Abstract: *This study examines the impact of the Real Effective Exchange Rate (REER), trade openness, and GDP growth on Turkiye’s service imports using a Nonlinear Autoregressive Distributed Lag (NARDL) model, analyzing data from 2005Q1 to 2023Q2. Services imports are crucial for Turkiye’s technological advancement and human capital development, but also worsen the trade deficit. The results reveal that in the short term, both positive and negative changes in the REER and trade openness affect service imports, confirming the rigidity of demand. GDP growth changes are insignificant. In the long term, however, the REER becomes insignificant; only positive shocks to trade openness permanently boost service imports while GDP growth remains insignificant. These findings emphasize the disconnection between exchange rates and service imports in the long run, and suggest that policymakers should focus on the structure of trade rather than currency policies to control import levels.*

Keywords: Service Imports; Real Effective Exchange Rate; Trade Openness; GDP Growth; NARDL Model

JEL Classification: F14, F31, C22

Introduction

The structural dynamics of global trade have undergone a significant transformation as the dominance of the services sector has been increasing rapidly since the beginning of the 2000s. In 2000, services trade represented only 9.23% of global

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GDP, however this figure rose to 14.54% by the end of 2023 (World Bank, 2025). Correspondingly, the share of services in total world trade surged from 9% in 1970 to 27.2% in 2024, marking its highest level since 2005 (World Trade Organization, 2019, 2025). Although traditional trade literature is mostly focused on the trade of goods, the dynamic structure of services trade offers crucial opportunities for economic diversification and integration into global value chains (World Trade Organization, n.d.). As developing economies are struggling with structural unemployment, the services sector is playing a more significant role for them as it has emerged as a primary source of job creation. Recent empirical studies conducted for both advanced and emerging economies suggest that engaging in services trade is mostly associated with employment growth and productivity gains brought by enhanced performance of service trading firms (Lassmann, 2020, p. 5; Bamieh, et al., 2021, p. 673; Gyimah-Brempong & Baah-Boateng, 2021, p. 166). However, this shift creates both advantages and disadvantages; while services exports especially in tourism and transport act as a vital source to reduce trade deficits, increased reliance, especially on technology-intensive imported services, can deteriorate the external balances further.

Turkiye represents a compelling case study within this context as the country's services trade has grown rapidly alongside persistent challenges. The country's trade in services was only 2.28% of its GDP in 1975, however, it escalated to 13.66% in 2023 (World Bank, 2025). This expansion is strategically critical for Turkiye as it has been experiencing a chronic external deficit since the 1940s. Services trade surpluses offset the permanent deficit that created by the trade in goods. In 2023, Turkiye's merchandise trade deficit is calculated as 105.9 billion USD, whereas the services trade balance recorded a surplus of 15.1 billion USD (Turkish Statistical Institute [TurkStat], 2024a, 2024b). Transportation services generated the highest surplus (20.4 billion USD), while the highest deficit is generated by intellectual property charges (-3.08 billion USD) (TurkStat, 2024b). Although the surplus is, the dynamics of the services imports should be analyzed carefully as they serve as essential intermediate inputs for domestic production and goods exports. Understanding services imports respond to macroeconomic fluctuations is crucial for sustaining the external balance deficit-offsetting role of the total services trade.

The structural vulnerability of the Turkish economy, which is characterized by a chronic external deficit spanning over eight decades, makes the investigation of exports and imports of the country with utmost details crucial for a sustainable economic development. While Turkiye generates a consistent surplus in services trade however, it notably lacks competitiveness especially in high-skilled subsectors (OECD, 2025). This gap highlights a structural dependency on sophisticated services imports. Unlike merchandise trade, these services imports are often non-discretionary intermediate inputs and essential for domestic production. The inherent rigidity of service import demand suggests that traditional currency-based adjustment poli-

cies fail to curb imports and could also exacerbate the trade deficits by inflating costs. Consequently, analyzing the potential asymmetries in how these imports respond to exchange rate shocks and income fluctuations is not merely an econometric exercise; it is a critical necessity for Türkiye's external balance and sustainable long-term growth.

Based on this background, this study investigates the macroeconomic determinants of Türkiye's service imports over the 2005Q1-2023Q2 period, focusing on the roles of the real exchange rate, trade openness and GDP growth. Türkiye's services trade balance has been widely discussed in the context of external adjustment, yet most of these studies focus on revenues from tourism sectors. However, empirical evidence on the drivers of services imports remains quite limited. This paper contributes by explicitly modelling the dynamic effects of the given macroeconomic factors on services import demand and testing whether appreciations and depreciations of these exert an asymmetric impact. For this purpose, the analysis employs the non-linear autoregressive distributed lag (NARDL) model, which allows the examination of short and long-run dynamics as well as potential asymmetries in the adjustment process. The findings aim to provide policy-relevant implications for the sustainability of the external balance-offsetting property of services trade as imported services play an increasingly important role in supporting production capacity, technology adoption and export performance.

This study is structured as follows: Section 2 provides a comprehensive review of the literature which concerns the nexus between service imports, exchange rates, trade openness and GDP growth. Section 3 outlines the data sources, variable definitions and the NARDL methodological framework. The empirical results, highlighting the asymmetric results are presented in Section 4. Finally, section 5 synthesizes the findings in light of existing literature and concludes with strategic policy implications for Türkiye.

Literature review

Services trade is fundamentally different from merchandise trade due to its intangible nature and the necessity for proximity between supplier and consumer. It requires cross-border movement or commercial presence rather than physical shipment (Copeland & Mattoo, 2008). Unlike the application of the tariffs of goods, services trade generally encounters regulatory barriers and it makes the determination of protectionist policies complex. The General Agreement on Trade in Services (GATS) established the legal framework for the liberalization of services trade while the IMF's Extended Balance of Payments Services Classification (EBOPS) provides the statistical basis for recording these flows (United Nations et al, 2010). Understanding these structural differences is essential when analyzing the macroeconomic determi-

nants of services import demand. However, the empirical literature mostly focuses on goods trade and studies on aggregate services imports are very limited. Consequently, this review includes studies on key services subsectors and total services trade in addition to aggregate services imports to establish a robust framework. This broader perspective aims to provide a more comprehensive understanding of the dynamics drivers of the services sector by compensating for data constraints.

