The Asymmetric Effects of Third-Country Exchange Rate Volatility on Turkish-German Commodity Trade

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Abstract

This study examines the asymmetric effects of third-country exchange rate volatility on Turkish-German commodity trade. We analyzed annual time-series data spanning 1980-2022 for 79 (93) Turkish export (import) industries. The ARDL model found that third-country volatility, using the lira-dollar, had a significant short-term symmetric effect on 59 (67) Turkish export (import) industries. The NARDL model found that third-country volatility had a short-run asymmetric effect on trade volumes in more than half of the Turkish export and import industries. However, the short-run asymmetric effects turned into long-run asymmetric effects in about 50 percent of the industries. The results establish that nonlinear models lead to more significant short-run and long-run effects. The empirical evidence shows that the asymmetric assumption alone is insufficient, and third-country volatility should also be considered. The results suggest that all traders should consider how policy changes in a third-country may affect cross-country trade when designing their trade policies in a diversified trade environment.

Keywords: Exchange rate volatility, Asymmetric effects, Third-country volatility, NARDL, Commodity trade.

JEL: F14, F31, F41.

1. Introduction

The transition from fixed to floating exchange rates in the 1970s raised concerns among economists, policymakers, and academics regarding the impact of exchange rate uncertainty on trade. As a result, both theoretical and empirical studies have attempted to explain the relationship between exchange rate uncertainty and trade flows. Paul De Grauwe (1988) posited that the response of traders to exchange rate uncertainty depends on their perception of risk. Risk-averse investors will likely reduce their trading activities due to exchange rate volatility. In contrast, risk-seeking investors are expected to expand their trading activities to avoid future income losses. Thus, the prevalence of risk-seeking and risk-averse trader behaviour is crucial in determining how exchange rate volatility affects trade flows.

Mohsen Bahmani-Oskooee and Scott W. Hegerty (2007) categorized existing empirical studies into three classes. The first class of studies examines a country's trade with the rest of the world using aggregate trade data. However, these studies are susceptible to aggregation bias and have faced criticism from researchers. To address this issue, another class of studies employs bilateral trade data to investigate the impact of exchange rate uncertainty on trade flows. However, these studies have also been criticized for producing country-specific results. Recent empirical studies, such as those by Mei-Se Chien, Nur Setyowati, and Chih-Yang Cheng (2020) and Javed Iqbal, Sabahat Aziz, and Misbah Nosheen (2022), used industry-level data to reduce aggregation bias and assess the relationship between exchange rate uncertainty and commodity trade.

This study investigates the impact of exchange rate volatility on commodity trade flows between Turkey and Germany. Germany represents the largest export destination for Turkey, with a significant proportion of its total exports, valued at $15,980 million (9.42%), destined for the German market in 2020. In turn, Germany is a significant source of imports for Turkey, with its imports from Germany valued at $21,733 million (9.90%) in 2020. The main exports from Turkey to Germany comprise road vehicles, machinery and boilers, textiles, and iron and steel. In contrast, Turkey's main imports from Germany include road vehicles, pharmaceuticals, plastics and products, aircraft, machinery, and boilers. Over the past two decades, Germany has emerged as one of the largest foreign investors in Turkey, with over 7,000 German companies operating in the country. These investments have focussed on several sectors, such as renewable energy, industrial and agricultural products, textiles, transportation, organic chemicals, and consumer goods. Between 2005 and 2021, foreign direct investment from Germany in Turkey amounted to $10.4 billion. In contrast, Turkish investments in Germany amounted to $3.1 billion during the same period. The favourable business environment created by Turkey's recent structural reforms has contributed to its improved position in the 2020 Ease of Doing Business ranking, in which the country ranks 33rd globally (World Bank, 2020). Germany's significance to Turkey is further highlighted by its status as Turkey's second most important source of tourism, with around 5 million German tourists visiting the country in 2019. Thus, Germany has become Turkey's most important trade, tourism, financial and technical cooperation, and defence industry partner. Therefore, considering the multifaceted relationships between the two nations, an empirical study on the impact of exchange rate volatility on bilateral trade flows between Turkey and Germany is of paramount importance.

The present study contributes to the existing empirical literature in two distinct ways. First, it aims to evaluate the third-country effect (the U.S.) on the trade volume between Turkey and Germany by using the lira-dollar volatility measure. The United States is considered a third-country because it was Turkey's third-largest export destination in 2020, accounting for 6% of exports worth $10.2 billion (UN Comtrade database, 2022). Moreover, the U.S. is the world's largest economy, and its role in the global economy cannot be ignored. In addition, while Turkey's imports from China have gradually increased over the years, the same trend has not been observed in Turkey's exports to China. Finally, China's economic and political system is much more controlled and authoritarian than the U.S., which is more capitalist and democratic (Ahmed Usman, Nicholas Apergis, and Sofia Anwar (2021)), indicating the heterogeneity of the economic structures of both Turkey's trading partners. These factors make the U.S. an obvious choice for inclusion as a third-economy.

In the case of Turkey, previous empirical studies have assumed that the impact of exchange rate volatility on trade flows is symmetric. Mohen Bahmani-Oskooee and Muhammad Aftab (2017) argued that exchange rate uncertainty could have asymmetric effects on trade. Therefore, this study assumes that the third-country volatility measure has an asymmetric impact on trade flows. In particular, this study focuses on whether the measure of third-country volatility affects trade flows symmetrically or asymmetrically, thus serving as the study's second objective. In this context, the study provides a literature review in Section 2, the methodology employed in the analysis is described in Section 3, the empirical results are presented in Section 4, and the study concludes with policy recommendations in Section 5.

2. Literature Review

Since this study examines the impact of exchange rate uncertainty on commodity trade flows between Turkey and Germany, we only review the existing empirical literature on Turkey. Empirical studies on the relationship between exchange rate uncertainty and trade flows in Turkey are relatively scarce. One of the earliest studies in this area was conducted by Ricardo J. Caballero and Vittorio Corbo (1989), which investigated the influence of exchange rate variability on the total exports of several developing countries, including Turkey. The empirical results demonstrated that exchange rate fluctuations have a significantly negative impact on Turkey's exports. However, the study has been criticized by researchers for only examining the export pattern of trade and ignoring the import pattern of trade with

other bilateral trading partners. In addition, the integrating properties of the variables studied were not considered, which could lead to misleading results. To resolve these issues, Murat Doğanlar (2002) applied the Engle-Granger cointegration approach to demonstrate that the real exports of South Korea, Indonesia, Pakistan, Turkey, and Malaysia are cointegrated with foreign income, the real exchange rate, and the measure of exchange rate volatility. The analysis revealed that exchange rate volatility harms the exports of all trading partners. However, the use of the Engle-Granger cointegration method has also been criticized as it may reveal more than two cointegrating relationships if there are more than two variables under investigation, and it does not provide information on the number of cointegrating vectors. In addition, as a single-equation model, the conclusions drawn from this methodology could be questioned, and the same can be said for Doganlar's conclusions related to his modelling framework. More importantly, studies that examine a country's aggregate exports with the rest of the world are subject to aggregation bias, as trade between two nations may respond differently to exchange rate fluctuations than trade between a country and the rest of the world. These aggregate-level studies on Turkey are no exception.

Another class of studies examines the trade response to exchange rate uncertainty using bilateral trade data to reduce the severity of aggregation bias. In this context, Jerry G. Thursby and Marie C. Thursby (1985) used bilateral trade data and considered Turkey in the list of sample countries. They used the export specification in which Turkey's exports to 19 trading partners were pooled. The study concluded that exchange rate fluctuations do not significantly affect Turkey's exports. Consequently, panel studies also suffer from aggregation bias, as results from one cross-section may not hold for another cross-section unit. Mohsen Bahmani-Oskooee and Nabil Ltaifa (1992), who included 87 countries (including Turkey) in their sample, faced the same criticism. In particular, bilateral-level studies provide country-specific results. Since bilateral-level studies also exhibit a second aggregation bias, empirical studies in the post-2007 period have focused on disaggregated commodity trade data (i.e., industry-level data) to investigate the association between exchange rate volatility and trade flows. To this end, Bahmani-Oskooee and Nazif Durmaz (2016) examined the influence of exchange rate uncertainty on 61 Turkish industries involved in trade with the rest of the world. The study found that exchange rate volatility significantly impacted the imports (exports) of 39 (23) industries. The industry-specific results have also been confirmed by other empirical studies, including Bahmani-Oskooee, Javed Iqbal, and Saqib U. Khan (2017) for U.S.-Pakistan trade, Bahmani-Oskooee and Aftab (2018) for EU-Malaysia trade, Bahmani-Oskooee and Tatchawan Kanitpong (2019) for Thailand-China trade, Chien, Setyowati, and Cheng (2020) for Taiwan-Indonesia trade, Jungho Baek and Soojang Nam (2021) for South Korea-China trade, and Iqbal, Aziz, and Nosheen (2022) for U.S.-Pakistan trade. Although these documented studies have solved the problems associated with the symmetric approach, researchers have criticized them for not accounting for the so-called *"third-country effect."*

Recent empirical studies have shown that the volatility of third-country exchange rates is also an important variable that can influence a country's trade flows (Bahmani-Oskooee and Jia Xu (2012), Bahmani-Oskooee, Hegerty, and Dan Xi (2016), Bahmani-Oskooee, Iqbal, and Khan (2017), Bahmani-Oskooee and Aftab (2018), Ghosia A. Abbasi and Iqbal (2020), and Usman, Apergis, and Anwar (2021)). The third-country effect causes risk-averse traders to shift their trades to the third-country because of the increased exchange rate instability between the two trading partners (David O. Cushman (1986)). Considering trade between Turkey and Germany, an increase in the volatility of the lira–euro exchange rate could hinder Turkish trade with Germany and shift trade activity from Turkey to a third-country (the United States). In contrast, an increase in the volatility of the lira-dollar exchange rate could reduce Turkey's trade with the United States and shift it toward Germany, as Turkish traders substitute U.S. markets for German markets. Studies dealing with the third-country effect have found that external volatility significantly affects trade flows (Taufiq Choudhry, Syed S. Hassan, and Fotios I. Papadimitriou (2014), Abdorreza Soleymani, Soo Y. Chua, and Abdul F. Hamat (2017)). Since the country's exchange rate acts as a proxy for commodity prices, movements in the exchange rate of a particular partner lead to a substitution effect that diverts trade to other countries (Bahmani-Oskooee, Hanafiyah Harvey, and Hegerty (2013)). Using commodity trade data, Bahmani-Oskooee, Hegerty, and Xu (2013) assessed the impact of third-country volatility on bilateral trade between the U.S. and Hong Kong. They confirmed strong evidence of external volatility risk for U.S. import industries. Bahmani-Oskooee and Xu (2012) found that most sectors trading between the USA and China did not show the influence of external volatility in the long-run. In contrast, Usman, Apergis, and Anwar (2021) found that the effect of external volatility risk persisted for 14 (34) export (import) sectors trading between China and Pakistan in the short-run and long-run. In addition, Bahmani-Oskooee, Iqbal, and Khan (2017) examined third-country exchange rate risk for 116 (53) exporting (importing) U.S. industries. According to their results, higher rupee-yuan volatility affected half of the major U.S. exporting industries. Recently, Bahmani-Oskooee and Aftab (2018) also assessed the asymmetric impact of the ringgit-yuan effect on U.S.-Malaysia industry trade. They found that nonlinear effects of ringgit-yuan volatility provided more robust empirical estimates.

In Turkey, no empirical study has thus far examined the asymmetric effects of third-country risk on Turkish-German commodity trade. Symmetric analysis has been the primary focus of the documented empirical studies; however, asymmetric analysis and the third-country volatility effect for Turkey have been wholly ignored. More importantly, Bahmani-Oskooee and Aftab (2017) argued that exchange rate dynamics may have asymmetric effects on trade flows due to traders' responses to exchange rate uncertainty, which may differ when volatility increases or decreases. This asymmetry can result from expectations and a priori information changes, leading to traders' varying responses to change

rate volatility. When the exchange rate volatility increases, an x percent increase in volatility may decrease a country's exports by y percent. However, when the volatility decreases by x percent, that country's exports may increase by more than y percent, as traders may become more optimistic about the possibility of more stable exchange rates. Bahmani-Oskooee, Ridha Nouira, and Sami Saafi (2019) argued that the asymmetric response to increased volatility occurs because traders may assume that a decline in volatility is short-lived and do not respond to it. In particular, this "wait-and-see" approach leads to an asymmetric response. The authors concluded that the asymmetric effects of exchange rate volatility are due to changes in traders' expectations, firms' pricing policies to hedge against uncertainty, and downward price rigidity. Moreover, empirical evidence also supports the notion that trade flows respond asymmetrically to exchange rate dynamics, and the same is expected of exchange rate volatility. Furthermore, Heba Ali (2019) argued that investors weight losses more heavily relative to economic gains (returns); they demand higher compensation for holding stocks with higher downside risk, leading to asymmetric behaviour. Following the same concept, Bahmani-Oskooee, Nouira, and Saafi (2019) argued that traders respond asymmetrically to exchange rate volatility when they weight losses higher than gains from holding foreign exchange to hedge against future transactions. Given this idea, this paper fills the existing research gap in the empirical international economics literature by examining the asymmetric impact of third-country exchange rate volatility on Turkish-German commodity trade. To the best of the author's knowledge, this is the first empirical study to explore the asymmetric effects of third-country exchange rate volatility on Turkish-German commodity trade.

3. Methodology

The impact of exchange rate dynamics on commodity flows is often estimated using export and import demand models. Each model includes a scale variable (i.e., real income) and a relative price term (i.e., the real exchange rate). In addition, we have included a measure of exchange rate volatility that accounts for the so-called "third-country effect". We closely follow Cushman (1986), Bahmani-Oskooee, Hegerty, and Xi (2016), Bahmani-Oskooee, Iqbal, and Khan (2017), Bahmani-Oskooee and Aftab (2018), Abbasi and Iqbal (2020), and Usman, Apergis, and Anwar (2021), who all considered external volatility risks. In this study, we specify the following export and import demand equations:

$$lnXV_{i,t} = \alpha_0 + \alpha_1 DM_t + \alpha_2 lnY_t^{GR} + \alpha_3 lnREX_t + \alpha_4 lnVOL_t^{TRUS} + \varepsilon_t \quad (1)$$

$$lnMV_{i,t} = \beta_0 + \beta_1 DM_t + \beta_2 lnY_t^{TR} + \beta_3 lnREX_t + \beta_4 lnVOL_t^{TRUS} + v_t \quad (2)$$

The data are constructed from the perspective of Turkey; therefore, $XV_{i,t}$ and $MV_{i,t}$ in Equations (1) and (2) denote real export flows from Turkey to Germany and real import flows from Germany to Turkey for a given commodity *i* in a year *t*. DM represents a structural dummy variable that captures the effect of the trade liberalization reforms on bilateral trade flows (i.e., DM_t = 0 for years from 1980-1983 and DM_t = 1 for years from 1984-2022). Theoretically, we expect $\alpha_1 > 0$ and $\beta_1 > 0$, showing that trade liberalization reforms in Turkey can positively affect commodity trading between the two countries. We also introduced other country-specific dummy variables that were not statistically significant. The export volume ($XV_{i,t}$) in Equation (1) is determined by three explanatory variables: Germany's real income (Y_t^{GR}), the real lira-euro exchange rate (REX_t), and the real lira-dollar exchange rate volatility (VOL_t^{TRUS}). Similarly, import volume ($MV_{i,t}$) in Equation (2) is determined by three explanatory variables: Turkey's real income (Y_t^{TR}), the real lira-euro exchange rate (REX_t), and the real lira-dollar exchange rate volatility (VOL_t^{TRUS}). We theoretically expect $\alpha_2 > 0$ and $\beta_2 > 0$, showing that an increase in real income within Germany and Turkey will stimulate commodity trade between the two countries. As outlined in Appendix A.2., the construction of the variable REX_t ensures that an increase in value implies a real depreciation of the lira against the euro. Given this definition, we anticipate that Turkish exports will increase in response to lira depreciation, thus lowering the price of Turkish commodities in euros. Hence, we theoretically expect $\alpha_3 > 0$. In contrast, we expect $\beta_3 < 0$ as lira depreciation reduces imports. To account for the third-country effect, Equations (1) and (2) feature the inclusion of a real exchange rate volatility measure, represented by VOL_t^{TRUS}, which denotes the volatility of the Turkish lira against the U.S. dollar. This volatility measure could positively or negatively impact Turkish commodity trade with Germany, reflecting the associated risks traders face and the degree of substitution for cross-border traded products.

The present study follows the approach of Bahmani-Oskooee and Aftab (2017, 2018) to derive the measure of third-country exchange rate volatility employing the generalized autoregressive conditional heteroskedasticity (GARCH 1, 1) approach. The variable of interest, *REX*, is assumed to be random and follow an *AR(1)* process as follows:

$$REX_t = \alpha_0 + \alpha_1 REX_{t-1} + \varepsilon_t \quad (3)$$

In equation (3), ε_t is white noise with $E(\varepsilon_t) = 0$ and $\delta^2(\varepsilon_t) = h_t^2$. To predict the variance of REX_t, the conditional variance of ε_t (h_t^2) can be estimated using the following specification:

$$h_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \varepsilon_{t-2}^2 + \beta_3 \varepsilon_{t-3}^2 + \cdots + \beta_q \varepsilon_{t-q}^2 + \omega_1 h_{t-1}^2 + \omega_2 h_{t-2}^2 + \omega_3 h_{t-3}^2 + \cdots + \omega_p h_{t-p}^2 \quad (4)$$

To determine the forecast values of the conditional variance (h_t^2), we used the GARCH (p,q) model according to Equation (4) as a measure to capture the time-varying volatility of the real exchange rate. Both Equations (3) and (4) are estimated simultaneously after an autoregressive conditional heteroscedasticity (ARCH) effect is detected. In Equation (4), the order of the GARCH model is determined by the significance of the parameters β_s and ω_s. As in most cases, a

GARCH (1,1) specification is appropriate as in our case. The estimation results of the parsimonious GARCH (1,1) model are presented below, where their respective p-values indicate the significance of the parameters in parentheses:

$$REX_t = \underset{(0.0150)}{0.6646} + \underset{(0.0000)}{0.7595}\, REX_{t-1} + \varepsilon_t$$

$$\hat{h}_t^2 = \underset{(0.0189)}{0.016015} + \underset{(0.0442)}{0.103758}\, \hat{\varepsilon}_{t-1}^2 + \underset{(0.0000)}{1.036535}\, \hat{h}_{t-1}^2$$

The real exchange rate volatility measure is illustrated in Figure 1 to provide further insights into the analysis.

