NEAR EAST UNIVERSITY
INSTITUTE OF GRADUATE STUDIES
DEPARTMENT OF ECONOMICS

ESSAYS ON EXCHANGE RATE DYNAMICS, TRADE AND THE GROWTH NEXUS IN TURKEY

PHD THESIS

WAQAR KHALID

Nicosia
September, 2023

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Nicosia
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Thesis defence was held online.The jury members declared their acceptance verbally

APPROVAL

We certify that we have read the thesis submitted by **WAQAR KHALID** titled **"ESSAYS ON EXCHANGE RATE DYNAMICS, TRADE AND THE GROWTH NEXUS IN TURKEY"** and that, in our combined opinion, it is fully adequate, in scope and quality, as a thesis for the degree of Doctor of Philosophy (PhD) in Economics.

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DECLARATION

I hereby declare that the thesis entitled **"Essays on Exchange Rate Dynamics, Trade and the Growth Nexus in Turkey"** submitted for the Doctor of Philosophy (PhD) in Economics at the Institute of Graduate Studies, Near East University, is entirely my own work. I also declare that all information, documents, figures, analysis and empirical results in this thesis have been collected and presented according to the academic rules and ethical guidelines of the Institute of Graduate Studies, Near East University. As required by these rules and conduct, I have fully cited and referenced information and data not original to this study.

I declare that this thesis has not been submitted in whole or in part for the award of any other degree or qualification in any other educational institution. The work presented in this thesis results from my original research efforts, conducted under the proper guidance and kind supervision of my supervisor, Prof. Dr. Hüseyin Özdeşer, and co-supervisor, Prof. Dr. Irfan Civcir.

I also declare that any opinions, interpretations, or conclusions presented in this thesis are solely my own and do not necessarily reflect those of Near East University or any other organization or individual associated with the research.

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WAQAR KHALID

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DEDICATION

I would like to dedicate this thesis to my late paternal grandfather, **KHAN MUHAMMAD**, who pioneered our family by sowing the seed of education. His unwavering belief in the transformative power of knowledge continues to inspire me on my academic journey. Through his guidance, encouragement, and dedication to learning, I have reached this significant milestone in my life. I am forever grateful for his profound influence and the lasting legacy he has left behind. May Allah (SWT) grant him a prominent place in Jannat-ul-Firdous!
Aammeenn!!!

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WAQAR KHALID

ABSTRACT

Essays on Exchange Rate Dynamics, Trade and the Growth Nexus in Turkey

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This research explores the influence of exchange rate uncertainty on the export and import volumes of commodities traded between Turkey and Germany. Previous empirical studies have suffered from aggregation bias and have assumed a symmetric association between exchange rate uncertainty and trade volumes. However, recent empirical studies have recognized the existence of asymmetry in this relationship. Therefore, this study uses industry data to assess the symmetric and asymmetric effects of exchange rate volatility on bilateral trade volumes between the two countries. Additionally, the study examines the symmetric and asymmetric effects of third-economy risk on commodity trade flows between the two countries. The study also investigates the symmetric and asymmetric influences of exchange rate misalignment on the economic growth of Turkey. The study employs the Hodrick-Prescott (H-P) filter technique to calculate the exchange rate misalignment. Furthermore, the study utilizes the generalized autoregressive conditional heteroscedasticity (GARCH) specification to measure exchange rate uncertainty. To achieve the objectives of the current research, the study employs the autoregressive distributed lag (ARDL) methodology and the nonlinear ARDL (NARDL) methodology to derive the short-run and long-run estimates of the proposed trade models.

The empirical results of the study are industry-specific and suggest that an increase (decrease) in lira-euro volatility increases (decreases) Turkish exports (imports) to (from) Germany, primarily for both small and large industries. The study suggests that export and import sectors that benefit from lira-euro volatility may consider expanding their production and trade activities. In contrast, sectors adversely affected by volatility may need to explore alternative strategies. This study highlights the importance of considering the asymmetric effects of volatility on trade volumes between the two countries, emphasizing the varying implications across specific industries. The empirical findings provide valuable insights for policymakers, market participants, and industry stakeholders to understand how exchange rate fluctuations impact bilateral trade dynamics. The industry-specific results also suggest that incorporating the effect of third-country volatility in export and import demand models is crucial to fully comprehending the actual pattern of trade between the two trading counterparts. Furthermore, the empirical findings of the linear ARDL model suggest that currency misalignment negatively affects Turkey's economic growth. Nevertheless, the nonlinear ARDL model reveals that both overvaluation and undervaluation hinder economic growth in Turkey. Therefore, the study recommends that Turkey should adopt a market-based exchange rate policy to reduce currency misalignment. Additionally, the central bank of the republic of Turkey (CBRT) should intervene in the exchange market in the short-run to mitigate significant uncertainties in exchange rates and avoid inefficiencies in resource allocation.