The Impact of Exchange Rates on Services Trade

Firstly, the literature investigating the relationship between services and exchange rates is discussed. Karagöz (2025) examined the effect of the exchange rate fluctuations on Türkiye's services trade over the 2013M1-2024M1 period by using NARDL model. The findings indicate that domestic currency appreciation has no effect on services imports and the J-curve phenomenon is not valid. Bahmani-Oskooee and Halicioğlu (2025) analyzed the link between the Turkish lira's REER and Türkiye's trade in services over the 2005Q1-2022Q4 period by employing both linear ARDL and NARDL models. Bahmani-Oskooee et al. (2024) investigated the effect of the exchange rates on Singapore's services trade over the 1998Q1-2024Q4 period. Both linear and nonlinear ARDL models are used for the analysis. The outcomes suggest that the impact of the exchange rates varies according to sub-sectors and trade partner. Bahmani-Oskooee and Saha (2024) assessed the effects of the effective exchange rate of the Indian rupee on India's services trade in eight categories spanning the 2010Q1-2021Q3 period by using both linear and nonlinear ARDL models. It is observed that the imports and the exports of all eight categories respond to changes in the exchange rate, however, in the long run, the insurance and travel sectors are unaffected. Bahmani-Oskooee and Baek (2023) evaluated the effects of the Korean won on Korean trade in 10 services categories with the rest of the world over the 1998Q1-2020Q4 period. Both linear and nonlinear ARDL models applied for this study. The evidence demonstrates that the effect of the exchange rates differs across sectors, so a uniform sign should not be expected. Koca and Sevinç (2023) focused the effect of the exchange rates and exchange rate volatility on services trade for EAGLE (emerging nations with rapid economic growth) countries over the 2010Q2-2020Q4 period. Both static and dynamic panel data analysis methods were used for the study and the results show that exchange rate volatility affects services exports and imports positively while exchange rates affect them negatively. Bahmani-Oskooee and Karamelikli (2021) looked into the effects of the changes in the dollar's value on U.S.' insurance and financial services outpayments and inpayments from nine partners over the 2003Q1-2019Q4 period. They employed the NARDL model for the analysis and their results show that changes in the real bilateral exchange rate have both short and long-run effects on selected U.S. services imports from most partners. Cheng (2021) conducted a similar study to Bahmani-Oskooee and Karamelikli (2021) to examine

the impact of the exchange rate on U.S. financial and insurance services trade with its six partners over the 2003-2007 period by using the ARDL model. However, this study revealed that there is no long-run impact of exchange rates on either financial or insurance services imports. For the aggregate services data, the REER is only significant in the short run. In summary, the existing literature presents a mixed and variable results regarding the relationship between exchange rates and services imports depending on countries or country groups, sectoral divisions and methodological choices. These heterogeneous results imply that there is no consensus on the relationship between the variables as the dynamics should be reevaluated according to the specific conditions of the countries.

Trade Openness and Liberalization as Determinants

Secondly, the literature regarding the relationship between trade openness and services imports is reviewed. The number of studies that directly use trade openness is very limited and as this ratio is used as an indicator of trade liberalization, its different proxies are also included in this review. For example, several studies employ regulation-based indicators such as the OECD Services Trade Restriction Index (STRI) to measure liberalization level of services trade. (Nordås & Rouzet, 2015; Borchert et al., 2019) Xiang and Zhao (2025) examined the effects of digital service trade liberalization (DSTL) on digital services imports. The data for 55 importing and 56 exporting countries are used over the 2014-2020 period with an extended gravity model. According to the results, DSTL significantly increases bilateral digital services imports. Akça (2024) analyzed the impact of digital STRI (DSTRI) on exports and imports of telecommunications, computers and information (TCI) services for 35 OECD countries over the 2014-2022 period. Poisson Pseudo Maximum Likelihood estimation was applied for the analysis and the results show that higher DSTRI reduces TCI service imports. Benz et al. (2023) researched if service trade liberalization increases services import or not, by using STRI as a proxy within multi-country (45 countries) gravity framework over the 2014-2019 period. The study shows that lower STRI, which indicates higher liberalization is associated with higher services imports. Abasiakan et al. (2021) used several variables including merchandise trade openness as a percentage of GDP as a determinant of services trade for over the 1981-2017 to conduct a study for Nigeria. They employed the ARDL model for the analysis and the results show that merchandise trade as a percentage of GDP does not affect services trade. Kang (2021) explored the determinants of Korea's exports and imports in eight disaggregated commercial services categories over the 2005-2019 period alongside macro controls within a gravity model. According to the results, the trade openness positively affects financial and personal/cultural/recreational services imports, however, it is insignificant for the most of the other services. Yu and Sun (2019) investigated the impact of real openness on services trade within the Belt

and Road Initiative context in China from 1995 to 2016. A vector error correction model and impulse response functions applied for the analysis. It is found that there are both long-run and short-run relationships between services trade and openness. Tang, Zhang and Findlay (2013) analyzed factors driving China's services trade with OECD countries using a modified gravity model and yearly data from 1982-2009. The findings revealed that China benefits from comparative advantages in low-end service tasks, with trade liberalization, goods trade, and a large domestic market contributing to high intra-industry trade levels. Overall, the literature suggests that when markets become more liberalized, services imports tend to increase. However, the results are not uniform across countries, methods, and service categories, similar to the relationship between services imports and the REER. Furthermore, some studies find insignificant effects for aggregate measures or most subsectors.