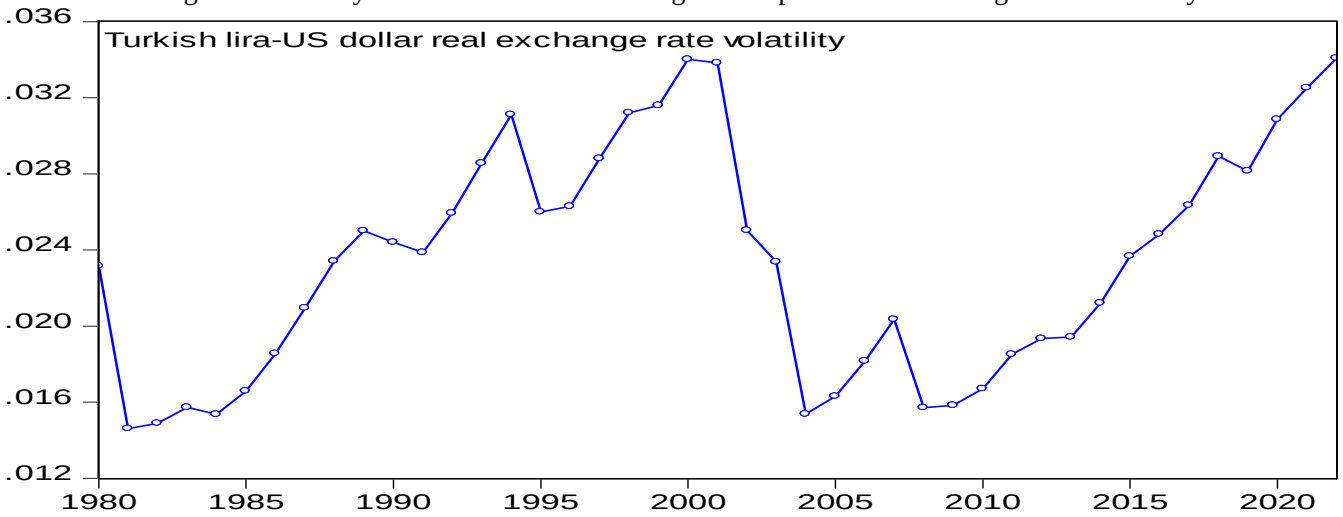

Figure 1. Volatility measure of the real exchange rate

In the context of evaluating the short-run effects of the explanatory variables on commodity trade, traditional Autoregressive Distributed Lag (ARDL) models (1) and (2) are not suitable as they are long-run equations. Therefore, a widely adopted approach is to specify Equations (1) and (2) as error-correction representations, enabling the estimation of the explanatory variables' short-run impacts on trade volumes. Consistent with this approach, we follow Hashem, M. Pesaran, Yongcheol Shin, and Richard J. Smith (2001) and use the error-correction models (5) and (6) as presented below:

$$\Delta lnXV_{i,t} = \alpha_0 + \alpha_1 DM_t + \sum_{j=1}^{n_1} \alpha_{2i} \Delta lnXV_{t-j} + \sum_{j=0}^{n_2} \alpha_{3i} \Delta lnY_{t-j}^{GR} + \sum_{j=0}^{n_3} \alpha_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \alpha_{5i} \Delta lnVOL_{t-j}^{TRUS} + \theta_1 lnXV_{t-1} + \theta_2 lnY_{t-1}^{GR} + \theta_3 lnREX_{t-1} + \theta_4 lnVOL_{t-1}^{TRUS} + \varepsilon_t \quad (5)$$

$$\Delta lnMV_{i,t} = \beta_0 + \beta_1 DM_t + \sum_{j=1}^{n_1} \beta_{2i} \Delta lnMV_{t-j} + \sum_{j=0}^{n_2} \beta_{3i} \Delta lnY_{t-j}^{TR} + \sum_{j=0}^{n_3} \beta_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_5} \beta_{5i} \Delta lnVOL_{t-j}^{TRUS} + \rho_1 lnMV_{t-1} + \rho_2 lnY_{t-1}^{TR} + \rho_3 lnREX_{t-1} + \rho_4 lnVOL_{t-1}^{TRUS} + \varepsilon_t' \quad (6)$$

In the above error-correction specifications, the short-term effects are captured by the first-differenced variables, while the normalized coefficients capture the long-term effects ($i.e., \theta_2 - \theta_4$on $\theta_1$in (5) and $\rho_2 - \rho_4$ on ρ_1 in (6)). For instance, the short-run effect of real lira-dollar volatility on export volumes is reflected in the estimate of α_{5i} in (5) and on import volumes by β_{5i} in (6). The models presented in Equations (5) and (6) are known as symmetric or linear ARDL models developed by Pesaran, Shin, and Smith (2001), which offer several advantages over alternative estimation methods. For example, they enable unbiased estimation for small samples and simultaneous estimation of short and long-run coefficients. In addition, mixed orders of integration can be considered, provided that none of the variables has an *I(2)* order. However, cointegration must be present for the long-run coefficients to be meaningful. Pesaran, Shin, and Smith (2001) proposed the F-test to test for cointegration, which employs new critical values. This test involves upper and lower critical bounds for a given significance level and several exogenous variables (*k*). The null hypothesis of no cointegration is rejected if the calculated value of the F-statistic exceeds the critical upper bound and vice versa.

Bahmani-Oskooee and Aftab (2017) criticized previous empirical studies that assumed that exchange rate uncertainty affects trade flows symmetrically. They showed that exchange rate dynamics violate this strict assumption and can have asymmetric effects on trade flows. In this study, our primary objective is to examine whether the effect of third-country exchange rate volatility on Turkish-German commodity trade is symmetric or asymmetric. To achieve this, we follow Yongcheol Shin, Byungchul Yu, and Matthew G. Nimmo (2014) by decomposing an increase from a decrease in volatility. We begin by constructing $\Delta lnVOL$, which includes both positive and negative fluctuations. Subsequently, we apply the concept of partial sums to generate two new series, namely the partial sum of positive variations (*POS*) and the partial sum of negative variations (*NEG*).

$$POS_t = \sum_{j=1}^{t} \Delta lnVOL_j^+ = \sum_{j=1}^{t} \max(\Delta lnVOL_j, 0)$$

$$NEG_t = \sum_{j=1}^{t} \Delta lnVOL_j^- = \sum_{j=1}^{t} \min(\Delta lnVOL_j, 0) \quad (7)$$

Researchers have widely used the decomposition of exchange rate volatility using the partial sum approach. Notable recent studies that have employed this method include Bahmani-Oskooee and Aftab (2017, 2018), Usman, Apergis, and Anwar (2021), and Iqbal, Aziz, and Nosheen (2022), among others. Following the same procedure, we utilize the method above to construct *POS* and *NEG* series for the lira-dollar volatility, denoted as POS^{TRUS} and NEG^{TRUS}, respectively.

$$POS_t^{TRUS} = \sum_{j=1}^{t} \max(\Delta lnVOL_j^{TRUS}, 0)$$
$$NEG_t^{TRUS} = \sum_{j=1}^{t} \min(\Delta ln\,VOL_j^{TRUS}, 0) \quad (8)$$

Following the decomposition of the lira-dollar exchange rate volatility measure (VOL_t^{TRUS}) into its positive and negative components, we proceed by incorporating the decomposed components into Equations (5) and (6), resulting in Equations (9) and (10):

$$\Delta lnXV_{i,t} = \chi_0 + \chi_1 DM_t + \sum_{j=1}^{n_1} \chi_{2i} \Delta lnXV_{t-j} + \sum_{j=0}^{n_2} \chi_{3i} \Delta lnY_{t-j}^{GR} + \sum_{j=0}^{n_3} \chi_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \chi_{5i} \Delta lnPOS_{t-j}^{TRUS} + \sum_{j=0}^{n_5} \chi_{6i} \Delta lnNEG_{t-j}^{TRUS} + \vartheta_1\, lnXV_{t-1} + \vartheta_2 lnY_{t-1}^{GR} + \vartheta_3 lnREX_{t-1} + \vartheta_4 lnPOS_{t-1}^{TRUS} + \vartheta_5 lnNEG_{t-1}^{TRUS} + \varepsilon_t \quad (9)$$

$$\Delta lnMV_{i,t} = \delta_0 + \delta_1 DM_t + \sum_{j=1}^{n_1} \delta_{2i} \Delta lnMV_{t-j} + \sum_{j=0}^{n_2} \delta_{3i} \Delta lnY_{t-j}^{TR} + \sum_{j=0}^{n_3} \delta_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \delta_{5i} \Delta lnPOS_{t-j}^{TRUS} + \sum_{j=0}^{n_5} \delta_{6i} \Delta lnNEG_{t-j}^{TRUS} + \sigma_1 lnMV_{t-1} + \sigma_2 lnY_{t-1}^{TR} + \sigma_3 lnREX_{t-1} + \sigma_4 lnPOS_{t-1}^{TRUS} + \sigma_5 lnNEG_{t-1}^{TRUS} + \varepsilon_t{}' \quad (10)$$

The utilization of partial sum variables in Equations (9) and (10) renders them nonlinear error-correction specifications, commonly referred to as Nonlinear Autoregressive Distributed Lag (NARDL) models, whereas Equations (5) and (6) are linear or symmetric ARDL models. The linear ARDL framework developed by Pesaran, Shin, and Smith (2001) can be extended to NARDL models. In a nonlinear ARDL approach, the F-test critical values proposed by Pesaran, Shin, and Smith (2001) can still be applied to determine the joint significance of the lagged-level variables.

To investigate whether there is an asymmetry between the positive and negative effects of volatility, we apply the Ordinary Least Squares (OLS) technique to estimate Equations (9) and (10) and perform asymmetry tests. The purpose of these tests is to determine whether the effects of volatility increases and decreases are the same or whether they are asymmetric. Specifically, we conduct short-run and long-run Wald tests to examine whether the effects of an increase in uncertainty are equal to those of a decrease in uncertainty or whether they are asymmetric (Bahmani-Oskooee and Aftab, 2017). In particular, (1) Short-run adjustment asymmetry occurs when *POS* has a different number of lags than *NEG*. (2) Short-run asymmetric effects occur when the sign/size of the estimates associated with *POS* and *NEG* differ for each lag order *j*. (3) Short-run cumulative/joint/impact asymmetry can be detected when the sum of estimates associated with *POS* is statistically different from the sum of estimates associated with *NEG* ($\sum \hat{\chi}_{5i} \neq \sum \hat{\chi}_{6i}$ in Equation (9) and $\sum \hat{\delta}_{5i} \neq \sum \hat{\delta}_{6i}$ in Equation (10)). (4) The long-term asymmetric effect is confirmed when the normalized estimate associated with *POS* and *NEG* is statistically different. The Wald test is applied to test the hypothesis of long-run asymmetry for model (9), i.e., $\left(\hat{\vartheta}_4/_{-\hat{\vartheta}_1} \neq \hat{\vartheta}_5/_{-\hat{\vartheta}_1}\right)$. In addition, the long-run asymmetry hypothesis is tested using the Wald test for model (10), i.e., $\left(\hat{\sigma}_4/_{-\hat{\sigma}_1} \neq \hat{\sigma}_5/_{-\hat{\sigma}_1}\right)$.

4. Empirical results

Usman, Apergis, and Anwar (2021) demonstrated the suitability of Equations (9) and (10) for estimating NARDL export and import models, respectively. In addition, we estimate linear ARDL models [(5) & (6)] to compare linear and nonlinear ARDL models. The estimation uses annual time-series data spanning 1980-2022 for 79 exporting and 93 importing industries. The exporting industries account for 86.73% of Turkey's total exports to Germany, while the importing industries account for 94.91% of Turkey's total imports from Germany. Although the ARDL approach does not require pretesting of variables for stationarity, we perform the Augmented Dickey-Fuller (ADF) test to confirm that no variables are *I(2).* The ADF unit root test revealed that our variables are mixed: *I(0)* and *I(1).* This result necessitates the use of the ARDL bounds test for empirical analysis. A maximum of three lags are applied to each first-differenced variable, as annual data are used, while Akaike's Information Criterion (AIC) is applied to determine the proper lag orders. In the analysis of annual time-series data, it is possible to include a maximum of 4 lags. However, prior studies, such as Bahmani-Oskooee and Yongqing Wang (2007, 2008) and Bahmani-Oskooee, Harvey, and Hegerty (2013), employed only 2 lags. It is worth noting that cointegration analysis tends to be more effective with longer time-series data rather than with many observations (Craig Hakkio and Mark Rush, 1991). Moreover, each industry's reported coefficient estimates and associated diagnostic tests are among the optimal models.

4.1 Linear export model

Table 1 contains estimated coefficients of the linear export model (5), and Table 2 shows its associated diagnostic tests. According to Bahmani-Oskooee and Marzieh Bolhassani (2014), if an exogenous variable has at least one significant lagged effect at the 10% (5%) significance level in the short-run, we refer to this as "Yes" in Table 1. Conversely, a "No" indicates no significant short-run lagged coefficient. The short-run estimates show that Germany's income (lnY^{GR}) has at least one significant short-run effect in 67 industries, reflecting the significance of the income effect on export volumes. The short-run estimates also demonstrate that the real bilateral exchange rate ($lnREX$) has a significant short-run impact on the exports of 65 Turkish industries. The diagnostics show that most export industries are small in terms of their export share, but some large export industries are also included, e.g., industries coded 711, 719, 732, and 841.

More importantly, the third-country volatility effect ($lnVOL^{TRUS}$) was observed in 70 cases, where at least one short-run estimate was significant. According to these results, the short-term third-country effect dominates Turkish exports to Germany. Do these short-run estimates hold in the long-run? To answer this question, we turn to the normalized long-run coefficients in Table 1.

Our long-run estimates demonstrate that the real bilateral exchange rate significantly impacts 37 industries. This estimate has a positive sign for 30 export industries and a negative sign for seven exporting industries. A negative sign means that a lira depreciation will lead to fewer exports to Germany. Similarly, Germany's income (lnY^{GR}) has a significant estimate in 51 cases. The long-run coefficient has an expected positive sign in 39 industries, suggesting that Germany imports more goods from Turkey as its economy grows. In the remaining 12 cases, however, the coefficient has a negative sign. This could be because Germany produces more substitute products at home and imports fewer products from Turkey (Bahmani-Oskooee, 1986). In addition, the effect of the trade liberalization reforms is significant in 55 industries, negative in 9 industries, and positive in 46 industries. As for the third-economy effect, the long-run findings show that the real lira-dollar volatility ($lnVOL^{TRUS}$) has a significantly negative estimate in nine small industries. As the lira-dollar exchange rate becomes more volatile in these export industries, Turkish importers shift from Germany to the U.S. This must be a risk-averse community of traders who benefit from increasing their revenues today to compensate for losses in the future. Nevertheless, there are 61 cases where lira-dollar volatility has a significant positive coefficient, suggesting that Turkish importers of these goods substitute U.S. products with German products when the lira-dollar exchange rate is highly volatile; this confirms the long-run substitution effect.

Since the long-run results depend on the presence of cointegration, we turn to Table 2. We compare the upper critical bounds of the F-statistic of Paresh K. Narayan (2005) with the calculated values of the F-statistic listed in the first column of the diagnostics in Table 2. The F-test confirms cointegration for all models at the 5% (10%) significance levels. Based on ECM_{t-1}, cointegration is also detected for all specifications using the critical values of Anindya Banerjee, Juan Dolado, and Ricardo Mestre (1998). Additionally, the adjusted R^2 shows that all models are well-fitted. The Lagrange Multiplier test (LM) is applied to check for serial correlation. The associated diagnostic is significant in only seven cases, meaning that only seven functions are affected by serial correlation. The Ramsey *RESET* test detects model misspecification, and the associated diagnostic is significant in only six cases. Hence, this confirms that our model is appropriately specified in most industries. In addition, *CUSUM* and *CUSUMSQ* tests are utilized to establish each function's short-run and long-run stability. Due to the large estimates, we report stable cases as "S" and unstable cases as "US". Based on the *CUSUM* or *CUSUMSQ* diagrams, the proposed specification is stable in almost all cases. Thus, we conclude that the results of the linear export specification are meaningful.