Keywords: third-country risk, exchange rate uncertainty, asymmetry analysis, Turkish-German commodity trade, currency misalignment, economic growth, NARDL.

ÖZ

Türkiye'de Döviz Kuru Dinamikleri, Ticaret ve Büyüme Bağlantısı Üzerine Yazılar

Khalid, Waqar
Doktora, İktisat Bölümü
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Eylül, 2023, 428 (sayfalar)

Bu araştırma, döviz kuru belirsizliğinin Türkiye ile Almanya arasında ticareti yapılan malların ihracat ve ithalat hacimleri üzerindeki etkisini araştırmaktadır. Önceki ampirik çalışmalar, toplama yanlılığından muzdaripti ve döviz kuru belirsizliği ile ticaret hacimleri arasında simetrik bir ilişki olduğunu varsayıyordu. Ancak son zamanlardaki ampirik çalışmalar bu ilişkide asimetrinin varlığını kabul etmiştir. Bu nedenle bu çalışma, döviz kuru oynaklığının iki ülke arasındaki ikili ticaret hacimleri üzerindeki simetrik ve asimetrik etkilerini değerlendirmek için sektör verilerini kullanmaktadır. Ayrıca çalışma, üçüncü ekonomi riskinin iki ülke arasındaki emtia ticareti akışları üzerindeki simetrik ve asimetrik etkilerini incelemektedir. Çalışma aynı zamanda döviz kurundaki sapmanın Türkiye'nin ekonomik büyümesi üzerindeki simetrik ve asimetrik etkilerini de araştırıyor. Çalışma, döviz kurundaki sapmayı hesaplamak için Hodrick-Prescott (H-P) filtre tekniğini kullanmaktadır. Ayrıca çalışma, döviz kuru belirsizliğini ölçmek için genelleştirilmiş otoregresif koşullu değişen varyans (GARCH) spesifikasyonunu kullanmaktadır. Mevcut araştırmanın hedeflerine ulaşmak için, çalışma, önerilen ticaret modellerinin kısa vadeli ve uzun vadeli tahminlerini türetmek için otoregresif dağıtılmış gecikme (ARDL) metodolojisinin yanı sıra doğrusal olmayan ARDL (NARDL) metodolojisini de kullanmaktadır.

Çalışmanın ampirik sonuçları sektöre özeldir ve lira-euro oynaklığında bir artışın (azalışın), özellikle hem küçük hem de büyük sanayiler için Türkiye'nin Almanya'ya (Almanya'dan) ihracatını (ithalatını) artırdığını (azalttığını) göstermektedir. Çalışma, lira-euro dalgalanmasından faydalanan ihracat ve ithalat sektörlerinin üretim ve ticaret faaliyetlerini genişletmeyi düşünebileceklerini öne sürüyor. Buna karşılık volatiliteden olumsuz etkilenen sektörlerin alternatif stratejiler keşfetmesi gerekebilir. Bu çalışma, oynaklığın iki ülke arasındaki ticaret hacimleri üzerindeki asimetrik etkilerini dikkate almanın önemini vurgulayarak, belirli sektörler arasında değişen etkileri vurgulamaktadır. Ampirik bulgular, politika yapıcılara, piyasa katılımcılarına ve sektör paydaşlarına döviz kuru dalgalanmalarının ikili ticaret dinamiklerini nasıl etkilediğini anlama konusunda değerli bilgiler sağlıyor. Sektöre özgü sonuçlar aynı zamanda üçüncü ülke oynaklığının etkisini ihracat ve ithalat talep modellerine dahil etmenin, ticaret yapan iki taraf arasındaki gerçek ticaret modelini tam olarak anlamak için çok önemli olduğunu göstermektedir. Ayrıca, doğrusal ARDL modelinin ampirik bulguları para birimi uyumsuzluğunun Türkiye'nin ekonomik büyümesini olumsuz etkilediğini göstermektedir. Bununla birlikte doğrusal olmayan ARDL modeli, Türkiye'de hem aşırı değerlemenin hem de düşük değerlemenin ekonomik büyümeyi engellediğini ortaya koymaktadır. Bu nedenle çalışma, Türkiye'nin para birimi uyumsuzluğunu azaltmak için piyasaya dayalı bir döviz kuru politikası benimsemesini önermektedir. Ayrıca döviz kurlarındaki önemli belirsizliklerin azaltılması ve kaynak tahsisindeki verimsizliklerin önlenmesi için Türkiye Cumhuriyet Merkez Bankası'nın (TCMB) kısa vadede döviz piyasasına müdahale etmesi gerekmektedir.