Domestic Income and Economic Activity

Lastly, the literature on the relationship between gross domestic product (GDP)/income and services imports is examined. Bahmani-Oskooee and Halicioglu (2025) also included domestic income by proxying it with Turkiye's industrial production index in their prior study. According to the analysis, higher domestic activity is expected to increase services import payments, which demonstrates a positive income effect. Boonman et al. (2025) analyzed the effect of the real income on services import demand for 15 advanced economies over the 1991Q1-2019Q4 period using panel Fully Modified Ordinary Least Square (FMOLS) and country-level ARDL models. The results show that higher domestic real income increases imports in the long run. Yin and Choi (2025) examined the determinants of services imports for G20 countries by including GDP as a key regressor over the 1991Q1-2019Q4 period using the Hausman-Taylor panel approach. The results reveal that GDP significantly increases services imports. Dong et al. (2023) explored the relationship between GDP and services imports relationship. They estimated an augmented gravity model for China with its 42 partner countries over 2000-2014 period. It is found that income significantly and positively increase China's services imports. Xu et al. (2022) examined China's disaggregated services import demand by using data over 2015M01-2021M08 with both ARDL and NARDL methods. The results reveal that domestic activity in China positively affects nearly all services import demand in the long run. Cheng (2021) also investigated effects of income changes on U.S. insurance and financial services imports from six major partners using quarterly data, 2013Q1-2017Q4 for insurance and 2006Q1-2017Q4 for financial services. The ARDL test was applied and the results indicate that income is a significant driver of U.S. insurance and financial services imports. Kang (2021) also employed per capita GDP as a determinant of services imports and the results show that the income effect is not uniform,

it is positive and significant for several import categories, however insignificant for construction, insurance and other business services imports. In general, the literature largely indicates a positive income effect on services import. However, the evidence is not fully uniform as some studies report statistically insignificant coefficients for particular service sub-sectors. This makes an insignificant income-services imports relationship empirically plausible, although it is less common.

Synthesis of the Literature and Research Questions

The existing literature provides a heterogeneous picture of the determinants of the services imports. Exchange rate effects are highly mixed across countries and service categories, while liberalization/openness and income generally exhibit positive impacts, albeit with occasional sector-level insignificance. However, the number of studies specific to Türkiye is very limited and it leaves a clear gap in the literature. Accordingly, this study addresses the following questions for both the short and long run: (i) Do changes in the REER significantly affect Türkiye's services imports? (ii) Does trade openness/liberalization have a measurable effect on services imports? (iii) Does domestic income/economic activity significantly explain services import demand? Using REER, trade openness and GDP growth data for Türkiye, the study aims to answer these questions and contribute to the services trade literature.

Data and methodology

Data

In this study a quarterly dataset is used that covers the period from 2005Q1 to 2023Q2. Firstly, the dependent variable is Türkiye's aggregate service imports value in USD, which is categorized as Balance of Payments 6 (BOP6) – Commercial Services. This data is taken from the World Trade Organization (2025) database. As the original data is nominal, it is deflated by the U.S. Consumer Price Index (CPI, 1982-1984=100), sourced from the Federal Reserve Bank of St. Louis (2024) to make it represent the real values. Since the services imports series is denominated in USD, using a U.S. price index provides a consistent deflator in the same currency for converting nominal USD values into real terms. The explanatory variables consist of Türkiye's real effective exchange rate (REER) based on the CPI, trade openness and the gross domestic product (GDP) growth rate by expenditure. The REER data is obtained from the Electronic Data Delivery System of the Central Bank of the Republic of Türkiye (2024) while both trade openness and GDP growth rate data are sourced from the Federal Reserve Bank of St. Louis Database (2024) as well.

The explanatory variables are selected according to the standard international trade theories. The first variable, the REER, is included in the model to capture price competitiveness effect as the traditional demand theory suggest that relative prices determine trade flows (Goldstein & Khan, 1985, p. 1044). Second, trade openness is included in the model as a proxy of trade liberalization and integration into the global economy (Yanikkaya, 2003, p. 67). Finally, the GDP growth rate is used to represent the changes in income to reflect the income effect as theoretically, higher economic activity stimulates demand for foreign services (Kimura & Lee, 2006, p. 96).

Consistent with standard economic practice, specific transformations are applied to ensure robust estimation. Seasonality in services imports data is addressed using the Census X-13 method. Subsequently, the natural logarithms of services imports and the REER are taken. This transformation is preferred for two reasons: it stabilizes the variance of the series and linearizes exponential trends. Conversely, trade openness and the GDP growth rate are kept in their level forms because they are already expressed as ratios (trade openness is measured as a trade-to-GDP ratio) and logging such variables is not necessary for variance stabilization in the same way as it is for level variables measured in currency units or index form. Since the dependent variable is in logarithmic form while these explanatory variables remain in levels, the specification implies that their coefficients are interpreted as semi-elasticities. This means they represent the percentage change in services imports in response to a one-unit change in the independent variable; when the explanatory variable is reported in percent, this corresponds to a one-percentage-point increase (Wooldridge, 2016, p. 39). Furthermore, GDP growth rates can take negative values during recessions, making logarithmic transformation mathematically undefined for those observations. In addition, standardized data (z-score) were not used in this analysis. While standardization is a linear transformation, it removes the original measurement units and therefore obscures the direct economic interpretation of the estimated coefficients, preventing the assessment of policy-relevant elasticity or semi-elasticity magnitudes (Pesaran et al., 2001, p. 290). For these reasons, the GDP growth rate and trade openness data are kept in their original forms. In addition, to account for potential regime shifts within the given sample period, a Zivot-Andrews (ZA) unit root test which allows for one endogenous structural break was applied to the services imports variable. The test identified 2020Q2 as the break date; therefore, a structural-break dummy (DI) taking the value of 1 from 2020Q2 onwards is included in the NARDL specification to control for the break.