4.2 Linear import model

Table 3 presents the empirical estimates of the linear import model (6), and Table 4 displays its associated diagnostics. The findings indicate that the third-country effect ($lnVOL^{TRUS}$) has at least one significant short-run lag estimate in 73 cases. Are the short-run estimates consistent in the long-run? The long-run coefficients reveal that the third-economy effect ($lnVOL^{TRUS}$) has a significant impact on 50 Turkish import industries. This volatility effect has a positive (negative) sign in 15 (35) industries. The positively affected industries include the two largest Turkish import industries, coded 541 and 581, which import about 12.57% of their products from Germany. In contrast, the three largest import industries, coded 711, 719, and 732, which import approximately 34.21% of goods from Germany, are negatively affected by third-country risk. Intuitively, the analysis suggests that Turkey continues to grow and relies more on imports from the United States to meet its increasing local demand. Hence, there is a strong indication that the U.S. dollar (external currency risk) should be included in the analysis to better understand Turkey's actual import patterns from Germany. As for the other explanatory variables in the linear import specification, the 1984 trade liberalization reforms (*DM*) impacted Turkish import industries in 62 cases. Moreover, improved Turkish economic activity (lnY_t^{TR}) favours German products in Turkey in 49 significant cases. Finally, the long-run impact of the real bilateral exchange rate (*lnREX*) is positive (negative) in 13 (60) cases. The expected negative estimate suggests that the depreciation of the lira against the euro hampers Turkish imports from Germany for most industries.

Once again, the validity of the linear import model estimates depends on the associated diagnostic tests being passed. The *F* or ECM_{t-1} test detects cointegration in those industries whose exogenous variables have significant normalized long-run coefficients. Due to the high adjusted R^2, almost every specification has a good fit. In most cases, the *LM* and *RESET* diagnostics confirm autocorrelation-free residuals and appropriate optimum econometric specifications. Finally, the *CUSUM* and *CUSUMSQ* tests indicate stable model estimates.

4.3 Nonlinear export model

We will now examine whether the effects of real exchange rate volatility on trade flows exhibit asymmetric effects. To this end, we tested the short-run and long-run asymmetry hypotheses using the Wald-SR^{TRUS} and Wald-LR^{TRUS} tests. We found that the short-run adjustment is asymmetric in most cases due to the lag order (*j*) associated with increased (ΔPOS^{TRUS}) and decreased (ΔNEG^{TRUS}) volatility not matching. In all cases, we observed short-run asymmetric effects of third-country volatility using the magnitude or sign difference between ΔPOS^{TRUS} and ΔNEG^{TRUS}. Furthermore, we also identified third-country short-run joint asymmetry, which is observed when the sum of coefficients attached to ΔPOS^{TRUS} differs from the sum of coefficients attached to ΔNEG^{TRUS}. Asymmetric effects of lira-dollar volatility can

be observed using the Wald-SR^{TRUS} test estimates for 63 industries (see Table 6). However, these significant estimates are notable for small and large Turkish export industries. These major export industries include 684 (aluminium), 711 (power generation machinery), 719 (machinery and appliances), 732 (road motor vehicles), and 841 (clothing except fur clothing), which together account for about 49.1% of exports. Regarding the third-country volatility effects, the third-economy effect is notable in 41 Turkish export industries where POS^{TRUS} or NEG^{TRUS} is statistically significant at 5% (10%) significance levels. Based on the difference in magnitude or sign between the POS^{TRUS} and NEG^{TRUS} estimates, we observe long-run asymmetric effects for all small and large export industries for the third-economy. However, the significant effects associated with the third-economy that depends on $Wald\text{-}LR^{TRUS}$ are noticeable in 49 industries (see Table 6).

For the nonlinear export specification (9), we first consider the short-run effects of real exchange rate uncertainty and the third-economy effect. According to the NARDL empirical estimates in Table 5, the short-run effect of the third-economy was found either by ΔPOS^{TRUS} and ΔNEG^{TRUS} in 61 cases. However, the short-run third-economy effect was found in 70 industries in the earlier linear modelling framework. The analysis suggests that the decrease in significant cases is due to the gradual nonlinear adjustment of the third-economy effect. Furthermore, the volatility effect for the third-economy reveals remarkable asymmetric effects on export flows. The long-run estimates of the NARDL export model show that the real bilateral exchange rate (*lnREX*) significantly impacts 35 industries. This estimate has a positive sign for 24 and a negative sign for 11 export industries in Turkey. Specifically, the positive coefficient of the real exchange rate shows that the depreciation of the Turkish lira against the euro favours more exports from Turkey to Germany. In contrast, the negative estimate of the real exchange rate means that the lira's depreciation leads to fewer goods exports from Turkey to Germany. The long-run estimates also show that German income (lnY^{GR}) has a significant positive estimate in 45 cases, suggesting that Germany imports more products from Turkey as its economy grows. Conversely, the income coefficient has a negative sign in 8 industries. This could be because Germany produces more substitute products domestically and imports fewer products from Turkey (Bahmani-Oskooee, 1986). Moreover, trade liberalization reforms (DM) are significant in 55 cases, negative in 53 small and large industries and positive in 2 small industries. As for the third-economy effect, the long-run estimates of negative volatility (NEG^{TRUS}) demonstrate that real lira-dollar volatility has a significantly negative coefficient in 37 small and large industries. As the lira-dollar exchange rate becomes more volatile in these export industries, Turkish importers are shifting their activities from Germany to the U.S. There must be a risk-averse group of traders who benefit from increasing their revenues today to compensate for futur losses in the future. In contrast, the long-run estimates of positive volatility (POS^{TRUS}) show that there are 33 cases where lira-dollar volatility has a significant positive coefficient, suggesting that Turkish importers of these goods turn away from U.S. products and prefer German products when the lira-dollar exchange rate is highly volatile; this confirms the long-run substitution effect in export industries.

Once again, diagnostic tests are necessary to support the validity of the long-run coefficient estimates. The asymmetry of cointegration is crucial in this regard. Table 6 presents significant F-test results in 69 cases that support cointegration. Additionally, all functions provide cointegration based on ECM_{t-1}. The high value of the adjusted R^2 implies that the proposed model is a good fit for each industry. The Ramsey *RESET* test also indicates that the nonlinear export specification is correctly specified in most industries. Serial correlation is not a significant problem in all cases, as shown by the *LM* test. Finally, the *CUSUM* or *CUSUMSQ* tests demonstrate that the short and long-run coefficients of all industries are stable.

4.4 Nonlinear import model

Before interpreting the results of the NARDL import model, we tested the short-run and long-run asymmetry hypotheses using the Wald-SR^{TRUS} and Wald-LR^{TRUS} tests. We observed short-run nonlinear effects for exchange rate uncertainty and the third-economy effect in all cases, based on the difference in sign or size between the ΔPOS and ΔNEG estimates. The lag orders of the estimates for ΔPOS^{TRUS} and ΔNEG^{TRUS}were different in most cases, thus confirming the short-run adjustment asymmetry concerning the influences of appreciation and depreciation on volatility. The asymmetry of third-country effects is detectable for 79 industries based on the significant Wald-SR^{TRUS} test. Therefore, based on the short-run modelling, where exchange rate uncertainty and external volatility are decomposed into *POS* and *NEG* components using nonlinear adjustment, we conclude that most import industries exhibit asymmetric effects. Similarly, the Wald-LR^{TRUS} test shows that the long-run asymmetry of lira-dollar volatility exists in 70 cases (see Table 8).

We will now discuss the short-run and long-run estimates of the NARDL import specification (10) in Table 7, and the associated diagnostics are shown in Table 8. The short-run asymmetric results for the third-economy effect show that ΔPOS^{TRUS}or ΔNEG^{TRUS} has at least one significant lagged effect in 68 cases. However, the earlier symmetric ARDL import model showed 69 significant cases. From the non-linear framework, we can conclude that the number of import industries affected by the volatility of the lira-dollar exchange rate remains roughly the same.

The long-run estimates of the NARDL import model in Table 7 show 67 industries where the third-economy effect captured by POS^{TRUS} or NEG^{TRUS} is significant. This volatility effect has a significant positive value in 49 import industries and a significant negative value in 43 import industries. The positively affected industries include the four

largest Turkish import industries with codes 541, 581, 711, and 729, which import about 20.6% of their products from Germany. In contrast, the two largest industries with codes 719 and 722, which together import about 17.6% of goods from Germany, are negatively affected by third-country risk in the long-run. In addition, the measure of third-country volatility mainly affected the small import industries in the long-run. However, the significant impact of third-country volatility was observed in 49 import industries for the linear modelling approach. We further explain the results of the third-country effect of volatility. For example, in the previous symmetric model, the estimated coefficient of the third-country effect was positive for the import industry coded 581 (plastic materials, regenerated cellulose & resins with an import share of 8.33%). However, our asymmetric analysis shows this result is primarily due to increased exchange rate uncertainty (POS^{TRUS}). Similarly, in the previous symmetric analysis, the coefficient of the third-country effect was positive for one of the largest import industries with code 541 (medical and pharmaceutical products with an import share of 4.24%). However, the asymmetric analysis shows that this result is primarily due to increased exchange rate volatility (POS^{TRUS}). The same results can be confirmed for other small import industries. Hence, we conclude that the effect of third-country volatility improves the estimation results of the import specification and affirms that it is a significant predictor of Turkey's import flows.

As for the other explanatory variables in the nonlinear import specification, we conclude that the dummy variable (*DM*) used to capture the impact of the 1984 trade liberalization reforms in Turkey has a significant negative effect in 70 cases. Moreover, improved Turkish economic activity (lnY_t^{TR}) favours German products in Turkey in 67 out of 93 significant cases, suggesting that Turkey will import more from Germany as its economy grows. In contrast, a significant negative estimated coefficient is associated with Turkish real income in 5 cases, indicating that as Turkey's economy grows, more import-substituting products are produced domestically, and imports decline over time. Finally, the long-run impact of the real bilateral exchange rate (*lnREX*) is positive (negative) in 40 (26) cases. The negative estimate of the real exchange rate confirms that the continuous depreciation of the Turkish lira against the euro hinders Turkish imports from Germany. Once again, cointegration is required to demonstrate the validity of the obtained long-run coefficient estimates. Table 8 shows that the ECM_{t-1} test is significant in all cases. In contrast, the *F*-test is not significant in 14 cases. Other diagnostic tests also support the long-run results. For example, the adjusted R^2 demonstrates the model's goodness in all functions. The *LM* test confirms that there is no autocorrelation in most cases. The Ramsey *RESET* test indicates that the proposed model is appropriately specified. Finally, the *CUSUM* and *CUSUMSQ* tests for all models support the short-run and long-run stability of the coefficients.

5. Summary and conclusion

Since all countries are interdependent in today's globalized world, trade flows between two trading partners can be affected by other countries' economic and trade policies. To capture the impact of the third-country effect, we followed Bahmani-Oskooee and Aftab (2018) and included the real lira-dollar exchange rate volatility. Thus, in addition to the real lira-euro exchange rate dynamics, we sought to capture the impact of lira-dollar exchange rate volatility on trade volumes between Turkey and Germany using commodity-level trade data. Previous empirical studies have shown that exchange rate volatility can positively and negatively affect trade, with higher volatility potentially impeding trade and lower volatility expanding it. However, recent research has shown that the impact of exchange rate volatility on trade can be asymmetric, i.e., an increase in volatility can affect trade flows differently than a decrease in volatility due to changes in traders' expectations, firms' pricing policies, and downward price rigidity.

This paper empirically examines the asymmetric effects of exchange rate uncertainty and the third-country effect on bilateral trade between Turkey and Germany. Based on annual time-series data spanning 1980–2022, we examined 79 export and 93 import industries trading between Turkey and Germany. Following the linear ARDL model developed by Pesaran, Shin, and Smith (2001), we observed significant short-run effects of the real lira-dollar volatility (third-country effect) in 70 Turkish industries exporting to Germany; however, the long-run effects persisted in 71 industries. In contrast, when we employed the linear ARDL import specification, we observed that real lira–dollar volatility had significant short-run effects in 69 cases, while these effects persisted in the long-run in 49 cases. The linear analysis of the third-country volatility effect showed that the short-run effects were short-lived, as they vanished over time in most industries. As traders in these industries hedge to escape exchange rate volatility over time (Bahmani-Oskooee, Usman, and Ullah, 2020), the hedging costs earned by exporters are passed on to importers in the form of higher commodity prices, which hurts commodity trade (Augustine C. Arize, Thomas Osang, and Daniel J. Slottje, 2000). In most industries, empirical research examining bilateral and third-country volatility (Bahmani-Oskooee and Kanitpong, 2019; Usman, Apergis, and Anwar, 2021) has found more significant effects in the short-run than in the long-run. In contrast, when we applied the NARDL specification developed by Shin, Yu, and Nimmo (2014), the number of industries affected by exports and imports changed. Based on empirical evidence, Cushman (1986) argued that exchange rate volatility might be overstated if the third-country effect is ignored. According to our analysis, the weak impact of exchange rate volatility after including external volatility risk could be due to the neglect of the asymmetry assumption. Based on short-run nonlinear analysis, the third-country effect of lira-dollar volatility was significant in most cases (i.e., for 61 Turkish exporting and 68 Turkish importing industries). These short-run asymmetric third-country volatility effects are even more substantial regarding significant long-term asymmetry effects.

Comparing the linear ARDL with the NARDL estimates, we found that they are industry-specific. For instance, the linear export model showed that the real lira–dollar volatility does not significantly affect Turkish exports to Germany for the largest Turkish export industry coded 841 (clothing except fur clothing with an 18.35% export share). If we had solely used the symmetric ARDL model, we would have concluded that real lira-dollar volatility has no long-run effect on Tukish exports to Germany in this industry. In contrast, the NARDL export specification showed that while an increase in volatility has a significant positive effect in this industry, a decrease in volatility has no long-term effect. This result is due to the nonlinear adjustment of the real lira–dollar volatility. Concerning Turkey's imports from Germany, the negative insignificant long-run estimate of the traditional ARDL model appeared to be linked solely to an increase in real lira–dollar volatility, not to the decrease in this volatility, as suggested by the nonlinear model estimates. Ultimately, we observed that an increase in real lira-dollar volatility appeared to increase Turkey's exports to and imports from Germany.

The empirical findings of the present study have important policy implications, particularly for traders who seek to manage their downside risks and capitalize on the return opportunities associated with trading activities. Specifically, the study results can aid potential investors and traders in export-oriented and import-substituting industries to make informed investments in sectors of the economy that benefit from exchange rate fluctuations when an economy chooses to float its exchange rate. Furthermore, including a third-country effect highlights the need for all market participants and stakeholders to recognize that changes in trade policy instruments in a third-country can significantly affect cross-border trade. Finally, incorporating asymmetric effects in the analysis yields more realistic results and provides policymakers clear evidence of traders' behaviour when volatility increases or decreases. The study recommends that policymakers prioritize export-oriented trade policies to boost foreign trade with other countries rather than engaging in short-term domestic currency manipulation. The main focus of economic policy should be on value addition to the existing production process to increase exports and meet the growing local demand for domestically produced goods. Similarly, import-substituting policies should prioritize the production of capital goods and luxury items. In addition, increased emphasis should be placed on improving the quality of domestically produced goods to enhance the competitiveness of local industries in the global market and contribute significantly to world trade, ultimately increasing citizens' economic well-being and long-term prosperity.

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Appendix A

A.1. Data definition and sources

This study examines the bilateral trade between Turkey and Germany by considering 79 export industries and 93 import industries. The sample is based on the SITC-1 (3-digit) level, and annual time-series data spanning 1980–2022 were used to conduct the empirical inquiry. The sources of data include the following:

A. World Integrated Trade Solution (WITS) of the World Bank (WB) [https://wits.worldbank.org/]
B. International Financial Statistics (IFS) of the International Monetary Fund (IMF) [https://data.imf.org/]
C. World Development Indicators (WDI) of the World Bank (WB) [https://databank.worldbank.org/source/world-development-indicators]
D. Organization for Economic Co-operation and Development (OECD) database [https://data.oecd.org/]

A.2. Variables

$\boldsymbol{XV_i}$ = Volume of exports of commodity *i* by Turkey to Germany. The nominal export value (in USD) for each exporting industry is obtained from Source A. In the absence of commodity prices, we followed Usman *et al.* (2021) and deflated nominal export values using the Turkish export unit value index (2015=100). We compiled data on the Turkish export unit value index from Source C.

$\boldsymbol{MV_i}$ = Volume of imports of commodity *i* by Turkey from Germany. The nominal import value (in USD) for each importing industry is obtained from Source A. In the absence of commodity prices, we followed Usman *et al.* (2021) and deflated the nominal import values using the Turkish import unit value index (2015=100). We compiled data on the Turkish import unit value index from Source C.

$\boldsymbol{Y^{TR}}$ = Measure of Turkey's real income. It is represented by Turkey's real GDP (constant 2015 US$). Data on Turkey's real GDP is obtained from Source C.

$\boldsymbol{Y^{GR}}$ = Measure of Germany's real income. It is represented by Germany's real GDP (constant 2015 US$). Data on Germany's real GDP is obtained from Source C.

$\boldsymbol{REX}$ = The real exchange rate between the Turkish lira and the euro. In the absence of readily available data for the lira-euro exchange rate, we calculated it using a cross-exchange rate against the USD using the following formula: $\left(\frac{Turkish\ Lira}{USD} * \frac{USD}{Euro}\right)$. The results of the cross-exchange rate show the nominal exchange rate (NEX) between the lira and the euro, which is then converted into the real exchange rate using the expression: $REX = \left(\frac{CPI^{GR} \times NEX}{CPI^{TR}}\right)$. Here, NEX = the nominal exchange rate (i.e., the number of lira per euro), CPI^{GR} = the price level in Germany (measured by CPI), and CPI^{TR} = the price level in Turkey (measured by CPI). Thus, the depreciation of the Turkish lira can be attributed to an increase in the exchange rate. The euro/dollar exchange rate was calculated before 1999 by applying the conversion rate of 1.95583 Deutsche Mark = 1 euro. Data for all nominal exchange rates are taken from Source B, except for the nominal euro/dollar exchange rate, which is taken from Source D. Similarly, data on consumer price indices are collected from Source B.