Anahtar Kelimeler: üçüncü ülke riski, döviz kuru belirsizliği, asimetri analizi, Türk-Alman emtia ticareti, para birimi uyumsuzluğu, ekonomik büyüme, NARDL.

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LIST OF ABBREVIATIONS

ADF:	Augmented Dickey-Fuller
AIC:	Akaike Information Criterion
APEC:	Asia-Pacific Economic Cooperation
ARCH:	Autoregressive conditional heteroscedasticity
ARDL:	Autoregressive Distributed Lag
BEER:	Behavioral equilibrium exchange rate
B-K:	Baxter-King
BRSA:	Banking Supervision and Regulation Agency
CA:	Current account
CBRT:	Central Bank of the Republic of Turkey
CMB:	Capital Markets Board
CPI:	Consumer Price Index
CUSUM:	Cumulative Sum of Recursive Residuals
CUSUMSQ:	Cumulative Sum of Squares of Recursive Residual
DARER:	Debt Adjusted Real Exchange Rate
DM:	Dummy Variable
ECM:	Error correction model
ECT:	Error Correction Term
EG:	Economic growth
EMU:	Expected marginal utility
ER:	Exchange rate
ERER:	Equilibrium real exchange rate
ERV:	Exchange rate volatility
EU:	European Union
EU-27:	European Union with 27 member countries
FDI:	Foreign direct investment
FEER:	Fundamental equilibrium exchange rate
FRER:	Fundamental Real Exchange Rate
GARCH:	Generalized Autoregressive Conditional Heteroscedasticity
GMM:	Generalized Method of Moments
H-O:	Heckscher-Ohlin
H-P:	Hodrick-Prescott

I.E:	Income effect
IFS:	International Financial Statistics
IIT:	Intra-industry trade
IMF:	International Monetary Fund
LPI:	Logistic Performance Index
LR:	Long run
M:	Import
MENA:	Middle East and North Africa
MNF:	Most Favored Nation
NAFTA:	North American Free Trade Agreement
NARDL:	Nonlinear Autoregressive Distributed Lag
NATREX:	Natural real exchange rate
NEER:	Nominal effective exchange rate
NEG:	Negative
NEX:	Nominal exchange rate
NFA:	Net foreign assets
NPV:	Net present value
NTM:	Non-tariff measures
NTT:	New trade theory
OECD:	Organization for Economic Co-operation and Development
OLS:	Ordinary Least Squares
PEER:	Permanent Equilibrium Exchange Rate
POS:	Positive
PP:	Phillips-Perron
PPP:	Purchasing power parity
R&D:	Research and development
REER:	Real effective exchange rate
RERMIS:	Real exchange rate misalignment
REX:	Real exchange rate
S.D:	Standard deviation
S.E:	Substitution effect
S:	Stable
SIC:	Schwartz Information Criterion
SITC:	Standard International Trade Classification

SR:	Short run
T.E:	Total effect
TB:	Trade balance
TCV:	Third-country volatility
TL:	Turkish lira
TurkStat:	Turkish Statistical Institute
U.K.:	United Kingdom
U.S.:	United States
UN:	United Nations
US:	Unstable
VAR:	Vector autoregressive
VECM:	Vector Error Correction Model
WDI:	World Development Indicators
WEO:	World Economic Outlook
WITS:	World Integrated Trade Solution
WPI:	Wholesale Price Index
WTO:	World Trade Organization
X:	Export

CHAPTER I
Introduction

1.1 Background

The academic history of flexible exchange rates dates back to the 1970s when the Bretton Woods system collapsed, leading to the abandonment of pegged exchange rates and the significant devaluation of the United States (U.S.) dollar in 1973 (Krugman, 1973; Edwards, 1993; Obstfeld et al., 1997; Bordo, 2017). Subsequently, numerous theoretical and empirical research has extensively examined the influence of flexible exchange rates on trade volumes for both developing and developed countries (Choudhry & Hassan, 2015). The exchange rate (ER) is an essential monetary instrument and a primary transmission mechanism for determining policy effectiveness (Abbasi & Iqbal, 2021). It possesses the potential to exert influence over both export (X) and import (M) flows, thereby shaping a country's international trade dynamics (Montiel, 1999).