Following above adjustments, the variables for the analysis are denoted as follows: the log of real services imports (LSIMP), log of the real effective exchange rate (LREER), trade openness (TROP) and the GDP growth rate (GDPGRW).

Methodology

The initial step of time series analysis is a stationarity test as non-stationary data may create spurious regression problem and results might be misleading. Three different unit root tests are used in this study. The first one is the Augmented Dickey-Fuller test, developed by Dickey and Fuller (1981), which is the most common test used in the literature. The second test used in this study is the Phillips-Perron (PP) unit root test. As this test adopts non-parametric statistical corrections for controlling autocorrelation and heteroskedasticity, it yields more robust results on heterogeneously distributed datasets (Phillips & Perron, 1988, p. 335). The last test used in the study is the Zivot-Andrews unit root test. Unlike ADF and PP, this test determines structural break dates endogenously to prevent the erroneous identification of a series containing a structural break as non-stationary (Zivot & Andrews, 1992, p. 251).

The main econometric method used in this model is the nonlinear autoregressive distributed lag (NARDL) method approach developed by Shin, Yu & Greenwood-Nimmo (2014) to investigate asymmetric impacts of the cointegration relationship for both the short and the long-run. The reason for using the NARDL method for the cointegration test is that this method is relatively new compared to other traditional methods and has distinct advantages. This method offers distinct advantages over other cointegration tests. This model captures asymmetric relationships between variables by separating them to their positive and negative components. The NARDL models allows for the simultaneous estimation of short-run and long-run dynamics within the same model. This provides a comprehensive understanding of variable interactions. The model also accommodates variables that are purely $I(0)$, purely $I(1)$, or a combination of both, making it robust for empirical analysis (Allen & McAleer, 2021, p. 16). Additionally, similar to the autoregressive distributed lag (ARDL) model, NARDL model also includes an error correction mechanism by applying a straightforward linear conversion, which helps in understanding the speed at which variables return to equilibrium after a shock (Nkoro & Uko, 2016, p. 79). This model provides more reliable and unbiased estimates compared to traditional linear cointegration methods.

This study predicts that services import demand may respond asymmetrically because of structural and behavioral factors. The essential input hypothesis suggests a structural rigidity as imported services are mandatory intermediate inputs for domestic production. This causes services import demand tend to be inelastic in the short run even when prices increase or the currency depreciates (Magee, 1973, p. 316; Bahmani-Oskooee, 1985, p. 501). In this case, firms are forced to keep their import levels the same to maintain their production capacities and it creates a divergence from the standard demand theory. Also, behavioral asymmetry implies that firms may react differently to positive and negative shocks in terms of speed and magnitude. While they rapidly cut service procurement during recessions for risk aversion (Kahneman & Tversky, 1979, p. 279), the adjustment to positive shocks is generally

more gradual as new service network establishments require time. The reason for employing the NARDL approach in this study is to capture these non-linearities and asymmetric adjustments.

The model presents the empirical equation in a decomposed manner, accommodating both positive and negative shocks and the interactions between the explanatory variables and the dependent variable, following the Shin et al. (2014) NARDL model with asymmetric error correction is as follows:

$$\begin{aligned} \Delta LSIMP_{2t} = & \beta_0 + \beta_1 LSIMP_{2t-1} + \beta_2^+ LREER_{t-1}^+ + \beta_3^- LREER_{t-1}^- + \\ & \beta_4^+ TROP_{t-1}^+ + \beta_5^- TROP_{t-1}^- + \beta_6^+ GDPGRW_{t-1}^+ + \beta_7^- GDPGRW_{t-1}^- + \gamma d1_t + \\ & \sum_{i=0}^p \alpha_1 \Delta LSIMP_{2t-i} + \sum_{i=0}^p \alpha_2 \Delta LREER_{t-i}^+ + \quad (1) \\ & \sum_{i=0}^p \alpha_3 \Delta LREER_{t-i}^- + \sum_{i=0}^p \alpha_4 \Delta TROP_{t-i}^+ + \sum_{i=0}^p \alpha_5 \Delta TROP_{t-i}^- + \\ & \sum_{i=0}^p \alpha_6 \Delta GDPGRW_{t-i}^+ + \sum_{i=0}^p \alpha_7 \Delta GDPGRW_{t-i}^- + \mu_t \end{aligned}$$

In Equation (1), β_i and α_i indicates short run and long run coefficients. The short-run and long-run analyses address the immediate impact of shocks in the independent variables on the dependent variable, as well as the evaluation of disequilibrium and the rate at which the system returns to equilibrium. P and q represent the optimal lags for the dependent and independent variables, respectively, determined using the Akaike Information Criterion (AIC). γ is the structural break dummy coefficient. The impact of shocks in the independent variables is divided into positive and negative effects on the dependent variable. This decomposition is represented by the partial sums of increases and decreases in the independent variables, as shown below:

$$X_t^+ = \sum_{j=1}^t \Delta X_j^+ = \sum_{j=1}^t \max(\Delta x_j, 0) \text{ and } X_t^- = \sum_{j=1}^t \Delta X_j^- = \sum_{j=1}^t \min(\Delta x_j, 0) \quad (2)$$

In equation (2), X represents independent variables which are LREER, TROP and GDPGRW in this study. A cointegration test is conducted using the bound test with F-statistics and t-statistics, following Pesaran et al. (2001) and Banerjee et al. (1998). This method, as emphasized by Shin et al. (2014), tests for asymmetric long-run cointegration by evaluating all lagged levels of the independent variables together. The null hypothesis for F-statistics ($\beta = \beta^+ = \beta^- = 0$) and t-statistics ($\beta = 0$) states no cointegration, while the alternative hypothesis ($\beta = \beta^+ = \beta^- \neq 0$ for F-statistics, $\beta \neq 0$ for t-statistics) indicates cointegration. If the test values exceed the critical bounds, the null hypothesis is rejected, indicating cointegration. If the values fall between the bounds, the result is inconclusive.