$\boldsymbol{VOL^{TRUS}}$= Volatility measure of the real bilateral exchange rate between the Turkish lira and the USD (REX), which is constructed as $REX^{TRUS} = \left(\frac{CPI^{US} \times NEX^{TRUS}}{CPI^{TR}}\right)$. In this expression, NEX^{TRUS} = the nominal exchange rate (i.e., the number of lira/USD), CPI^{US} = the price level in the United States (measured by CPI), and CPI^{TR} = the price level in Turkey (measured by CPI). Following Bahmani-Oskooee and Aftab (2017), the measure of volatility is obtained using the GARCH (1, 1) approach.

Appendix B

Table 1 Long-run coefficient estimates of the linear ARDL export model (5)

There are at Least One Short-Run Coefficient Significant						Long-run Coefficient Estimates		
SITC	lnY^{GR}	lnREX	$lnVOL^{TRUS}$	Constant	DM	lnY^{GR}	lnREX	$lnVOL^{TRUS}$
031	Yes	Yes	Yes	-3.01**	1.03**	3.91**	1.04**	-11.85**
032	No	No	No	4.66	0.03**	-2.33**	0.05	67.31
046	Yes	Yes	No	22.65	1.36**	0.59	2.76**	-38.29
047	Yes	Yes	Yes	4.63**	1.27*	3.62**	2.25**	-7.56*
048	Yes	Yes	Yes	6.36	0.16	0.63**	3.22	1.09**
051	Yes	Yes	Yes	11.56*	0.05	1.18**	1.15**	-1.20*
052	No	No	Yes	8.90**	0.10**	-0.11	3.09*	1.32**
053	Yes	No	Yes	3.55**	0.43**	0.84**	2.35**	2.43**
054	Yes	Yes	Yes	5.36**	0.38**	1.53	3.22	1.33**
055	Yes	Yes	Yes	13.99	0.12	1.37**	1.34**	5.33**
061	Yes	Yes	Yes	14.54**	0.34*	2.83**	0.84**	-11.49
062	Yes	Yes	Yes	-34.21	0.12**	1.39**	1.22**	3.20**
073	Yes	Yes	Yes	-6.33**	0.23	1.21**	11.32	1.47**
074	Yes	No	Yes	-24.53	-1.33**	-1.34	-3.22	1.45**
075	Yes	Yes	Yes	5.60**	-2.46**	-2.69	-4.49	1.32**
099	No	Yes	Yes	6.55**	0.36**	4.67	1.23**	1.70**
112	No	Yes	No	-54.32	3.45**	1.33**	1.26*	0.46**
121	Yes	Yes	Yes	14.64	0.44	2.57**	-1.22**	-3.52
221	Yes	Yes	Yes	64.66	0.40	2.34*	1.22**	-1.34
263	Yes	Yes	Yes	-9.65**	-0.49**	1.64**	-3.54	2.79**
266	Yes	Yes	Yes	-32.93	-0.84	1.70*	-2.64	1.30**
273	Yes	Yes	Yes	17.00	0.62	-8.35	-3.42**	1.32**
276	Yes	Yes	Yes	-9.54	3.45**	-1.00	1.28**	0.25*
283	Yes	Yes	Yes	1.66**	1.83**	-1.70**	-9.58	0.39**
292	Yes	No	Yes	6.46**	0.23	5.35	1.46**	0.23**
421	Yes	Yes	Yes	-5.19**	3.79**	2.39**	1.56**	2.02
422	Yes	Yes	Yes	-64.60	1.93**	0.66	-3.43	1.23**
512	Yes	Yes	Yes	12.28**	0.82	1.41**	-0.32	0.56**
513	Yes	No	Yes	3.46*	0.06	-3.55	1.13**	1.07**
514	Yes	Yes	Yes	14.75**	-1.32**	-2.83	-3.86	1.35*
541	Yes	Yes	Yes	5.64	4.63**	-1.79**	-2.40**	0.22*
551	Yes	No	Yes	10.44**	0.27	1.34**	2.00**	0.09**

553	Yes	Yes	Yes	-0.32	-3.22**	-3.55	1.94*	3.22**
554	Yes	Yes	Yes	35.22**	0.82	-2.21	-6.33	1.86**
581	Yes	Yes	Yes	4.64**	0.80	5.67	-1.45**	0.94**
599	Yes	Yes	No	-0.45	0.89	-1.47**	-0.34	3.53**
621	Yes	Yes	Yes	34.33	0.33	-2.42**	-1.33	4.56**
632	Yes	No	Yes	4.22**	-2.46**	1.65**	0.13**	3.04**
651	Yes	No	Yes	6.76	2.19**	2.73**	4.36	-3.32**
652	Yes	Yes	Yes	9.80**	2.73**	3.59**	2.08*	-0.45**
653	Yes	Yes	Yes	-10.01**	0.35**	-11.33**	4.22	2.48**
654	Yes	Yes	Yes	0.81	1.33**	3.11**	9.44	-2.44
656	Yes	Yes	Yes	4.66	0.88**	-0.78	-10.01	1.34**
657	Yes	Yes	Yes	4.33*	0.19	10.33	-9.33	3.54**
661	Yes	Yes	Yes	-5.38**	1.66**	-1.11	-1.43**	3.53
662	Yes	Yes	Yes	5.66**	2.54**	2.84**	-9.88	0.51**
663	Yes	Yes	Yes	-23.68*	1.50**	1.99**	2.11**	2.46**
664	No	No	Yes	16.35**	0.59*	-7.44	1.90**	0.43**
665	Yes	Yes	Yes	-23.12	0.45*	-4.35**	-2.43	0.33**
666	Yes	Yes	Yes	12.12*	0.84	3.36	-3.48	4.25**
672	Yes	Yes	Yes	5.33	3.59**	-1.85	2.45	1.48**
673	Yes	Yes	Yes	5.45*	0.45**	3.22**	1.43**	2.19**
678	Yes	No	No	-2.45**	0.30**	2.33**	1.49	2.42**
684	Yes	Yes	Yes	3.24	0.85	5.09**	-3.43	0.45*
691	Yes	No	Yes	-0.54**	0.89	-0.49**	-2.56	0.34**
695	Yes	Yes	Yes	-7.44**	0.68	4.44**	1.33	3.84**
696	Yes	Yes	No	2.54**	0.34**	0.74**	5.34	1.33**
697	Yes	No	No	12.74	0.96*	1.34**	3.09*	-1.22*
698	Yes	Yes	Yes	1.02**	0.60*	1.09**	1.34	0.95**
711	Yes	Yes	Yes	-4.34**	1.22**	1.32**	2.54	1.31**
715	Yes	Yes	Yes	10.06**	0.23**	-1.45	-1.30**	0.38*
717	No	Yes	Yes	-2.43**	0.55**	0.79**	3.33**	0.46*
718	Yes	Yes	Yes	3.55**	0.48*	-4.63	0.56	2.18**
719	Yes	Yes	Yes	-12.49	0.83**	-0.27**	0.43	6.43**
722	Yes	Yes	Yes	3.33**	-0.34*	3.43**	0.22	-3.55**
723	No	Yes	Yes	12.47	-2.11**	1.56	3.44	1.34**
724	Yes	Yes	No	-4.55**	0.36*	1.36**	-2.53	2.34*
725	Yes	Yes	Yes	6.89	0.64**	-1.53*	0.20**	0.45*
729	Yes	Yes	Yes	2.94**	0.34**	1.75**	1.54**	-1.34**

732	Yes	Yes	Yes	3.55**	0.21**	-1.66**	-4.35	4.33**
812	Yes	Yes	Yes	2.77**	3.32**	4.04**	-2.44	2.03**
821	Yes	Yes	Yes	-10.01**	1.02**	2.57**	11.43	2.33*
831	No	Yes	Yes	-3.66**	0.28	-0.07*	-4.35**	5.33*
841	No	Yes	Yes	-10.70**	1.24**	4.53	1.56**	0.01*
842	No	Yes	Yes	-5.77**	0.44	-2.43	7.81	-20.02
851	No	Yes	Yes	6.36	0.40	-1.50	0.34**	2.35**
861	No	Yes	Yes	6.39	-0.50**	-0.53	0.23	3.54**
891	Yes	Yes	Yes	11.48	0.62**	2.03**	-0.01	-4.08*
894	Yes	No	No	-7.34**	2.00**	1.10**	1.09*	3.49**

Notes: '*' and '**' indicate significance at the 10% and 5% levels, respectively.

Table 2 Diagnostics associated with estimates of the linear ARDL export model (5)

SITC	Industry Name	Export Share	F-test	ECM_{t-1}	Adj. R^2	LM	RESET	CUSUM	CUSUMSQ
031	Fish, fresh & simply preserved	0.36%	5.98**	-0.37(5.13)**	0.96	0.98	0.12	S	S
032	Fish, in airtight containers, n.e.s & fish preparations.	0.01%	5.12**	-0.54(4.73)**	0.79	0.75	0.30	S	US
046	Meal and flour of wheat or of meslin	0.00%	5.82**	-0.52(5.05)**	0.77	0.19	0.26	S	S
047	Meal & flour of cereals, except wheat/meslin	0.00%	7.72**	-0.94(7.83)**	0.97	0.21	0.64	S	S
048	Cereal preps & preps of flour of fruits & vegs.	0.25%	5.41**	-0.63(6.34)**	0.98	0.86	0.38	S	S
051	Fruit, fresh, and nuts excl. Oil nuts	2.16%	7.76**	-0.72(7.44)**	0.78	0.82	0.43	S	S
052	Dried fruit including artificially dehydrated	0.54%	8.65**	-0.85(8.14)**	0.99	0.26	0.77	S	S
053	Fruit, preserved and fruit preparations	0.63%	4.92**	-0.69(5.82)**	0.93	0.40	0.07*	S	US
054	Vegetables, roots & tubers, fresh or dried	0.57%	5.82**	-0.61(6.64)**	0.95	0.14	0.42	S	S
055	Vegetables, roots & tubers pres or prepared n.e.s.	0.08%	12.35**	-0.75(9.46)**	0.92	0.17	0.33	S	S
061	Sugar and honey	0.03%	5.90**	-0.90(6.56)**	0.89	0.45	0.95	S	S
062	Sugar confectionery, sugar preps. Ex chocolate confectionery	0.13%	7.33**	-0.63(5.28)**	0.97	0.62	0.14	S	US
073	Chocolate & other food preptns. cont. Cocoa, n.e.s.	0.13%	6.35**	-0.57(6.78)**	0.94	0.86	0.86	S	US
074	Tea and mate	0.01%	8.16**	-0.63(7.66)**	0.90	0.82	0.04**	US	US
075	Spices	0.06%	4.99**	-0.80(5.87)**	0.97	0.79	0.20	S	S

099	Food preparations, n.e.s.	2.25%	6.45**	-0.59(6.75)**	0.97	0.68	0.58	S	US
112	Alcoholic beverages	0.10%	5.84**	-0.74(4.58)**	0.97	0.80	0.99	S	S
121	Tobacco, unmanufactured	0.02%	9.06**	-0.66(8.33)**	0.79	0.45	0.83	S	S
221	Oil seeds, oil nuts and oil kernels	0.08%	6.78**	-0.85(7.04)**	0.89	0.23	0.58	S	S
263	Cotton	0.26%	4.95**	-0.83(5.80)**	0.83	0.01**	0.36	S	S
266	Synthetic and regenerated artificial fibres	0.22%	5.57**	-0.73(4.44)**	0.88	0.77	0.71	S	S
273	Stone, sand and gravel	0.08%	7.81**	-0.92(7.62)**	0.91	0.42	0.35	S	US
276	Other crude minerals	0.20%	4.94**	-0.66(5.50)**	0.87	0.32	0.42	S	US
283	Ores & concentrates of non ferrous base metals	0.24%	11.58**	-0.57(9.32)**	0.79	0.09*	0.20	S	S
292	Crude vegetable materials, n.e.s.	0.09%	5.96**	-0.67(5.92)**	0.93	0.39	0.18	S	S
421	Fixed vegetable oils, soft	0.04%	6.72**	-0.62(6.88)**	0.88	0.60	0.21	S	S
422	Other fixed vegetable oils	0.00%	8.01**	-0.72(7.75)**	0.76	0.19	0.98	S	S
512	Organic chemicals	0.20%	6.07**	-0.78(6.66)**	0.87	0.61	0.18	S	S
513	Inorg. chemicals elems., oxides, halogen salts	0.05%	4.98**	-0.97(4.89)**	0.83	0.24	0.15	US	S
514	Other inorganic chemicals	0.06%	6.68**	-0.70(4.86)**	0.89	0.12	0.70	S	US
541	Medicinal & pharmaceutical products	0.06%	5.52**	-0.66(6.43)**	0.96	0.08*	0.21	S	S
551	Essential oils, perfume and flavour materials	0.05%	5.46**	-0.62(6.06)**	0.98	0.13	0.45	S	US
553	Perfumery, cosmetics, dentifrices, etc.	0.24%	11.88**	-0.89(9.40)**	0.95	0.30	0.36	S	S
554	Soaps, cleansing & polishing preparations	0.08%	5.02**	-0.74(5.70)**	0.98	0.09*	0.08*	S	US
581	Plastic materials, regenerd. cellulose & resins	3.78%	6.14**	-0.75(7.01)**	0.93	0.40	0.15	S	S
599	Chemical materials and products, n.e.s.	0.38%	6.94**	-0.76(7.22)**	0.89	0.82	0.77	US	S
621	Materials of rubber	0.65%	10.17**	-0.69(8.69)**	0.98	0.13	0.07*	S	US
632	Wood manufactures, n.e.s.	0.12%	8.82**	-0.78(5.89)**	0.96	0.93	0.42	S	S
651	Textile yarn and thread	0.54%	4.59*	-0.65(5.25)**	0.89	0.01**	0.40	S	S
652	Cotton fabrics, woven ex. narrow or spec. Fabrics	0.23%	6.73**	-0.72(7.04)**	0.96	0.17	0.28	S	S
653	Text fabrics woven ex narrow, spec, not cotton	0.59%	19.28**	-0.64(9.03)**	0.98	0.20	0.43	S	S
654	Tulle, lace, embroidery, ribbons, trimmings	0.07%	9.57**	-0.77(8.43)**	0.95	0.18	0.35	S	S
656	Made up articles, wholly or chiefly of text.mat.	0.51%	10.53**	-0.76(8.84)**	0.94	0.19	0.58	S	US

657	Floor coverings, tapestries, etc.	0.62%	7.07**	-0.78(9.32)**	0.92	0.92	0.54	S	S
661	Lime, cement & fabr. bldg.mat. Ex glass/clay mat	0.24%	7.25**	-0.75(7.28)**	0.97	0.37	0.64	S	S
662	Clay and refractory construction materials	0.74%	13.84**	-0.86(9.19)**	0.97	0.15	0.31	S	S
663	Mineral manufactures, n.e.s.	0.15%	8.58**	-0.66(8.16)**	0.89	0.52	0.36	S	S
664	Glass	0.33%	6.92**	-0.72(7.20)**	0.99	0.15	0.22	S	S
665	Glassware	0.16%	6.20**	-0.80(6.82)**	0.92	0.55	0.96	US	S
666	Pottery	0.10%	7.38**	-0.85(7.52)**	0.96	0.22	0.35	S	S
672	Ingots & other primary forms of iron or steel	0.43%	8.07**	-0.81(7.68)**	0.84	0.09*	0.53	S	S
673	Iron and steel bars, rods, angles, shapes, sections	0.65%	7.98**	-0.85(5.98)**	0.81	0.64	0.13	S	S
678	Tubes, pipes and fittings of iron or steel	0.56%	9.20**	-0.84(8.31)**	0.93	0.25	0.33	US	US
684	Aluminium	4.39%	5.82**	-0.68(6.77)**	0.99	0.17	0.40	US	US
691	Finished structural parts and structures, n.e.s	1.00%	13.67**	-0.92(8.18)**	0.98	0.17	0.35	S	US
695	Tools for use in the hand or in machines	0.31%	5.99**	-0.59(6.92)**	0.98	0.20	0.41	S	S
696	Cutlery	0.02%	11.86**	-0.95(9.48)**	0.96	0.17	0.24	S	S
697	Household equipment of base metals	0.57%	11.19**	-0.67(9.26)**	0.83	0.50	0.31	S	S
698	Manufactures of metal, n.e.s.	2.62%	16.86**	-0.78(8.29)**	0.99	0.61	0.15	S	S
711	Power generating machinery, other than electric	4.64%	14.01**	-0.81(5.46)**	0.99	0.13	0.42	S	S
715	Metalworking machinery	0.30%	7.90**	-0.68(7.74)**	0.97	0.28	0.33	S	S
717	Textile and leather machinery	0.89%	14.69**	-0.77(7.61)**	0.96	0.24	0.22	S	S
718	Machines for special industries	0.28%	6.42**	-0.58(4.99)**	0.97	0.86	0.30	S	S
719	Machinery and appliances non electrical parts	7.16%	7.32**	-0.94(7.45)**	0.99	0.65	0.52	S	S
722	Electric power machinery and switchgear	2.02%	11.61**	-0.73(9.21)**	0.99	0.93	0.39	S	S
723	Equipment for distributing electricity	1.73%	7.70**	-0.69(8.04)**	0.97	0.36	0.19	S	US
724	Telecommunications apparatus	0.01%	10.04**	-0.79(9.26)**	0.98	0.87	0.25	S	S
725	Domestic electrical equipment	0.79%	15.51**	-0.66(9.60)**	0.99	0.30	0.68	S	US
729	Other electrical machinery and apparatus	0.75%	9.75**	-0.78(7.81)**	0.97	0.35	0.43	S	S
732	Road motor vehicles	14.56%	6.89**	-0.67(5.26)**	0.99	0.41	0.68	S	S
812	Sanitary, plumbing, heating & lighting fixtures	0.89%	5.85**	-0.69(7.21)**	0.82	0.30	0.38	S	S
821	Furniture	2.20%	9.03**	-0.86(5.89)**	0.99	0.52	0.57	S	S

831	Travel goods, handbags and similar articles	0.02%	10.46**	-0.68(8.78)**	0.91	0.09*	0.19	S	US
841	Clothing except fur clothing	18.35%	9.67**	-0.78(9.85)**	0.99	0.69	0.46	S	S
842	Fur clothing and articles of artificial fur	0.03%	6.94**	-0.86(7.97)**	0.85	0.11	0.12	S	S
851	Footwear	0.43%	10.63**	-0.58(8.65)**	0.93	0.86	0.04**	US	US
861	Scientific, medical, optical, meas./contr. İnstruments	0.01%	16.56**	-0.87(8.51)**	0.97	0.22	0.74	S	S
891	Musical instruments, sound recorders and parts	0.01%	17.03**	-0.77(5.37)**	0.91	0.64	0.06*	S	US
894	Perambulators, toys, games and sporting goods	0.05%	10.32**	-0.84(6.32)**	0.93	0.24	0.73	S	S

Notes: '*' ('**') indicates significance at the 10% (5%) levels. At the 10% (5%) significance level when *k=3*, the upper bound critical value of the F-test is 4.020 (4.803). These critical values for the bounds test come from Narayan (2005, Case III, page 1988). Number inside the parenthesis next to ECM_{t-1} is the absolute value of the *t*-statistic. Its critical value at the 10% (5%) significance level is -3.45 (-3.82) when *k=3*. These critical values of the *t*-statistic for the *ECM* test come from Banarjee *et al.* (1998, Table 1, Case A, page 276). *LM* is the Langrange Multiplier test of residual serial correlation, and *RESET* is Ramsey's test for functional misspecification. *LM* and *RESET* tests are distributed as χ^2 with one degree of freedom. The critical values of these diagnostics are 2.70 (3.84) at the 10% (5%) significance level, respectively. *CUSUM* and *CUSUMSQ* are recursive estimates used to test the stability of all estimated coefficients. Each industry export share is calculated as a percentage of Turkey's total exports to Germany over the sample period. This export share value is based on 2022.
n.e.s refers to not elsewhere defined.

Table 3 Long-run coefficient estimates of the linear ARDL import model (6)

There are at Least One Short-Run Coefficient Significant				Long-run Coefficient Estimates				
SITC	lnY^{TR}	lnREX	$lnVOL^{TRUS}$	Constant	DM	lnY^{TR}	lnREX	$lnVOL^{TRUS}$
001	No	Yes	Yes	-12.01**	0.18	2.01*	-0.43**	-2.34*
054	No	Yes	Yes	-8.32*	-0.33**	0.11*	-0.88**	-2.33**
061	Yes	Yes	Yes	-4.22**	-0.45**	0.35*	-1.39**	-9.66
071	Yes	Yes	Yes	-1.46	-1.44**	2.42**	-0.47**	-3.22**
072	Yes	No	Yes	-4.67**	-2.93**	4.25*	1.11**	-1.78*
081	Yes	Yes	Yes	-9.55*	-0.34**	2.45*	2.35**	-6.36
231	Yes	Yes	Yes	4.11*	-0.25**	0.45**	-0.34**	4.29**
251	Yes	No	Yes	-7.45*	-0.78*	7.32**	-0.23**	-3.39**
266	Yes	Yes	Yes	11.22*	-0.38**	3.45**	0.94**	2.34**
276	Yes	Yes	Yes	-36.56	-1.37**	1.25	-0.67**	1.56
282	Yes	Yes	Yes	13.00**	0.45	23.24	-2.30**	-4.56**
284	Yes	No	No	9.03**	-1.34**	2.79	-1.57**	9.62
291	Yes	Yes	Yes	-2.44**	-0.74**	6.36	11.40	-1.45**
292	Yes	Yes	Yes	12.56**	-2.84**	0.87**	-5.29**	2.56**

332	No	Yes	Yes	-10.49**	-8.74**	4.64**	-9.32	-3.49**
422	No	No	Yes	-11.33**	-4.38**	12.56	-6.38	0.00
431	Yes	No	Yes	-43.02**	-4.83**	1.24**	-10.03	-0.99**
512	Yes	No	Yes	-23.55	-3.06**	3.80**	-0.78**	1.29**
513	Yes	No	Yes	-25.90**	-0.34**	23.22	-1.69**	-3.55
521	Yes	Yes	No	-2.44**	-0.93**	4.46	-1.40**	-6.77
531	Yes	Yes	Yes	2.46	-0.14**	6.46*	-3.05**	-5.35**
532	Yes	Yes	No	-4.66*	-0.38**	10.01*	-6.33**	-9.85
533	Yes	No	Yes	-3.45**	-1.45**	2.35*	-20.22	3.37**
541	Yes	No	Yes	3.24*	-1.30*	4.75*	-2.44**	3.29**
551	Yes	Yes	Yes	-63.42	-0.38**	3.28*	-0.44**	-1.41**
554	Yes	Yes	Yes	13.57**	-0.51*	12.55	-3.49**	-3.56**
561	Yes	Yes	No	2.56**	-0.23**	20.21	-0.89**	-6.39
571	No	Yes	Yes	-43.67**	-0.52**	9.43	3.21*	-5.36
581	No	Yes	Yes	35.35**	-2.59**	2.42*	-0.43*	1.36*
599	Yes	Yes	Yes	-42.44**	-2.83**	4.24	-2.03**	1.49*
621	Yes	No	Yes	-3.25**	-0.33**	2.64	11.22	-3.22
631	Yes	Yes	No	13.67**	-2.90**	1.75	-4.23**	-3.56*
632	Yes	Yes	Yes	25.33**	-2.45**	9.66	-2.42*	-4.34
642	Yes	Yes	No	9.36*	-1.34**	3.24*	3.49**	3.55
651	Yes	Yes	Yes	-32.45**	-6.83**	23.45	-2.45**	-3.56**
654	No	Yes	No	34.00	-3.99**	6.36	-3.45**	-3.53**
655	Yes	No	Yes	-7.35**	-4.82**	-8.56	1.67**	-1.35**
662	Yes	Yes	No	3.66**	-7.37**	11.42	-3.40*	-12.34
663	Yes	Yes	Yes	-7.33**	-0.84*	2.423*	-9.93**	-1.43**
664	Yes	Yes	Yes	2.56**	-0.47*	4.33*	-4.38**	-2.44**
665	Yes	No	Yes	67.34	-0.73*	-10.34	-2.49**	-5.33**
671	No	No	Yes	-7.77**	0.34	1.34	-10.07	-3.22**
672	Yes	Yes	Yes	2.33*	0.69	4.44**	-3.29*	-1.47**
673	Yes	Yes	Yes	5.33**	1.69	8.57	12.02	-8.54
674	Yes	No	No	4.26**	0.48	-4.50	-3.22**	-6.43
676	Yes	Yes	Yes	2.44	0.22	3.24**	-8.78	-3.23
677	No	Yes	No	-4.35	0.19	6.45	-2.23*	-2.35**
678	Yes	Yes	Yes	5.35**	0.39	7.34	-3.05*	-2.44*
679	No	Yes	Yes	23.22**	-3.28**	2.43**	-4.44*	-6.36
681	Yes	Yes	Yes	-44.25**	-2.98**	7.35	-9.87	-8.35
682	Yes	Yes	Yes	36.33	0.04	1.78*	-4.25*	2.45*

683	Yes	Yes	Yes	4.58**	3.85	2.44*	3.48*	1.56*
684	Yes	Yes	Yes	-3.25*	-2.84**	4.67	-1.59**	-4.66
686	No	No	No	4.55**	-3.33**	-9.46	-4.24	-7.35
687	Yes	Yes	No	-0.45**	-4.92**	-7.89	-4.33**	-9.34
689	No	Yes	Yes	-3.45**	-3.01**	4.20**	-7.38	-3.41*
691	Yes	Yes	Yes	-12.33**	-0.34**	3.25**	-2.04*	-1.75*
692	No	Yes	No	-6.67**	-4.88**	-4.35	-5.98	-3.31**
693	Yes	Yes	Yes	3.44**	-0.43*	-4.44	3.09**	-4.24
694	Yes	No	Yes	-10.90*	0.34	3.26*	1.23**	1.43**
695	Yes	Yes	Yes	4.35**	3.76	5.34**	-2.94**	3.21
696	Yes	Yes	No	-11.11	6.82	3.55**	-1.32**	3.22
697	Yes	Yes	Yes	5.33**	5.32	3.55**	-2.23**	-7.45
698	Yes	Yes	Yes	9.35**	-0.26	42.38	-1.44**	-6.34
711	Yes	Yes	Yes	-3.55**	3.95	9.34**	-3.42**	-4.67
712	Yes	Yes	Yes	-11.40**	3.58	-4.49	1.90**	1.44**
714	Yes	Yes	Yes	-6.33*	-0.55**	-22.22	-2.45**	-2.33*
715	Yes	No	Yes	-5.39*	-0.47**	13.01*	1.94**	0.64**
717	Yes	No	Yes	35.22	-2.44**	6.38	-0.87**	-0.94**
718	Yes	No	No	-3.43**	3.58	12.22**	-8.57	0.34
719	Yes	Yes	No	-20.54*	3.57*	4.23**	-2.47**	-2.56**
722	Yes	Yes	Yes	-20.33*	0.82*	3.29**	-1.12**	-3.54**
723	Yes	Yes	Yes	3.44**	0.23	9.03	-4.43**	-6.46
724	Yes	No	Yes	6.35*	1.44**	4.49*	-3.44**	-5.34
725	Yes	Yes	Yes	-10.43*	0.34	10.20	-14.33	-6.35
726	Yes	Yes	Yes	-48.45	2.58	3.49*	-9.55	3.22*
729	Yes	Yes	No	6.35**	11.30**	-9.99	-6.47	-6.98
731	Yes	Yes	Yes	2.44*	5.74*	4.55	-1.30**	3.55
732	Yes	Yes	Yes	-0.45*	3.92**	-24.22	-4.33	-3.04**
734	Yes	Yes	Yes	-12.03*	-0.44**	7.48**	1.44**	-2.73**
735	Yes	Yes	Yes	53.22	0.34**	4.22**	-20.01	1.47**
812	No	Yes	Yes	7.57**	-0.48**	2.44**	-2.34**	6.78
821	Yes	Yes	Yes	2.45**	-0.33**	3.24	-1.45**	-1.30**
841	Yes	Yes	Yes	-4.44**	0.24	2.44**	-0.65**	6.74
861	Yes	Yes	Yes	-5.35**	5.82	2.33**	-3.24	5.35
862	Yes	No	Yes	42.10*	5.39	12.34	-1.34**	-6.74
864	Yes	Yes	No	-9.49**	1.59	5.93	-2.04*	-1.44
891	Yes	Yes	No	3.24**	5.30	1.34**	2.89**	-2.77

892	Yes	Yes	Yes	-2.46**	4.44	2.44	-3.51*	-6.40
894	No	Yes	Yes	-3.66**	-3.33**	1.03*	-3.43**	-3.23**
895	Yes	Yes	Yes	-0.56**	2.85	2.29**	-2.61*	-3.56
897	Yes	Yes	No	2.56**	4.99	4.22	-2.68**	2.56
899	Yes	Yes	Yes	13.45*	3.96	1.07**	-1.33*	-2.56**

Notes: '*' and '**' indicate significance at the 10% and 5% levels, respectively.

Table 4 Diagnostics associated with estimates of the linear ARDL import model (6)

SITC	Industry Name	Import Share	F-test	ECM_{t-1}	Adj. R^2	LM	RESET	CUSUM	CUSUMSQ
001	Live animals	0.05%	5.43**	-0.83(5.24)**	0.72	0.90	0.12	S	S
054	Vegetables, roots & tubers, fresh or dried	0.01%	6.04**	-0.91(6.34) **	0.87	0.65	0.31	S	S
061	Sugar and honey	0.03%	7.45**	-0.84(6.99) **	0.95	0.27	0.11	S	S
071	Coffee	0.04%	5.54**	-0.87(5.65) **	0.78	0.40	0.12	S	S
072	Cocoa	0.09%	7.12**	-0.68(7.22) **	0.93	0.31	0.23	S	US
081	Feed. Stuff for animals excl. unmilled cereals	0.11%	6.33**	-0.82(6.64) **	0.84	0.19	0.24	S	US
231	Crude rubber incl. synthetic & reclaimed	0.06%	12.44**	-0.47(5.69) **	0.87	0.48	0.12	S	S
251	Pulp & waste paper	0.08%	4.45*	-0.86(5.56) **	0.76	0.12	0.26	US	S
266	Synthetic and regenerated artificial fibers	0.22%	7.74**	-0.92(7.46) **	0.96	0.89	0.13	S	S
276	Other crude minerals	0.09%	10.19**	-0.85(8.91) **	0.63	0.18	0.34	US	S
282	Iron and steel scrap	1.29%	8.83**	-0.95(8.34) **	0.85	0.06*	0.14	S	S
284	Non-ferrous metal scrap	0.11%	15.73**	-0.57(7.09) **	0.88	0.56	0.85	S	S
291	Crude animal materials, n.e.s.	0.01%	4.03*	-0.75(5.51) **	0.93	0.09*	0.43	S	US
292	Crude vegetable materials, n.e.s.	0.11%	5.90**	-0.69(5.58) **	0.83	0.21	0.92	S	S
332	Petroleum products	0.51%	5.15**	-0.65(6.05) **	0.79	0.57	0.12	S	S
422	Other fixed vegetable oils	0.02%	4.63*	-0.64(5.30) **	0.69	0.07*	0.04**	US	S
431	Anim./veg. Oils & fats, processed, and waxes	0.04%	5.40**	-0.77(6.18) **	0.59	0.92	0.19	S	S
512	Organic chemicals	2.35%	7.04**	-0.49(4.31) **	0.84	0.13	0.08*	US	S
513	Inorg. chemicals elems., oxides, halogen salts	0.48%	4.57*	0.50(6.04) **	0.78	0.50	0.07*	S	S
521	Crude chemicals from coal, petroleum and gas	0.02%	6.70**	-0.69(7.17) **	0.97	0.34	0.11	S	S
531	Synth. organic dyestuffs, natural indigo & lakes	0.21%	12.53**	-0.52(17.33) **	0.93	0.17	0.46	US	S

532	Dyeing & tanning extracts, synth. tanning mat.	0.02%	5.96**	-0.67(6.96) **	0.75	0.51	0.12	S	S
533	Pigments, paints, varnishes & related materials	1.37%	7.75**	-0.91(7.32) **	0.94	0.54	0.16	S	US
541	Medicinal & pharmaceutical products	4.24%	6.97**	-0.59(4.15) **	0.95	0.09*	0.45	S	US
551	Essential oils, perfume and flavour materials	0.34%	4.64*	-0.62(5.59) **	0.93	0.65	0.70	S	US
554	Soaps, cleansing & polishing preparations	0.55%	9.93**	-0.56(4.39) **	0.87	0.96	0.90	S	S
561	Fertilizers manufactured	0.05%	15.69**	-0.77(10.53) **	0.96	0.27	0.13	S	S
571	Explosives and pyrotechnic products	0.02%	6.92**	-0.88(5.11) **	0.87	0.66	0.04**	S	S
581	Plastic materials, regenerd. cellulose & resins	8.33%	4.67*	-0.47(5.98) **	0.91	0.01**	0.30	S	US
599	Chemical materials and products, n.e.s.	2.98%	6.70**	-0.99(7.26) **	0.82	0.67	0.25	S	US
621	Materials of rubber	0.46%	5.83**	-0.55(5.47) **	0.79	0.48	0.72	S	S
631	Veneers, plywood boards & other wood, worked, n.e.s.	0.02%	11.02**	-0.68(5.26) **	0.73	0.62	0.57	S	S
632	Wood manufactures, n.e.s.	0.06%	10.04**	-0.95(4.95) **	0.79	0.33	0.98	S	S
642	Articles of paper, pulp, paperboard	0.13%	4.93**	-0.73(4.81) **	0.86	0.32	0.74	S	US
651	Textile yarn and thread	0.20%	5.39**	-0.45(6.32)**	0.93	0.85	0.23	S	S
654	Tulle, lace, embroidery, ribbons, trimmings	0.04%	4.73*	-0.79(5.90) **	0.81	0.41	0.60	S	US
655	Special textile fabrics and related products	0.51%	6.69**	-0.57(7.12) **	0.85	0.47	0.46	US	S
662	Clay and refractory construction materials	0.23%	4.88**	-0.60(5.89) **	0.88	0.52	0.17	S	S
663	Mineral manufactures, n.e.s.	0.41%	5.29**	-0.76(5.34) **	0.95	0.34	0.23	S	S
664	Glass	0.36%	6.69**	-0.84(6.99) **	0.97	0.69	0.87	S	US
665	Glassware	0.06%	5.29**	-0.67(6.19) **	0.79	0.43	0.21	S	S
671	Pig iron, spiegeleisen, sponge iron etc.	0.12%	6.94**	-0.78(7.09) **	0.82	0.09**	0.43	S	S
672	Ingots & other primary forms of iron or steel	0.82%	7.33**	-0.95(4.51) **	0.76	0.50	0.45	S	US
673	Iron and steel bars, rods, angles, shapes, sections	0.91%	7.31**	-0.88(7.34) **	0.87	0.03	0.11	S	S
674	Universals, plates and sheets of iron or steel	1.28%	9.37**	-0.64(5.37) **	0.82	0.34	0.17	S	S
676	Rails & rlwy track constr mat. Of iron or steel	0.02%	7.11**	-0.94(7.88) **	0.75	0.26	0.12	S	S