The calculation of long-term asymmetric coefficients is based on $L_{mi} = \alpha^+/\phi$ and $L_{mi} = \alpha^-/\phi$, measuring the relationship between the dependent and independent variables by separating them into positive and negative shocks in long-run equilibrium. Additionally, the analysis includes asymmetric dynamic multiplier effects, which can be expressed as follows:

$$\begin{aligned}
 m_{\phi}^{+} &= \sum_{j=0}^{\phi} \frac{\phi SIMP_{2t+j}}{LREER_t^{+}}, m_{\phi}^{-} = \sum_{j=0}^{\phi} \frac{\phi SIMP_{2t+j}}{LREER_t^{-}}, m_{\phi}^{+} = \sum_{j=0}^{\phi} \frac{\phi SIMP_{2t+j}}{TROP_t^{+}}, m_{\phi}^{-} = \\
 &\sum_{j=0}^{\phi} \frac{\phi SIMP_{2t+j}}{TROP_t^{-}}, m_{\phi}^{+} = \sum_{j=0}^{\phi} \frac{\phi SIMP_{2t+j}}{GDPGRW_t^{+}}, m_{\phi}^{-} = \sum_{j=0}^{\phi} \frac{\phi SIMP_{2t+j}}{GDPGRW_t^{-}}
 \end{aligned}
 \tag{3}$$

In equation (3) ϕ approaches ∞ , m_{ϕ}^{+} approaches L_{mi}^{+} and m_{ϕ}^{-} approaches L_{mi}^{-} . In this model, dynamic multipliers capture the asymmetric responses of the dependent variable to positive and negative shocks in the independent variables. These multipliers reveal how the system adjusts dynamically from the initial equilibrium to a new equilibrium following these shocks.

Results and discussion

Firstly, descriptive statistics and correlation matrix of the variables are given in Table 1 and Table 2:

Table 1: Descriptive Statistics of the Variables

	LIMP	LREER	TROP	GDPGRW
Observations	74	74	74	74
Mean	22.4809	4.5254	55.5202	5.2577
Median	22.5256	4.6306	52.1856	5.8877
Maximum	23.9045	4.8497	89.7715	22.5835
Minimum	21.5179	3.8632	44.4162	-12.9339
Std. Dev.	0.5806	0.2644	9.8321	5.0094
Skewness	0.4255	-0.9587	1.4864	-0.7191
Kurtosis	2.6357	2.6647	4.8775	6.4874
Jarque-Bera	2.6420	11.6823	38.1202	43.8786
P-values	0.2668	0.0029	0.0000	0.0000

In [Table 1], the descriptive statistics of the variables are given. According to the Jarque-Bera normality test, only the LIMP series is normally distributed ($p > 0.05$) while all the other series deviate from normality. Especially, the high kurtosis and wide range span of GDPGRW reflects the high volatility of Turkiye’s GDP growth. Also, the negative skewness of LREER (-0.96) shows Turkish lira’s real devaluation is dominant in the series and the positive skewness of TROP (1.49) reflects the expanding structure of the foreign trade.

Table 2: Correlation Matrix of the Variables

	LIMP	LREER	TROP	GDPGRW
LSIMP	1.0000	-0.9054	0.8709	0.0185
LREER	-0.9054	1.000	-0.9116	-0.0104
TROP	0.8709	-0.9116	1.0000	0.0912
GDPGRW	0.0185	0.0104	0.0912	1.0000

[Table 2] shows that there is a strong positive correlation between LIMP and TROP (0.87) as the relationship between LIMP and LREER is negative (-0.91). These high coefficients reflect the Turkish economy's structural trend in the study period. The weak relationship between LIMP and GDPGRW (0.02) is due to periodic volatility of growth. High correlations between independent variables do not constitute a problem for the estimation results of the cointegration method used in this study.

Prior to the nonlinear autoregressive distributed lag (NARDL) analysis, the primary step is testing the stationarity of the series as it has to be done before all cointegration tests. Also, the NARDL test requires that none of the variables are integrated of order two. For this purpose, the Augmented Dickey Fuller (ADF) and Phillip-Peron (PP) tests are conducted. Including the unit root tests, Akaike Information Criteria (AIC) is used for all the tests employed in this study. The unit root test results are given in Table 3:

Table 3: ADF and PP Unit Root Test Results

Variables	Level		First Difference	
	ADF	PP	ADF	PP
With Intercept				
LSIMP	0.7369	0.9734	-10.5250***	-10.5060***
LREER	1.6807	0.7180	-10.9625	-11.9402***
TROP	0.8811	-1.6802	-4.6266	-8.6939***
GDPGRW	-3.0736**	-4.0933***	-4.5932	-10.4250***
With Intercept and Trend				
LSIMP	-2.3101	-2.4102	-3.4360***	-10.6011***
LREER	-2.1360	-2.7040	-6.3922***	-14.4724***
TROP	-3.9655**	-3.0948	-4.6926***	-8.6226***
GDPGRW	-3.0671	-4.0595**	-4.6426***	-10.3522***

Note: *** indicates 1% significance level, ** indicates 5% significance level and * indicates 10% significance level.

[Table 3] reports the results of ADF and PP unit root tests used to determine the integration order of the variables. The results show that LIMP, LREER and TROP

exhibit a unit root at their levels but become stationary at the 1% significance level after taking their first differences, indicating they are integrated of order one I(1) conversely, the GDPGRW series is found to be stationary at levels. It is integrated of order zero, I(0). The mixed order of integration is the primary justification for employing the NARDL model. Crucially, none of the variables are integrated of order two, I(2). The NARDL method is not suitable to be used if any of the series is integrated of order two, I(2), which is not the case in this study.