677	Iron and steel wire, excluding wire rod	0.08%	17.74**	-0.89(11.43) **	0.80	0.16	0.56	S	US
678	Tubes, pipes and fittings of iron or steel	0.55%	7.20**	-0.89(7.23) **	0.91	0.61	0.45	S	S
679	Iron steel castings forgings unworked, n.e.s.	0.02%	18.53**	-0.72(12.97) **	0.94	0.19	0.73	S	S
681	Silver and platinum group metals	0.04%	5.75**	0.76(6.64) **	0.83	0.46	0.09*	S	US
682	Copper	0.51%	6.11**	0.65(6.70) **	0.92	0.33	0.35	US	US
683	Nickel	0.04%	5.92**	-0.67(4.83) **	0.85	0.57	0.17	S	S
684	Aluminium	0.74%	5.81**	-0.71(6.43) **	0.86	0.44	0.22	S	S
686	Zinc	0.02%	5.69**	-0.61(3.22) **	0.60	0.07*	0.54	US	S
687	Tin	0.01%	13.67**	-0.94(10.37) **	0.92	0.68	0.09*	S	S
689	Miscellaneous nonferrous base metals	0.01%	18.83**	-0.82(12.29) **	0.68	0.21	0.43	S	US
691	Finished structural parts and structures, n.e.s	0.26%	5.94**	-0.76(6.73) **	0.76	0.52	0.07*	S	S
692	Metal containers for storage and transport	0.10%	5.99**	-0.98(7.35) **	0.62	0.83	0.44	S	US
693	Wire products ex electric & fencing grills	0.06%	9.92**	-0.95(8.65) **	0.69	0.46	0.53	S	S
694	Nails, screws, nuts, bolts, rivets and sim. Articles	0.01%	6.75**	-0.92(7.22) **	0.89	0.93	0.81	S	S
695	Tools for use in the hand or in machines	0.64%	7.98**	-0.62(5.24) **	0.67	0.66	0.95	S	S
696	Cutlery	0.08%	7.39**	-0.59(5.43) **	0.83	0.56	0.34	S	S
697	Household equipment of base metals	0.06%	5.82**	-0.67(2.97) **	0.85	0.35	0.09*	S	US
698	Manufactures of metal, n.e.s.	1.72%	11.23**	-0.67(9.13) **	0.92	0.63	0.45	S	US
711	Power generating machinery, other than electric	4.83%	5.28**	-5.69(6.89) **	0.72	0.75	0.54	S	S
712	Agricultural machinery and implements	0.45%	9.75**	-0.71(8.51) **	0.73	0.65	0.03**	S	S
714	Office machines	0.57%	4.74*	-0.69(5.82) **	0.88	0.37	0.27	S	S
715	Metalworking machinery	1.13%	7.56**	-0.78(7.36) **	0.67	0.26	0.33	S	S
717	Textile and leather machinery	2.45%	6.90**	-0.55(4.08) **	0.84	0.68	0.09*	US	S
718	Machines for special industries	1.15%	7.60**	-0.59(7.55) **	0.81	0.58	0.53	S	S
719	Machinery and appliances non electrical parts	13.24%	22.09**	-0.89(12.87) **	0.72	0.48	0.71	S	S
722	Electric power machinery and switchgear	4.36%	8.43**	-0.70(7.70) **	0.76	0.53	0.21	S	S
723	Equipment for distributing electricity	0.46%	5.20**	-0.67(5.23) **	0.75	0.06*	0.34	S	US
724	Telecommunications apparatus	0.16%	4.33*	-0.76(5.80) **	0.86	0.99	0.55	S	S
725	Domestic electrical equipment	0.27%	6.83**	-0.86(7.33) **	0.79	0.23	0.37	S	S

726	Elec. apparatus for medical purposes, radiological ap.	0.35%	6.10**	-0.75(7.12) **	0.89	0.29	0.33	S	S
729	Other electrical machinery and apparatus	3.20%	9.74**	-0.64(6.81) **	0.81	0.70	0.44	S	S
731	Railway vehicles	0.11%	7.09**	-0.66(7.20) **	0.77	0.25	0.08*	S	US
732	Road motor vehicles	16.14%	5.93**	-0.91(5.94) **	0.86	0.51	0.32	S	S
734	Aircraft	6.04%	8.87**	-0.54(8.36) **	0.81	0.25	0.10	S	S
735	Ships and boats	0.41%	5.39**	-0.93(6.17) **	0.66	0.17	0.12	S	S
812	Sanitary, plumbing, heating & lighting fixtures	0.18%	11.45**	-0.69(3.96) **	0.83	0.98	0.41	US	S
821	Furniture	0.32%	5.93**	-0.78(5.50) **	0.84	0.65	0.59	S	S
841	Clothing except fur clothing	0.25%	5.57**	-0.59(6.80) **	0.94	0..43	0.53	S	S
861	Scientific, medical, optical, meas./contr. İnstruments	1.50%	6.39**	-0.68(5.73) **	0.74	0.88	0.74	US	S
862	Photographic and cinematographic supplies	0.08%	7.49**	-0.65(5.80) **	0.90	0.48	0.34	US	S
864	Watches and clocks	0.01%	7.79**	-0.94(7.89) **	0.91	0.89	0.45	S	S
891	Musical instruments, sound recorders and parts	0.11%	4.96**	-0.89(5.62) **	0.90	0.52	0.37	S	S
892	Printed matter	0.13%	6.38**	-0.86(6.67) **	0.73	0.44	0.43	US	S
894	Perambulators, toys, games and sporting goods	0.02%	4.95**	-0.56(5.55) **	0.83	0.82	0.11	S	S
895	Office and stationery supplies, n.e.s.	0.07%	6.88**	-0.55(5.60) **	0.89	0.34	0.56	S	S
897	Jewellery and gold/silver smiths' wares	0.10%	11.47**	-0.68(6.66) **	0.79	0.53	0.63	S	S
899	Manufactured articles, n.e.s.	0.28%	8.93**	-0.72(6.44) **	0.84	0.56	0.68	S	S

Notes: (i) The same notes apply to this table as under Table 2. (ii) Each industry import share is calculated as a percentage of Turkey's total imports from Germany over the sample period. This import share value is based on 2022.

Table 5 Long-run coefficient estimates of the nonlinear ARDL export model (9)

There are at Least One Short-Run Coefficient Significant						Long-run Coefficient Estimates			
SITC	lnY^{GR}	lnREX	$lnVOL^{TRUS}$	Constant	DM	lnY^{GR}	lnREX	POS^{TRUS}	NEG^{TRUS}
031	No	Yes	Yes	54.57	-1.69**	-1.88	-0.15	2.36	-7.55**
032	No	No	No	66.96**	-0.90	-2.30	0.11	64.42	64.26
046	No	Yes	Yes	-36.17**	-0.89*	12.95**	2.85**	14.25**	45.93
047	Yes	Yes	Yes	12.42	-0.33**	0.56**	0.87**	2.33*	-1.29*
048	Yes	Yes	Yes	-16.36**	-0.69**	5.83**	0.10	4.99*	-17.83
051	No	Yes	Yes	-11.23**	0.88**	4.32**	1.18**	-7.62	-8.31**
052	Yes	Yes	Yes	-18.09	-1.77**	4.26	0.71**	6.85**	-2.91**
053	No	Yes	Yes	-19.56*	-1.30**	4.33*	-0.19	4.48*	-1.93

054	Yes	No	Yes	-14.54**	-1.56**	5.14**	0.86*	5.50*	-23.80
055	No	No	No	-96.92	-1.50**	3.48	0.05	6.35	-5.62
061	Yes	Yes	Yes	-58.58	-1.27**	2.12	0.69	2.40	24.06
062	Yes	Yes	Yes	-18.53**	-1.02**	6.47**	0.82**	-35.12	-21.47
073	Yes	No	Yes	-39.64	0.37	1.33	0.76*	11.41**	-19.20
074	Yes	Yes	Yes	-126.03	0.20	4.45	0.90	-14.56	-6.30**
075	Yes	Yes	Yes	-99.66**	-1.40**	3.61**	0.12	6.79	-23.18**
099	Yes	No	Yes	115.35	-1.15**	-4.10	0.61	15.66**	-16.59
112	Yes	Yes	Yes	-15.69**	-1.21**	5.59**	0.16	-24.94	-19.85**
121	Yes	Yes	Yes	-129.29	-1.86**	4.84	-1.86**	-50.35	-8.33**
221	No	Yes	Yes	-28.82**	-0.30	10.19**	1.65**	-47.02	7.93
263	Yes	Yes	Yes	103.95*	-1.33**	3.63*	0.87	31.50	33.66
266	No	No	Yes	51.10**	-1.00**	17.91**	-2.16**	14.26**	-7.16**
273	No	No	Yes	-20.50	-0.32	0.69	1.18**	-27.05	-17.46**
276	Yes	Yes	Yes	36.84**	-1.52**	12.53**	-4.12**	4.91**	-12.73**
283	Yes	Yes	Yes	-80.53	-2.06**	2.87	1.67**	-52.92	-6.69**
292	Yes	Yes	No	89.41*	-1.59**	3.10*	0.51*	5.84**	-9.72**
421	Yes	Yes	Yes	-31.79**	-1.64**	11.01**	0.46	-63.13	-16.37
422	No	No	Yes	54.79	-0.95	-1.90	-1.78*	97.48	19.01
512	No	No	No	18.47**	-1.17**	-6.41*	-1.35**	15.92**	-4.69**
513	No	No	Yes	-80.36	-0.12	2.94	-2.03**	33.53	-6.29**
514	Yes	Yes	Yes	29.15	-1.04**	-0.97**	0.29	5.12*	-0.99*
541	Yes	Yes	Yes	105.26	-1.74**	-3.59**	-1.16*	43.13	-31.15*
551	Yes	Yes	Yes	-39.61**	-0.96	13.98**	0.52	-93.80	20.43
553	Yes	Yes	No	-74.07**	-0.26	25.91**	2.26**	19.19**	-11.78**
554	Yes	Yes	Yes	-43.46*	1.00	15.19*	2.63*	16.08**	-14.79**
581	No	No	Yes	157.80	-6.31**	-5.54**	0.17	68.10	-56.16*
599	No	No	Yes	-139.65	-1.51	4.97	0.46	49.79	-8.33
621	Yes	Yes	Yes	22.46	-0.78*	-0.73	-0.35	30.02	0.18
632	Yes	Yes	No	-54.82**	1.21	19.06**	2.03**	2.75**	-26.45**
651	Yes	Yes	No	115.53**	-0.64**	3.95**	-0.32	60.64	4.46
652	Yes	Yes	Yes	28.94	-0.88**	-0.93	-0.43**	24.47	4.50
653	No	Yes	No	-19.94*	0.36	5.60*	-0.14	-40.80	8.32
654	Yes	Yes	Yes	-545.22**	0.11	19.42**	-0.52	15.31**	-8.14**
656	No	Yes	Yes	-16.86**	-0.74*	6.06**	-0.44	7.06**	12.53
657	Yes	Yes	Yes	-50.00	-0.12	1.83	0.35	-14.41	-4.98
661	Yes	No	No	-168.61	1.29**	5.92	0.88	-61.01	-16.68

662	Yes	Yes	Yes	47.33**	-1.45**	16.68**	1.05**	13.75**	25.98
663	No	Yes	Yes	-86.68**	-2.18	3.69**	0.62	4.42*	63.73
664	No	Yes	Yes	81.11**	-2.00	2.81**	0.02	7.65**	-5.63**
665	Yes	Yes	Yes	30.29	-1.34**	-0.99*	0.26	10.68	-5.52**
666	Yes	Yes	Yes	-43.60**	-1.30*	15.57**	-0.22	12.86*	22.35
672	Yes	No	Yes	8.37	0.58	-0.31*	-0.09	49.31	-28.76**
673	Yes	Yes	Yes	-269.37*	0.20	9.44*	1.80**	14.67*	-14.35**
678	No	No	Yes	87.65*	-1.43**	3.04*	0.15	5.14**	-27.48**
684	Yes	Yes	Yes	7.22**	-1.44**	2.48**	1.25**	2.64**	-2.54**
691	No	No	Yes	-73.40	-1.82**	2.61	0.11	7.50	-9.40
695	Yes	Yes	Yes	-155.70	-2.17**	5.57*	0.17	8.71	-21.97
696	Yes	No	Yes	-49.07**	-6.02**	17.49**	2.03**	-52.67	-41.30
697	Yes	No	Yes	-18.37**	-0.89**	6.52**	0.56*	-33.52	12.85
698	No	No	No	-21.07	-1.84**	7.46	0.97	9.69*	-6.35*
711	No	Yes	Yes	-501.80**	-2.40**	17.94**	-1.09*	-75.62	19.74
715	Yes	Yes	Yes	-263.87**	-1.57**	9.34**	0.76**	5.16**	-15.12**
717	No	No	No	148.09	1.50	-5.23*	0.41	13.66	-28.07
718	Yes	Yes	Yes	-222.43**	-1.07**	7.96**	0.83**	7.82**	-27.43**
719	Yes	Yes	Yes	-165.87**	-1.02*	5.98**	-0.15	33.18	-15.76*
722	Yes	Yes	Yes	215.78**	-2.24**	7.60**	0.59**	6.57*	-44.21**
723	Yes	Yes	Yes	-223.44	-2.20**	7.94	2.10**	9.37*	-13.72**
724	Yes	Yes	Yes	-161.95**	-1.49	5.06**	0.86	5.29**	21.88
725	Yes	No	Yes	27.53	-3.42**	-0.98**	1.24**	-25.60	-29.11
729	No	No	No	-33.25	-0.53	1.25	-0.56	62.68	-13.55
732	Yes	Yes	Yes	-111.56*	-1.40**	4.08*	-0.97**	23.28	40.71**
812	Yes	Yes	No	-56.17	-0.53*	2.03	0.21	-18.54	-8.55*
821	Yes	No	No	-214.75*	-1.28**	7.62**	-0.15	-20.49	16.88
831	Yes	Yes	No	-61.79	-1.21*	2.23	-0.12	-32.74	5.91
841	No	No	No	-7.18	-0.49**	0.36	0.21	2.77**	3.27
842	No	Yes	Yes	-88.14	-0.96**	3.13	0.38	-38.71	11.31
851	Yes	No	Yes	-39.44**	-2.48**	14.09**	1.65**	-50.13	-23.06*
861	No	Yes	Yes	-87.90**	-3.12**	3.91**	1.13	20.41*	-0.43**
891	Yes	Yes	No	-133.08*	0.92	4.77*	0.59	-13.88	-3.46**
894	No	Yes	No	-26.17**	-0.66	9.18**	0.86	-19.01	12.40

Notes: '*' and '**' indicate significance at the 10% and 5% levels, respectively.

Table 6 Diagnostics associated with estimates of the nonlinear ARDL export model (9)

SITC	Industry Name	Export Share	*F*-test	ECM_{t-1}	Adj. R^2	LM	RESET	CUSUM	CUSUMSQ	Wald-SR^{TRUS}	Wald-LR^{TRUS}
031	Fish, fresh & simply preserved	0.36%	8.93**	-0.53(7.27)**	0.97	0.15	0.68	US	US	0.09*	0.10*
032	Fish, in airtight containers, n.e.s & fish preparations.	0.01%	4.10**	-0.55(4.78)**	0.51	0.88	0.36	US	US	0.32	0.63
046	Meal and flour of wheat or of meslin	0.00%	11.58**	-0.98(8.22)**	0.86	0.24	0.17	S	US	0.00**	0.01**
047	Meal & flour of cereals, except wheat/meslin	0.00%	5.87**	-0.60(5.78)**	0.71	0.07*	0.14	S	S	0.07*	0.41
048	Cereal preps & preps of flour of fruits & vegs.	0.25%	5.85**	-0.51(5.75)**	0.98	0.98	0.53	S	S	0.01**	0.02**
051	Fruit, fresh, and nuts excl. Oil nuts	2.16%	26.99**	-0.56(12.67)**	0.93	0.15	0.33	S	S	0.04**	0.04**
052	Dried fruit including artificially dehydrated	0.54%	11.81**	-0.53(8.38)**	0.96	0.56	0.22	S	S	0.04**	0.04**
053	Fruit, preserved and fruit preparations	0.63%	4.35**	-0.41(4.97)**	0.88	0.44	0.40	S	S	0.03**	0.07*
054	Vegetables, roots & tubers, fresh or dried	0.57%	7.04**	-0.77(6.29)**	0.81	0.33	0.53	S	S	0.06*	0.09*
055	Vegetables, roots & tubers pres or prepared n.e.s.	0.08%	2.79	-0.84(3.98)**	0.80	0.44	0.48	S	S	0.08*	0.00**
061	Sugar and honey	0.03%	4.81**	-0.49(5.22)**	0.68	0.96	0.94	S	S	0.04*	0.01*
062	Sugar confectionery, sugar preps. Ex chocolate confectionery	0.13%	8.22**	-0.83(6.86)**	0.97	0.95	0.24	S	S	0.03*	0.02*
073	Chocolate & other food preptns. cont. Cocoa, n.e.s.	0.13%	5.46**	-0.96(5.57)**	0.96	0.70	0.22	S	S	0.00*	0.00*
074	Tea and mate	0.01%	6.80**	-0.90(6.18)**	0.44	0.64	0.02**	S	US	0.27	0.49
075	Spices	0.06%	12.38**	-0.78(8.38)**	0.94	0.80	0.16	S	US	0.01**	0.04**
099	Food preparations, n.e.s.	2.25%	4.07**	-0.67(4.82)**	0.97	0.87	0.21	S	S	0.00**	0.02**
112	Alcoholic beverages	0.10%	20.31**	-0.82(10.85)**	0.97	0.79	0.87	S	S	0.03*	0.00**
121	Tobacco, unmanufactured	0.02%	7.38**	-0.78(6.60)**	0.80	0.25	0.93	S	S	0.04*	0.02**