Table 4: Zivot & Andrews Unit Root Test Results

Variables	Level	
	T-statistic	Break Date
With Intercept		
LSIMP	-3.2831	2020Q3
LREER	-3.4941	2018Q2
TROP	-4.2460	2020Q3
GDPGRW	-3.6790	2010Q4
With Intercept and Trend		
LSIMP	-5.5180	2020Q2
LREER	-4.6488	2015Q4
TROP	-3.7782	2014Q2
GDPGRW	-4.1494	2009Q3

Note: *** indicates 1% significance level, ** indicates 5% significance level and * indicates 10% significance level.

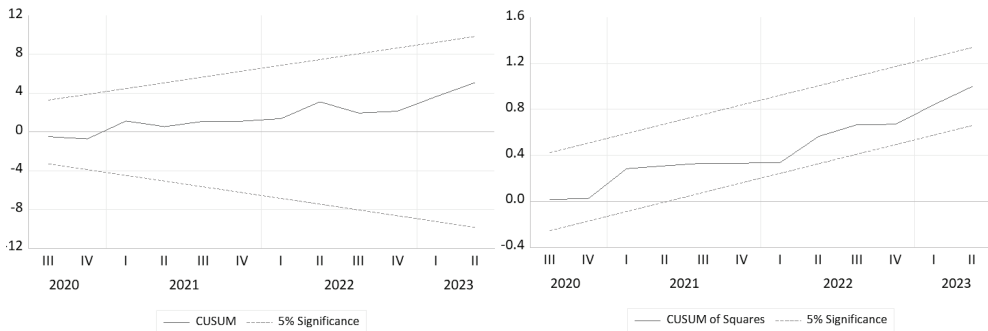
[Table 4] displays the results of the ZA unit root test. The results confirm that LREER and TROP are non-stationary even when structural breaks are accounted for. For LSIMP, the test identifies a break in 2020Q2 when only the intercept is included in the model and 2020Q3 when both the trend and intercept are included in the model and suggest stationarity at the 5% level. However, as both the ADF and PP tests indicate that LSIMP is I(1), consistent with the standard literature, LSIMP is treated as an I(1) process and the structural break is explicitly accounted for by including a dummy variable, $D1$, in the NARDL model, ensuring that the cointegration results are robust.

Before conducting the NARDL analysis, the optimal lag length should be determined. For this purpose, the vector autoregressive (VAR) approach is adopted. According to the lag order selection criteria, the maximum lag length is determined as 2 since the AIC is used for all the tests as indicated. Based on this, the most suitable NARDL model is selected as (2,1,1,2,1,0,0). Prior to bounds test, diagnostic tests and Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests are conducted to ensure the stability of the model. The diagnostic test results and CUSUM and CUSUMSQ test graphs are given in Table 5 and Figure 1:

Table 5: Diagnostic Test Results

Test Name	Coefficient	Statistic	P-Value
Normality	Jarque - Bera	1.1759	0.5554
Heteroskedasticity	Obs. R-Squared	9.8041	0.7764
Serial Correlation	Obs. R-Squared	3.2842	0.1936
Ramsey RESET	F-Statistic	1.8004	0.2397

Figure 1: CUSUM & CUSUMSQ Test Graphs



According to the diagnostic test results presented in [Table 5], the data are normally distributed and homoscedastic, and there is no serial correlation. Ramsey RESET test result indicates that there are no omitted variables. [Figure 2] also shows that both CUSUM and CUSUMSQ test graphs are within the 5% significance bounds so the model is stable. Following these results, the bounds test is conducted to check the existence of a cointegration relationship. The results of the test are given in Table 6:

Table 6: The Bounds Test Results

Test Statistic	Value	k
F-Statistic	4.1908	6
Significance	I(0) Bound	I(1) Bound
10%	1.99	2.94
5%	2.27	3.28
1%	2.88	3.99

According to the bounds test results presented in [Table 6], the F-statistic value exceeds the I(1) bound at all significance levels, including 10%, 5% and 1%. Therefore, it can be concluded that a cointegration relationship exists between the dependent variable and the independent variables. Following these results, the short-run coefficients and the Error Correction Term (ECT) are presented in Table 7:

Table 7: Short Run Coefficients and Error Correction Term

Variable	Coefficient	Std. Error	t-Statistic	Probability
D(LSIMP(-1))	-0.222368	0.088134	-2.523075	0.0145
D(LREER_POS)	-0.577395	0.247576	-2.332187	0.0233
D(LREER_NEG)	-0.507956	0.203809	-2.492313	0.0157
D(TROP_POS)	0.007778	0.004289	1.813601	0.0751
D(TROP_POS(-1))	0.010556	0.003947	2.674154	0.0098
D(TROP_NEG)	0.016720	0.005033	3.322301	0.0016
D(GDPGRW_POS)	-0.001634	0.002783	-0.587080	0.5595
D(GDPGRW_NEG)	0.003464	0.003488	0.993267	0.3249
D(D1)	-0.097337	0.093049	-1.046079	0.3000
CointEq(-1)	-0.237646	0.041201	-5.767973	0.0000

Regarding the REER, the short-run analysis reveals that both positive and negative coefficients are statistically significant at the 5% level as presented in [Table 7]. The coefficient for positive shocks indicates that a 1% appreciation in the REER leads to a 0.58% decrease in services imports, which is consistent with standard demand theory. However, a depreciation generates a result that runs counter to conventional expectations. When the REER depreciates by 1%, the value of services imports increases by 0.51%. The initial phase of the J-Curve hypothesis is empirically supported by these findings, which suggest that while depreciation increases import prices, total import spendings rise as import volumes are rigid in the short-term. This situation can also be explained by the essential input hypothesis: since Türkiye's services imports serve as mandatory inputs for domestic production, demand remains inelastic in the short-run. As a result, firms are obligated to sustain service procurement despite rising costs, which inflate the import value. It inflates the nominal import value. This structural dependency was demonstrated especially during the August 2018 currency shock; despite the sharp depreciation of the Turkish Lira, the reliance on imported intermediate services caused the nominal import bill to spike rather than contract in the short run. Furthermore, the expectation channel likely intensifies this effect as the anticipation of further depreciation incentivizes firms to front-load the services demand. These results are grounded in recent literature, as Bahmani-Oskooee and Halicioğlu (2025) support these results as they reached to a similar conclusion as the impact of the REER on Türkiye's aggregate services trade is mainly observed in the short run. Also, the broader empirical evidence presented by Koca and Sevinç (2023) regarding the negative relationship between the exchange rates and services imports aligns with the findings of the analysis conducted in this study.