221	Oil seeds, oil nuts and oil kernels	0.08%	7.28**	-0.99(6.52)**	0.92	0.00**	0.20	S	US	0.73	0.18
263	Cotton	0.26%	2.49	-0.39(3.86)**	0.70	0.58	0.29	S	S	0.04**	0.01**
266	Synthetic and regenerated artificial fibres	0.22%	5.74**	-0.69(5.84)**	0.81	0.92	0.08*	S	S	0.06*	0.00**
273	Stone, sand and gravel	0.08%	4.87**	-0.23(5.28)**	0.92	0.60	0.08*	S	S	0.07*	0.62
276	Other crude minerals	0.20%	11.35**	-0.61(8.33)**	0.90	0.58	0.15	S	S	0.03**	0.01**
283	Ores & concentrates of non ferrous base metals	0.24%	10.85**	-0.99(7.80)**	0.52	0.86	0.40	S	S	0.09*	0.90
292	Crude vegetable materials, n.e.s.	0.09%	7.24**	-0.88(6.48)**	0.89	0.02**	0.51	US	US	0.55	0.21
421	Fixed vegetable oils, soft	0.04%	9.47**	-0.53(7.39)**	0.90	0.49	0.05**	S	S	0.09*	0.13
422	Other fixed vegetable oils	0.00%	5.14**	-0.89(5.35)**	0.60	0.79	0.22	S	S	0.00**	0.18
512	Organic chemicals	0.20%	6.97**	-0.37(6.29)**	0.85	0.45	0.36	S	S	0.07*	0.08*
513	Inorg. chemicals elems., oxides, halogen salts	0.05%	6.55**	-0.84(6.11)**	0.86	0.15	0.15	S	S	0.07*	0.06*
514	Other inorganic chemicals	0.06%	7.20**	-0.83(6.35)**	0.81	0.04**	0.20	US	US	0.47	0.04**
541	Medicinal & pharmaceutical products	0.06%	14.82**	-0.55(9.12)**	0.84	0.02**	0.71	S	US	0.37	0.53
551	Essential oils, perfume and flavour materials	0.05%	4.12**	-0.63(4.79)**	0.89	0.79	0.02**	S	US	0.28	0.07**
553	Perfumery, cosmetics, dentifrices, etc.	0.24%	6.44**	-0.72(6.11)**	0.97	0.59	0.35	S	S	0.08*	0.08*
554	Soaps, cleansing & polishing preparations	0.08%	4.10**	-0.91(4.83)**	0.90	0.07*	0.00**	S	S	0.06*	0.78
581	Plastic materials, regenerd. cellulose & resins	3.78%	11.40**	-0.42(8.05)**	0.95	0.02**	0.01**	S	US	0.33	0.42
599	Chemical materials and products, n.e.s.	0.38%	5.67**	-0.93(5.70)**	0.82	0.59	0.33	S	S	0.04**	0.89
621	Materials of rubber	0.65%	10.30**	-0.62(7.71)**	0.99	0.12	0.03**	S	US	0.64	0.62
632	Wood manufactures, n.e.s.	0.12%	3.13	-0.60(4.19)**	0.89	0.63	0.25	S	S	0.02**	0.00**
651	Textile yarn and thread	0.54%	3.55*	-0.52(4.51)**	0.59	0.41	0.75	S	S	0.07*	0.09*
652	Cotton fabrics, woven ex. narrow or spec. Fabrics	0.23%	5.02**	-0.37(5.31)**	0.90	0.85	0.45	S	S	0.00**	0.37
653	Text fabrics woven ex narrow, spec, not cotton	0.59%	3.58*	-0.60(4.57)**	0.87	0.00**	0.00**	S	US	0.34	0.30
654	Tulle, lace, embroidery, ribbons, trimmings	0.07%	6.04**	-0.91(5.87)**	0.81	0.45	0.63	S	S	0.06*	0.06*

656	Made up articles, wholly or chiefly of text.mat.	0.51%	5.76**	-0.37(5.71)**	0.89	0.35	0.16	S	S	0.04**	0.14
657	Floor coverings, tapestries, etc.	0.62%	1.95	-0.38(3.33)**	0.80	0.63	0.07*	S	S	0.03**	0.70
661	Lime, cement & fabr. bldg.mat. Ex glass/clay mat	0.24%	1.08	-0.27(2.49)**	0.94	0.01**	0.75	S	S	0.02**	0.05**
662	Clay and refractory construction materials	0.74%	8.83**	-0.61(7.10)**	0.98	0.28	0.00**	S	S	0.06*	0.00**
663	Mineral manufactures, n.e.s.	0.15%	6.86**	-0.99(6.25)**	0.72	0.35	0.07*	S	S	0.01**	0.04**
664	Glass	0.33%	53.52**	-0.48(17.79)**	0.99	0.11	0.96	S	S	0.00**	0.03**
665	Glassware	0.16%	17.89**	-0.39(10.22)**	0.93	0.02**	0.15	S	S	0.09*	0.07*
666	Pottery	0.10%	4.24*	-0.76(5.01)**	0.86	0.53	0.75	S	S	0.03**	0.09*
672	Ingots & other primary forms of iron or steel	0.43%	5.30**	-0.57(1.09)**	0.88	0.20	0.15	S	S	0.06*	0.08*
673	Iron and steel bars, rods, angles, shapes, sections	0.65%	10.93**	-0.94(7.90)**	0.80	0.17	0.06*	S	S	0.05*	0.80
678	Tubes, pipes and fittings of iron or steel	0.56%	8.89**	-0.44(7.23)**	0.83	0.06*	0.00**	S	US	0.46	0.22
684	Aluminium	4.39%	43.61**	-0.43(4.44)**	0.99	0.25	0.12	S	S	0.09*	0.01**
691	Finished structural parts and structures, n.e.s	1.00%	2.23	-0.38(3.54)**	0.93	0.23	0.87	S	S	0.07*	0.09*
695	Tools for use in the hand or in machines	0.31%	5.97**	-0.45(5.81)**	0.87	0.00**	0.42	US	US	0.50	0.62
696	Cutlery	0.02%	41.08**	-0.77(15.53)**	0.92	0.26	0.54	S	S	0.06*	0.33
697	Household equipment of base metals	0.57%	6.36**	-0.60(5.96)**	0.96	0.88	0.58	S	S	0.02**	0.07*
698	Manufactures of metal, n.e.s.	2.62%	5.25**	-0.48(5.50)**	0.97	0.18	0.24	S	S	0.04**	0.12
711	Power generating machinery, other than electric	4.64%	12.64**	-0.62(8.56)**	0.95	0.66	0.21	S	S	0.01**	0.07*
715	Metalworking machinery	0.30%	20.57**	-0.79(10.89)**	0.99	0.31	0.50	S	S	0.08*	0.04**

717	Textile and leather machinery	0.89%	1.62	-0.64(3.04)**	0.65	0.00**	0.02**	US	US	0.39	0.24
718	Machines for special industries	0.28%	7.64**	-0.64(6.56)**	0.96	0.96	0.57	S	S	0.09*	0.01**
719	Machinery and appliances non electrical parts	7.16%	6.28**	-0.94(5.95)**	0.96	0.13	0.60	S	S	0.09*	0.03**
722	Electric power machinery and switchgear	2.02%	16.39**	-0.44(7.68)**	0.98	0.22	0.43	S	S	0.08*	0.04**
723	Equipment for distributing electricity	1.73%	10.23**	-0.51(7.75)**	0.91	0.16	0.25	S	S	0.04**	0.00**
724	Telecommunications apparatus	0.01%	7.64**	-0.51(6.70)**	0.88	0.01**	0.00**	S	US	0.42	0.74
725	Domestic electrical equipment	0.79%	9.70**	-0.03(7.50)**	0.97	0.04**	0.02	US	US	0.19	0.44
729	Other electrical machinery and apparatus	0.75%	2.82	-0.76(3.97)**	0.88	0.79	0.54	S	S	0.00**	0.02**
732	Road motor vehicles	14.56%	5.16**	-0.84(5.40)**	0.98	0.70	0.31	S	S	0.03**	0.01**
812	Sanitary, plumbing, heating & lighting fixtures	0.89%	4.41*	-0.49(4.99)**	0.97	0.14	0.28	S	S	0.01**	0.51
821	Furniture	2.20%	4.44*	-0.43(5.07)**	0.98	0.11	0.19	S	S	0.01**	0.06*
831	Travel goods, handbags and similar articles	0.02%	3.29	-0.24(4.28)**	0.82	0.76	0.00**	S	US	0.58	0.43
841	Clothing except fur clothing	18.35%	9.90**	-0.62(7.62)**	0.97	0.12	0.32	S	S	0.01**	0.09*
842	Fur clothing and articles of artificial fur	0.03%	2.62	-0.71(3.89)**	0.87	0.11	0.91	S	S	0.02**	0.00**
851	Footwear	0.43%	16.95**	-0.73(9.92)**	0.90	0.11	0.63	S	S	0.03**	0.20
861	Scientific, medical, optical, meas./contr. instrum.	0.01%	7.56**	-0.67(6.57)**	0.88	0.74	0.33	S	S	0.00**	0.01**
891	Musical instruments, sound recorders and parts	0.01%	9.69**	-0.45(7.46)**	0.79	0.16	0.43	S	S	0.01**	0.02**
894	Perambulators, toys, games and sporting goods	0.05%	8.83**	-0.53(7.01)**	0.81	0.75	0.41	S	S	0.06*	0.39

Notes: '*' ('**') indicates significance at the 10% (5%) levels. At the 10% (5%) significance level when *k=4*, the upper bound critical value of the F-test is 3.772 (4.450). These critical values for the bounds test come from Narayan (2005, Case III, page 1988). The number inside the parenthesis next to ECM_{t-1} is the absolute value of the *t*-ratio. Its critical value at the 10% (5%) significance level is -3.64 (-4.05) when *k=4*. These critical values of the *t*-ratio for the *ECM* test come from Banarjee *et al.* (1998, Table 1, Case A, page 276). *LM* is the Langrange Multiplier test of residual serial correlation. *RESET* is Ramsey's test for functional misspecification. *LM*, *RESET*, and *Wald* tests are all distributed as χ^2 with one degree of freedom. The critical values of these diagnostics are 2.70 (3.84) at the 10% (5%) significance level, respectively. *CUSUM* and *CUSUMSQ* are recursive

estimates used to test the stability of all estimated coefficients. Each industry export share is calculated as a percentage of Turkey's total exports to Germany over the sample period. This export share value is based on 2022.

Table **7** Long-run coefficient estimates of the nonlinear ARDL import model (10)

There are at Least One Short-Run Coefficient Significant						Long-run Coefficient Estimates			
SITC	lnY^{TR}	lnREX	$lnVOL^{TRUS}$	Constant	DM	lnY^{TR}	lnREX	POS^{TRUS}	NEG^{TRUS}
001	Yes	Yes	No	-294.78**	-0.77	11.59**	0.48	-32.19	10.94
054	Yes	Yes	No	-75.54	-4.41**	3.05	-1.18*	-56.16	66.28
061	Yes	Yes	Yes	-92.07	-6.45**	3.59	0.25	-129.63	-20.52**
071	Yes	Yes	Yes	-5.26	-1.04*	0.21	0.26	-19.51	-7.29**
072	Yes	No	Yes	-129.25*	-2.12**	4.99*	1.72**	19.01**	-40.19
081	No	No	No	-4.90	1.01	0.21	0.20	18.10	-13.46**
231	No	Yes	Yes	4.90	-1.61**	-0.14	0.37	-31.66	-7.70**
251	No	Yes	No	5.98	-1.18*	-0.16	-0.87**	66.26	33.72
266	Yes	Yes	Yes	-34.78*	-0.79**	1.46*	-0.69*	-24.98	38.03
276	No	Yes	No	-191.20**	-1.40	7.48**	-1.72**	-46.34	26.6
282	No	No	No	-13.86	-0.82**	0.55	0.42	-14.81	-8.54**
284	No	No	No	57.57	0.13	-2.25	1.98	11.18	-60.68
291	Yes	Yes	Yes	-108.86**	-1.96**	4.23**	0.09	-73.57	23.78
292	Yes	Yes	Yes	129.09**	-2.77**	4.86**	-0.87**	28.93**	22.71
332	Yes	Yes	Yes	28.14**	-1.65**	1.05**	0.61**	8.21**	-50.29**
422	Yes	Yes	Yes	-85.64**	0.42	3.24**	1.83**	17.15**	-79.70**
431	Yes	Yes	Yes	-63.42**	-0.18	2.51**	-0.49**	-31.66	61.45
512	No	No	No	1.21	-0.83**	0.08	0.24	14.22*	-4.13**
513	Yes	Yes	Yes	-41.85**	-1.10**	1.74**	0.23**	29.99**	5.01
521	Yes	Yes	Yes	-118.88**	-0.94	4.47**	2.28**	16.49**	-46.80
531	Yes	Yes	Yes	-22.53*	-1.46**	0.96*	0.10	-23.91	29.39
532	No	No	No	12.09	-1.28**	-0.43	0.12	14.53	-1.84**
533	No	No	No	-3.30	-0.89	0.18*	0.06	6.94**	1.63
541	Yes	Yes	Yes	2.28	-1.28**	0.07*	-0.44**	4.78**	-5.06
551	No	No	No	-18.49	-1.61**	0.75	0.18	-18.49	-9.30**
554	Yes	Yes	Yes	-5.05	-0.62**	0.23*	0.12	-7.15	-5.99**
561	No	No	No	-47.93	-1.07	1.95	-0.14**	-6.69	35.86
571	Yes	Yes	Yes	-2.97	-1.26**	0.23**	-1.11**	76.12	72.58
581	Yes	Yes	Yes	1.95	-1.14**	0.06**	-0.22**	32.47*	10.27
599	Yes	Yes	Yes	-9.72	-1.15**	0.49*	0.01	5.27**	-1.80*
621	Yes	Yes	Yes	-6.62	-1.33**	0.32**	0.14	10.80*	-1.30**

631	Yes	Yes	Yes	10.12**	-0.82*	3.99**	0.90*	10.27**	-6.38**
632	Yes	Yes	Yes	-1.80	-4.59**	0.07**	2.41**	3.58*	-7.08**
642	Yes	Yes	Yes	-6.84	-0.53*	0.24*	1.08**	-32.81	-25.81
651	Yes	Yes	Yes	47.60*	-0.81**	0.66**	0.47**	0.33**	-0.66**
654	Yes	Yes	No	-36.92*	-0.42	1.44*	0.19	-39.44	20.38
655	Yes	Yes	Yes	-33.66**	-0.19**	1.31**	0.09**	0.19**	-0.08**
662	No	No	Yes	-21.91	-0.30	0.89	0.27	-24.17	-1.23*
663	Yes	Yes	Yes	-37.24**	-1.14**	1.55**	-0.23*	-23.30	17.06
664	Yes	Yes	Yes	-35.58*	-1.53**	1.43**	0.02	-24.83	16.32
665	No	No	Yes	-19.49	-0.57	0.78	0.07	3.36**	22.43
671	Yes	Yes	Yes	11.65*	-1.95**	4.52*	0.21*	0.07*	-0.79**
672	Yes	Yes	Yes	21.55*	-1.32**	3.83**	0.23**	0.21**	-4.22**
673	No	Yes	Yes	35.28*	-0.89**	1.24**	0.84**	57.61*	-53.24**
674	Yes	Yes	Yes	-15.28	-4.95**	6.64**	0.32*	0.50*	-2.24*
676	Yes	Yes	Yes	-3.90*	-2.38**	0.93**	0.02**	0.02*	-0.04*
677	Yes	Yes	Yes	-11.53	-2.57*	3.55**	2.64*	4.80*	-5.92*
678	Yes	Yes	Yes	5.38**	-2.25**	9.60**	1.92**	2.09**	-0.61
679	Yes	Yes	No	61.55	-0.23	-2.39*	0.79	7.30*	6.56
681	Yes	Yes	Yes	5.82**	-0.63**	2.50**	0.11**	0.28**	-0.12**
682	Yes	Yes	Yes	-7.91	-1.17**	0.38**	0.79**	-2.18	-3.49**
683	Yes	Yes	Yes	-0.62**	-0.20**	1.01**	2.13**	0.01**	0.06
684	Yes	Yes	Yes	2.32	-1.66**	3.75**	6.32**	4.26*	-2.74**
686	Yes	Yes	Yes	-3.18**	-0.01**	0.51**	1.20	4.01**	-0.11*
687	Yes	Yes	Yes	-2.97	-0.15**	0.11**	4.01*	2.34**	-0.32*
689	Yes	Yes	Yes	3.01	-4.07**	1.05**	3.22**	4.11**	-0.04**
691	Yes	Yes	Yes	2.16*	-0.61**	0.25**	-0.18**	0.16**	0.10
692	Yes	Yes	Yes	3.10*	-0.10*	0.87*	-0.07**	2.64*	-0.07
693	Yes	Yes	Yes	-6.32*	-1.16*	2.40*	-1.59**	1.19*	1.58
694	Yes	Yes	Yes	14.99	-0.14*	2.59**	1.04*	0.04*	0.05
695	Yes	No	Yes	-3.95	-0.63**	1.28**	0.17*	3.01*	-1.36*
696	Yes	Yes	Yes	-6.44*	-0.03*	0.25*	0.02**	0.01**	0.02
697	Yes	Yes	Yes	8.87*	-8.07**	1.33**	-0.04*	0.01**	-0.04**
698	Yes	Yes	Yes	-4.08**	-1.97**	15.75**	0.29**	0.79**	1.45
711	Yes	Yes	Yes	-8.82	0.97	0.45*	-0.04*	3.89*	11.91
712	Yes	Yes	Yes	-10.87**	-0.29	4.15**	0.80	-13.37	-51.92*
714	Yes	Yes	Yes	-47.23**	-0.27	1.84**	1.14**	-7.54	-19.40
715	Yes	Yes	Yes	-0.64	-1.03**	0.13*	-0.33*	24.11	21.53