In terms of trade openness, the estimation reveals significant asymmetric effects interpreted as semi-elasticities and it highlights the economy's varying sensitivity to global integration shocks. Positive shocks show a dynamic adjustment pattern

where a 1 percentage point increase in trade openness leads to a weakly significant immediate rise of 0.78% and the impact intensifies to 1.06% after one quarter lag. In contrast, negative shocks exert a much more abrupt and potent influence: a 1 percentage point decrease in the trade openness ratio results in a 1.67% reduction in services imports. These findings indicate that an increased share of the total trade volume in GDP stimulates derived demand for services imports. More importantly, these results underscore a behavioral asymmetry; the economy reacts more swiftly and severely to trade contractions compared to expansions. The 2020 COVID-19 pandemic serves as a plain validation of this asymmetry. As the borders closed and global trade volumes shrank, services imports also decreased sharply. This validates the high magnitude of the negative shock coefficient. This suggests that service procurement is rapidly cut during downturns, whereas the adjustment to trade liberalization is more gradual. The association between trade openness and services imports is consistent with the findings of Tang et al. (2013). In addition, the stimulation created by the increasing trade openness on import demand is supported by the recent empirical evidence provided by Benz et al. (2023) and Xiang and Zhao (2024), regarding the impact of trade liberalization.

Both the positive and negative short-run coefficients for the shocks to GDP growth are statistically insignificant. This indicates the fact that, in short term, aggregate services imports in Turkiye are largely decoupled from immediate fluctuations in economic activity. While a positive income effect is common in the literature, these insignificant findings align with the results of Kang (2021), who also reported that the income effect is not uniform and can be statistically insignificant for specific services categories.

Finally, the coefficient of the ECT is estimated at -0.2379 and it is statistically significant. The validity of the model and the exhibition of a long-run cointegration relationship among the variables is empirically confirmed by this result. Economically, the coefficients suggest that approximately 24% of the short-run disequilibrium is corrected within the following quarter and the system fully restores within one year. This indicates a moderate speed of adjustment in the market's systematic capacity to absorb shocks.

The long-term test results of the NARDL analysis are given in Table 8:

Table 8: Long Term Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Probability
LREER_POS	0.351335	1.071496	0.327892	0.7442
LREER_NEG	1.240596	0.745686	1.663698	0.1018
TROP_POS	0.034440	0.011584	2.972968	0.0043
TROP_NEG	-0.035132	0.023366	-1.503585	0.1383
GDPGRW_POS	-0.006802	0.007140	-0.952681	0.3448
GDPGRW_NEG	0.009179	0.012982	0.707040	0.4825
C	21.81951	0.268848	81.15930	0.0000

In the long-run equilibrium, trade openness emerges as the only significant determinant. The results highlight a profound asymmetric structure as detailed in [Table 8]. The coefficient for positive shocks in trade openness is 0.0344 and it is statistically significant at the 1% level. Economically, this translates to a substantial 3.44% increase in services imports for every 1% percentage point rise in trade openness over the long term. This finding strongly reinforces the complementary hypothesis supported by Tang et al. (2013), as well as recent evidence from Benz et al (2023) and Xiang and Zhao (2025). These studies also suggest that trade liberalization acts as a permanent catalyst for service imports. As Türkiye integrates more deeply into global value chains, the demand for sophisticated, complementary services becomes structurally embedded in economy. However, the negative shocks to trade openness are insignificant in the long-term, along with both positive and negative components of the REER and GDP growth. This disconnection of the exchange rate in the long run is particularly consistent with the findings of Bahmani-Oskooee and Halicioglu (2025) for Türkiye's aggregate services trade. This evidence underscores a critical transition. While currency fluctuations and the price competitiveness state short-term fluctuations, structural requirements and necessity of technology intensive service inputs become the dominant drives of import decisions over the long term. Once the service related infrastructure for global trade is established, neither price changes nor short-term income volatility can easily reverse these long-term patterns.

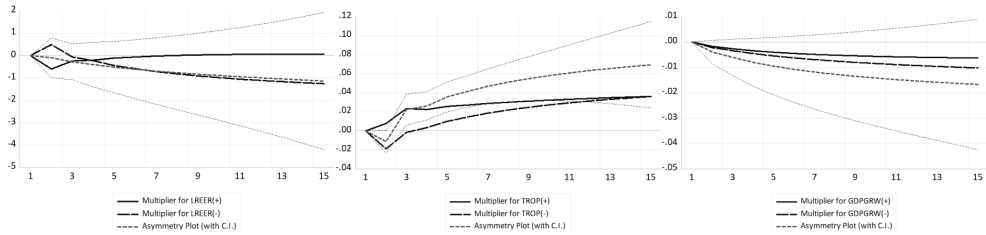
To formally validate the long-run asymmetry, the Wald test is conducted. This test checks for the statistical differences between the impacts of positive and negative partial sum decompositions. The results are presented in Table 9:

Table 9: Wald Test Results

Variable	Null Hypothesis	F-Statistic	P-Value
LREER	POS = NEG	0.8299	0.3662
TROP	POS = NEG	16.2498	0.0002
GDPGRW	POS = NEG	2.0282	0.1599

The Wald test results presented in [Table 9] indicate significant long-run asymmetry only for trade openness. The results confirms that positive and negative shocks to trade liberalization exert statistically different impacts on services imports. In contrast, the REER and GDP growth, the null hypothesis of symmetry cannot be rejected. Accordingly, in the long run, the magnitude of the impact does not differ significantly depending on the direction of the shock for these variables, consistent with their statistically insignificant long-run coefficients.