717	Yes	Yes	Yes	-76.86**	-10.45**	9.07**	0.64**	0.89**	-1.59**
718	Yes	Yes	Yes	18.21	-3.42*	-4.06**	-0.81*	-0.91	1.25
719	No	Yes	No	28.58	1.68	8.32**	-0.50**	-1.04	-0.66**
722	Yes	Yes	Yes	41.29	0.27	1.19*	-0.35**	0.23	-0.67*
723	No	Yes	No	11.26	1.53	4.18**	-0.35**	-0.03	-0.74*
724	Yes	No	No	29.22	-0.06*	-8.34	0.09**	0.18**	0.35
725	Yes	Yes	Yes	-29.62**	0.49	1.14**	0.09**	-0.06	-0.21**
726	No	Yes	No	26.38	0.57	-4.78	-0.21**	0.06**	-0.28
729	Yes	Yes	Yes	69.69	-1.92**	2.56**	1.09*	0.42**	1.84
731	No	No	No	-70.87	-1.23	2.96	-0.92**	31.41	76.27
732	Yes	Yes	Yes	-20.20	-1.41**	0.81	0.78**	-37.98	-26.27
734	Yes	Yes	Yes	10.77	-0.16*	3.74**	0.07**	15.49*	9.01
735	Yes	Yes	Yes	-9.90	-1.81**	0.39*	0.82**	-45.86	-26.95*
812	Yes	Yes	Yes	-15.83**	-0.19*	6.04**	0.27**	0.16**	-0.14**
821	Yes	Yes	Yes	-26.02**	-0.35**	6.19**	0.39**	0.04*	0.24
841	Yes	Yes	Yes	-65.30**	-0.73**	2.50**	1.12**	-10.38	-6.60
861	Yes	Yes	Yes	-22.40	-5.33**	2.85**	4.67**	7.38*	-2.74*
862	No	No	No	-38.32	-1.13**	1.49	0.52	-61.50	-1.68**
864	Yes	Yes	Yes	-14.94**	-1.69**	4.45**	0.88**	-19.52	-17.26
891	Yes	Yes	No	-29.57	-0.96**	1.17	0.16	-52.81	1.78
892	Yes	Yes	No	5.43	-1.15**	-0.17**	-0.06**	-12.48	-6.30
894	Yes	Yes	No	72.51	-0.81	-2.74*	-0.15**	47.25	-34.51
895	Yes	Yes	No	7.30	-0.82**	-0.25**	0.39	15.56	-6.17
897	Yes	Yes	Yes	69.62**	-3.19**	2.63*	-0.56**	16.34**	-12.54
899	No	Yes	No	-16.28	-0.69**	0.66	0.22	-24.08	-5.35**

Notes: '*' and '**' indicate significance at the 10% and 5% levels, respectively.

Table 8 Diagnostics associated with estimates of the nonlinear ARDL import model (10)

SITC	Industry Name	Import Share	*F*-test	ECM_{t-1}	Adj. R^2	LM	RESET	CUSUM	CUSUMSQ	Wald-SR^{TRUS}	Wald-LR^{TRUS}
001	Live animals	0.05%	3.15	-0.49(4.21)**	0.60	0.41	0.41	S	S	0.01**	0.02**
054	Vegetables, roots & tubers, fresh or dried	0.01%	8.71**	-0.55(7.03)**	0.77	0.19	0.38	S	S	0.08*	0.03**
061	Sugar and honey	0.03%	11.95**	-0.77(8.33)**	0.73	0.53	0.07*	S	S	0.07*	0.48
071	Coffee	0.04%	4.08*	-0.33(4.85)**	0.94	0.23	0.03**	S	S	0.01**	0.56
072	Cocoa	0.09%	4.20*	-0.49(4.96)**	0.77	0.54	0.48	S	S	0.00**	0.02**
081	Feed. Stuff for animals excl. unmilled cereals	0.11%	2.12	-0.43(3.44)**	0.81	0.54	0.29	S	US	0.38	0.27

231	Crude rubber incl. synthetic & reclaimed	0.06%	9.67**	-0.52(7.59)**	0.94	0.23	0.64	S	US	0.02**	0.64
251	Pulp & waste paper	0.08%	2.36	-0.45(3.65)**	0.84	0.92	0.35	S	S	0.00**	0.03**
266	Synthetic and regenerated artificial fibers	0.22%	10.28**	-0.29(7.72)**	0.93	0.02**	0.01**	S	US	0.82	0.56
276	Other crude minerals	0.09%	6.48**	-0.81(6.05)**	0.62	0.92	0.87	S	S	0.13	0.07*
282	Iron and steel scrap	1.29%	2.09	-0.26(3.42)**	0.89	0.01**	0.21	S	S	0.03**	0.70
284	Non-ferrous metal scrap	0.11%	2.11	-0.57(3.45)**	0.51	0.23	0.00**	S	US	0.73	0.36
291	Crude animal materials, n.e.s.	0.01%	11.67**	-0.97(8.20)**	0.83	0.89	0.16	S	S	0.00**	0.13
292	Crude vegetable materials, n.e.s.	0.11%	11.50**	-0.59(8.27)**	0.93	0.19	0.11	S	S	0.07*	0.79
332	Petroleum products	0.51%	19.71**	-0.33(10.75)**	0.98	0.41	0.35	S	S	0.00**	0.06*
422	Other fixed vegetable oils	0.02%	5.55**	-0.55(5.57)**	0.60	0.59	0.84	S	S	0.00**	0.09*
431	Anim./veg. Oils & fats, processed, and waxes	0.04%	2.77	-0.34(3.94)**	0.76	0.99	0.11	S	S	0.01**	0.08*
512	Organic chemicals	2.35%	3.92*	-0.53(4.72)**	0.89	0.34	0.72	S	S	0.09*	0.04**
513	Inorg. chemicals elems., oxides, halogen salts	0.48%	52.79**	-0.71(17.73)**	0.99	0.11	0.40	S	S	0.06*	0.09*
521	Crude chemicals from coal, petroleum and gas	0.02%	3.96*	-0.63(4.75)**	0.75	0.36	0.61	S	S	0.03**	0.07*
531	Synth. organic dyestuffs, natural indigo & lakes	0.21%	43.81**	-0.34(16.04)**	0.98	0.14	0.23	S	S	0.03**	0.01**
532	Dyeing & tanning extracts, synth. tanning mat.	0.02%	4.25*	-0.56(4.91)**	0.86	0.35	0.99	S	S	0.07*	0.00**
533	Pigments, paints, varnishes & related materials	1.37%	2.62	-0.26(3.90)**	0.95	0.01**	0.02**	US	S	0.29	0.03**
541	Medicinal & pharmaceutical products	4.24%	29.91**	-0.63(13.29)**	0.99	0.35	0.44	S	S	0.07*	0.08*
551	Essential oils, perfume and flavour materials	0.34%	8.46**	-0.78(6.92)**	0.98	0.16	0.35	S	S	0.03**	0.01**
554	Soaps, cleansing & polishing preparations	0.55%	6.64**	-0.58(6.13)**	0.98	0.24	0.34	S	S	0.02**	0.09*
561	Fertilizers manufactured	0.05%	4.52**	-0.80(5.04)**	0.71	0.15	0.19	S	S	0.09*	0.04**

571	Explosives and pyrotechnic products	0.02%	9.71**	-0.98(7.47)**	0.60	0.50	0.38	S	S	0.04**	0.04**
581	Plastic materials, regenerd. cellulose & resins	8.33%	25.91**	-0.45(12.29)**	0.99	0.34	0.49	S	S	0.03**	0.07*
599	Chemical materials and products, n.e.s.	2.98%	36.32**	-0.46(14.47)**	0.99	0.86	0.68	S	S	0.01**	0.04**
621	Materials of rubber	0.46%	6.69**	-0.38(6.18)**	0.96	0.60	0.19	S	S	0.11	0.33
631	Veneers, plywood boards & other wood, worked, n.e.s.	0.02%	8.86**	-0.33(7.29)**	0.93	0.31	0.99	S	S	0.01**	0.07*
632	Wood manufactures, n.e.s.	0.06%	28.55**	-0.59(13.04)**	0.93	0.14	0.49	S	S	0.01**	0.07*
642	Articles of paper, pulp, paperboard	0.13%	4.75**	-0.41(5.21)**	0.95	0.14	0.18	S	S	0.04**	0.09*
651	Textile yarn and thread	0.20%	4.67**	-0.45(8.51)**	0.94	0.39	0.17	S	S	0.07*	0.08*
654	Tulle, lace, embroidery, ribbons, trimmings	0.04%	4.56**	-0.79(5.12)**	0.96	0.34	0.41	S	S	0.05*	0.85
655	Special textile fabrics and related products	0.51%	7.27**	-0.64(23.87)**	0.97	0.56	0.80	S	S	0.00**	0.02**
662	Clay and refractory construction materials	0.23%	3.63	-0.39(4.53)**	0.83	0.03**	0.00**	S	S	0.53	0.53
663	Mineral manufactures, n.e.s.	0.41%	15.49**	-0.53(9.45)**	0.97	0.02**	0.00**	S	S	0.27	0.81
664	Glass	0.36%	10.13**	-0.32(7.63)**	0.97	0.26	0.02**	S	S	0.82	0.98
665	Glassware	0.06%	2.12	-0.20(3.49)**	0.89	0.39	0.01**	S	S	0.02**	0.33
671	Pig iron, spiegeleisen, sponge iron etc.	0.12%	7.39**	-0.90(6.51)**	0.86	0.91	0.91	S	S	0.01**	0.08*
672	Ingots & other primary forms of iron or steel	0.82%	21.20**	-0.63(27.03)**	0.99	0.20	0.29	S	S	0.02**	0.04**
673	Iron and steel bars, rods, angles, shapes, sections	0.91%	9.21**	-0.92(7.31)**	0.94	0.52	0.03**	US	US	0.06*	0.02**
674	Universals, plates and sheets of iron or steel	1.28%	21.46**	-0.87(6.09)**	0.87	0.52	0.22	S	S	0.05*	0.04**
676	Rails & rlwy track constr mat. Of iron or steel	0.02%	8.82**	-0.76(13.61)**	0.64	0.40	0.17	S	S	0.03**	0.09*

677	Iron and steel wire, excluding wire rod	0.08%	4.02*	-0.55(4.81)**	0.87	0.69	0.96	S	S	0.02**	0.06*
678	Tubes, pipes and fittings of iron or steel	0.55%	16.90**	-0.75(23.62)**	0.90	0.25	0.23	S	S	0.03**	0.07*
679	Iron steel castings forgings unworked, n.e.s.	0.02%	10.91**	-0.72(12.14)**	0.77	0.35	0.60	S	S	0.03**	0.05*
681	Silver and platinum group metals	0.04%	6.64**	-0.79(6.42)**	0.75	0.73	0.47	S	S	0.09*	0.03**
682	Copper	0.51%	21.73**	-0.60(11.42)**	0.95	0.56	0.54	S	S	0.00**	0.07*
683	Nickel	0.04%	19.00**	-0.73(38.98)**	0.99	0.37	0.23	S	S	0.00**	0.03**
684	Aluminium	0.74%	2.58	-0.60(3.82)**	0.93	0.57	0.18	S	S	0.07*	0.06*
686	Zinc	0.02%	6.65**	-0.75(12.48)**	0.93	0.14	0.31	S	S	0.03**	0.09*
687	Tin	0.01%	10.71**	-0.62(29.46)**	0.83	3.64	0.56	S	S	0.00**	0.03**
689	Miscell.non ferrous base metals	0.01%	23.02**	-0.66(45.87)**	0.99	0.32	0.31	S	S	0.03**	0.05*
691	Finished structural parts and structures, n.e.s	0.26%	13.69**	-0.69(13.65)**	0.86	0.13	0.41	S	S	0.03**	0.09*
692	Metal containers for storage and transport	0.10%	9.61**	-0.55(20.79)**	0.95	0.35	0.90	S	S	0.02**	0.04**
693	Wire products ex electric & fencing grills	0.06%	12.27**	-0.49(23.50)**	0.86	0.63	0.38	S	S	0.00**	0.03**
694	Nails, screws, nuts, bolts, rivets and sim. Articles	0.01%	13.53**	-0.46(17.80)**	0.97	0.27	0.66	S	S	0.08*	0.07*
695	Tools for use in the hand or in machines	0.64%	3.11*	-0.45(15.88)**	0.81	0.63	0.33	S	S	0.06*	0.05*
696	Cutlery	0.08%	7.85**	-0.97(6.66)**	0.73	0.40	0.54	S	S	0.04**	0.01**
697	Household equipment of base metals	0.06%	24.55**	-0.85(15.82)**	0.99	0.74	0.33	S	S	0.00**	0.00**
698	Manufactures of metal, n.e.s.	1.72%	23.16**	-0.79(23.28)**	0.98	0.52	0.13	S	S	0.08*	0.03**
711	Power generating machinery, other than electric	4.83%	14.89**	-0.53(34.72)**	0.91	0.24	0.32	S	S	0.00**	0.00**
712	Agricultural machinery and implements	0.45%	8.64**	-0.97(7.03)**	0.82	0.73	0.89	S	S	0.08*	0.07*
714	Office machines	0.57%	8.78**	-0.30(7.10)**	0.91	0.04**	0.00**	S	S	0.04**	0.23

715	Metalworking machinery	1.13%	4.23*	-0.36(4.93)**	0.91	0.01**	0.06*	S	S	0.46	0.93
717	Textile and leather machinery	2.45%	19.55**	-0.57(92.36)**	0.99	0.13	0.10	S	S	0.08*	0.07*
718	Machines for special industries	1.15%	10.28**	-0.51(21.51)**	0.93	0.90	0.29	S	S	0.06*	0.05*
719	Machinery and appliances non-electrical parts	13.24%	6.77**	-0.58(23.42)**	0.90	0.34	0.28	S	S	0.04**	0.01**
722	Electric power machinery and switchgear	4.36%	37.76**	-0.61(17.50)**	0.99	0.26	0.64	S	S	0.00**	0.00**
723	Equipment for distributing electricity	0.46%	6.26**	-0.73(16.79)**	0.90	0.42	0.50	S	S	0.08*	0.03**
724	Telecommunications apparatus	0.16%	7.96**	-0.98(15.47)**	0.87	0.28	0.35	S	S	0.00**	0.00**
725	Domestic electrical equipment	0.27%	9.63**	-0.70(16.13)**	0.94	0.74	0.75	S	S	0.06*	0.05*
726	Elec. apparatus for medic.purp., radiological ap.	0.35%	2.07	-0.64(12.94)**	0.44	0.00**	0.65	US	US	0.04**	0.01**
729	Other electrical machinery and apparatus	3.20%	9.95**	-0.69(7.08)**	0.89	0.23	0.41	S	S	0.06*	0.05*
731	Railway vehicles	0.11%	7.72**	-0.50(6.64)**	0.63	0.24	0.94	S	S	0.01**	0.07*
732	Road motor vehicles	16.14%	7.11**	-0.51(6.41)**	0.97	0.22	0.62	S	S	0.08*	0.09*
734	Aircraft	6.04%	4.06*	-0.73(4.77)**	0.80	0.74	0.42	S	S	0.06*	0.05*
735	Ships and boats	0.41%	12.22**	-0.74(8.36)**	0.97	0.16	0.21	US	S	0.04**	0.07*
812	Sanitary, plumbing, heating & lighting fixtures	0.18%	12.97**	-0.47(18.72)**	0.97	0.24	0.98	S	S	0.00**	0.00**
821	Furniture	0.32%	9.02**	-0.95(17.26)**	0.92	0.22	0.87	S	S	0.06*	0.09*
841	Clothing except fur clothing	0.25%	13.63**	-0.37(8.81)**	0.99	0.44	0.00**	S	S	0.36	0.49
861	Scientific, medical, optical, meas./contr. instrum.	1.50%	10.30**	-0.51(6.75)**	0.97	0.09*	0.15	S	S	0.00**	0.02**

862	Photographic and cinematographic supplies	0.08%	2.93	-0.15(4.15)**	0.84	0.06*	0.68	S	S	0.28	0.77
864	Watches and clocks	0.01%	16.21**	-0.63(9.86)**	0.93	0.27	0.64	S	S	0.03**	0.05*
891	Musical instruments, sound recorders and parts	0.11%	6.48**	-0.42(6.12)**	0.92	0.23	0.11	S	S	0.09*	0.49
892	Printed matter	0.13%	2.90	-0.70(4.05)**	0.90	0.51	0.03**	S	S	0.06*	0.09*
894	Perambulators, toys, games and sporting goods	0.02%	1.31	-0.33(2.70)**	0.77	0.75	0.12	S	US	0.15	0.48
895	Office and stationery supplies, n.e.s.	0.07%	5.48**	-0.54(5.59)**	0.92	0.41	0.10	S	S	0.05*	0.66
897	Jewellery and gold/silver smiths' wares	0.10%	15.05**	-0.86(9.20)**	0.94	0.81	0.63	S	S	0.00**	0.01**
899	Manufactured articles, n.e.s.	0.28%	6.82**	-0.50(6.24)**	0.97	0.01**	0.01**	S	S	0.28	0.45

Notes: (i) The same notes apply to this table as under Table 6. (ii) Each industry import share is calculated as a percentage of Turkey's total imports from Germany over the sample period. This import share value is based on 2022.