Figure 2. Dynamic Multiplier Graphs



[Figure 2] displays the cumulative dynamic multipliers graphs of trade openness on services imports. These graphs show a distinct difference between the responses to positive and negative shocks. This distinction confirms the strong long-run asymmetry detected by the Wald test. A positive shock to trade openness leads to a permanent upward adjustment in services imports. This upward movement is stabilized at a higher level after 4-5 quarters.

The graph reveals a distinct divergence between the responses to positive and negative shocks, visually confirming the strong long-run asymmetry detected by the Wald test. Specifically, a positive shock to trade openness leads to a sustained upward adjustment in services imports, stabilizing at a higher equilibrium level after approximately 4-5 quarters. This evidence aligns with the positive and significant long-run coefficient of TROP_POS, so the complementarity hypothesis is reinforced. The asymmetry plot lies significantly away from the zero line which nourishes that the expansion of trade volume has a permanent and dominant stimulating effect on service imports compared to trade contractions. Also, visually confirming the non-significant Wald test statistics, the dynamic multiplier plots for the REER and GDP growth display no permanent divergence between positive and negative shocks. The asymmetry curves for both variables remain within the 95% confidence intervals and converge towards zero. It confirms the absence of long-run asymmetric effects.

When the findings of this analysis are compared to those of other emerging economies, Turkiye's dynamics show both similarities and distinctions. The finding that trade openness is the basic driver aligns with studies conducted on China (Benz et al., 2023; Tang et al., 2013) and Korea (Kang, 2021). According to this alignment, integration into global value chains stimulates the demand for services in emerging countries. However, as the exchange rates effect is insignificant in Turkiye in the long-run, it contrasts with India (Bahmani-Oskooee and Saha, 2024) where the long-run effects are found to be significant in specific subsectors. This divergence reveals that services imports in Turkiye exhibit essential input rigidity and when compared to India, they are less sensitive to price competitiveness.

Conclusion

In this study, determinants of services imports are investigated for Türkiye, which is a developing and open economy. The explanatory variables included to the model are the REER, trade openness and GDP growth. The distinct novelty of this research is its differentiation from traditional linear frameworks by employing a NARDL approach. This approach uncovers the hidden asymmetric adjustment mechanism of service imports that are often overlooked in aggregate linear models. By decomposing macroeconomic shocks into their positive and negative components, this study fills a critical literature gap, providing a deeper understanding of how services trade responds differently across various time horizons and shock directions.

The empirical evidence reveals the contrast between short and long run dynamics. In the short run, Türkiye's services import demand exhibits a highly inelastic structure regarding price changes. Specifically, a depreciation in the REER increases the value of service imports rather than decreasing it. This finding constitutes a significant contribution to the literature as it provides robust empirical support for both the initial phase of the J-curve effect and the essential input hypothesis in the context of an emerging market. This evidence coincides with the findings of Koca and Sevinç's (2023) who emphasize the negative relationship between exchange rates and services trade. It also verifies the results of the study conducted by Bahmani-Oskooee and Halicioglu (2025), who concluded that the exchange rate effects are mostly experienced in the short run. These results underscore Turkish firm's dependency on imported services as they are critical for production and export processes and it leads an increase in import costs. Additionally, the response to the negative shocks is much larger and faster than the response to the positive shocks in trade openness. It suggests that while services imports are cut immediately during economic contractions, firms act cautiously during expansion periods, which points to an important behavioral asymmetry.

In the long run, the research uncovers a significant exchange rate disconnection as neither the REER nor GDP growth statistically influences services imports. The primary long-term driver is exclusively found to be positive shocks to trade openness, which reinforces the complementarity hypothesis between the goods and services trade. As Türkiye integrates further into global markets, the demand for sophisticated services like logistics and finance becomes structurally embedded. This result is supported by Tang et al. (2013) and the stimulative effect of liberalization aligns with the recent studies conducted by Benz et al. (2023) and Xiang and Zhao (2024). The results provides a new perspective on Türkiye's external balance by shifting the focus from price competitiveness to structural trade integration.

These empirical findings suggest several important policy implications. First, the ineffectiveness of the REER in curbing imports indicates that competitive exchange rate policies are not sufficient. Moreover, they may become a potentially harm-

ful instrument for balancing the services account. Given the high dependence on sophisticated service imports, depreciation of the Turkish lira may increase costs without leading to a reduction in import volumes, thereby, it undermines the expected price-competitiveness gains. Second, since service imports are a natural and necessary complement to trade openness, protectionist measures could inadvertently weaken Turkiye's overall export capacity. Therefore, policymakers should shift their focus toward structural incentives that enhance the quality and diversity of the domestic services sector. Reducing dependence on imported sophisticated services through domestic innovation, rather than exchange rate manipulation, is essential for long-term external stability.

Finally, there are several limitations of this study. This analysis relies on aggregate services import value, which may obscure the unique dynamics of subsectors such as tourism, transportation and finance. Additionally, the model does not include global geopolitical risks or supply chains disruptions as exogenous variables. Furthermore, given Turkiye's volatile inflation history, future research could incorporate inflation uncertainty or financial deepening indices to capture monetary transmission channels more comprehensively. Future researches may conduct asymmetrical analyses by disaggregating services imports into its subsectors or enrich the literature by conducting comparative studies with other developing countries.

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Conflicts of interest/Competing interests

There is no conflict of interest/Competing interests

Availability of data and material

The data that support the findings of this study are openly available from the official sources cited in the manuscript.

Code Availability

The computer program results are reported through the tables in the manuscript.

Authors' Contributions

The author confirms sole responsibility for the conception and design of the study, data collection, data analysis and interpretation, manuscript preparation, and final approval of the submitted version.

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