Understanding the critical role of exchange rates in transmitting external shocks to the economy, it becomes imperative to comprehend the implications of changes in exchange rates on exports, imports, and domestic economic activities, which have significant policy implications (Rodrik, 2008; Baek, 2014). Frequent fluctuations in exchange rates can lead to heightened instability in exported and imported goods prices. This, in turn, increases the risks associated with foreign transactions (Cottani et al., 1990). As a consequence, many economies may face elevated levels of risk, shorter investment horizons, and greater adjustment costs as investment moves between tradable and non-tradable sectors (Rodrik, 2008; Nicita, 2013; Frenkel & Rapetti, 2014; Guzman et al., 2018). Similarly, risk-averse investors and traders respond by reallocating resources from tradable to non-tradable sectors (Branson & School, 1985; Abbasi & Iqbal, 2021). As a result, the sectoral transformation leads to higher adjustment costs, which can manifest an increased interest rate volatility, financial instability, and fluctuations in economic growth (Guzman et al., 2018; Abbasi, 2021).

Macroeconomic policies like exchange rate management are crucial for a country's economic growth. Fluctuations in exchange rates directly impact international trade by influencing the prices of goods and services. When a country's currency depreciates, its exports become cheaper, boosting competitiveness and potentially increasing export volumes. This outcome can stimulate economic growth, generate revenue, and create employment. Conversely, currency appreciation may reduce export competitiveness, hampering economic growth (Naseem & Hamizah, 2013). Exchange rate changes affect inflation, as currency depreciation increases import prices and potential inflationary pressures. Conversely, appreciation can lower imported commodities prices, resulting in lower inflation.

Furthermore, exchange rate fluctuations influence a country's investment attractiveness. Currency depreciation can make a country's assets cheaper for foreign investors, encouraging capital inflows that promote economic growth and infrastructure development. Conversely, appreciation may deter foreign investment by reducing returns (Edwards, 1993). Exchange rate changes also influence a country's external debt burden and balance of payments. Depreciation increases the value of foreign currency-dominated debt, potentially straining debt servicing capabilities. Furthermore, fluctuations in exchange rates notably influence the values of imports and exports. These fluctuations, in turn, have consequences for the balance of payments and affect both macroeconomic stability and economic growth (Conrad & Jagessar, 2018; Abbasi, 2021).

Doroodian et al. (2002) proposed that countries that adopt suitable exchange rate policies have the potential to improve the competitiveness of their domestic firms in the global marketplace. Johnson et al. (2006) viewed exchange rate policies as "growth levers," even in economically weak countries with underdeveloped financial institutions. The persistently over-valued exchange rate tends to explain persistent price misalignment within and across countries, impacting the overall economic growth level and pattern (Mcpherson & Rakovski, 2000). An exchange rate perceived as misaligned is thought to carry substantial implications for societal welfare and a nation's economic growth. These implications, notably, encompass issues such as capital flight, export competitiveness, external debt, and the state of the balance of payments. Gala and Lucinda (2006) have highlighted that the persistent overvaluation of real exchange rates leads to a decline in consumer confidence and is expected to affect savings and investment levels, subsequently weakening businesses and impacting economic activity[1].

In addition, Razin and Collins (1997) and Aizenman and Lee (2010) have presented evidence supporting the notion that the overvaluation of a country's domestic currency can lead to currency crises and hinder economic growth, particularly in numerous developing countries. Several developing countries, including Turkey, Argentina, Mexico, Brazil, and East Asian countries, have experienced currency crises and economic decline due to persistent

[1] It is widely recognized that certain currencies, such as the Swiss franc, exhibit persistent overvaluation over extended periods, while others, like the Chinese currency, demonstrate enduring undervaluation. The factors influencing exchange rates vary, with political strategies being employed in some instances to influence the exchange rate, while in other cases, market dynamics play a significant role in determining exchange rates.

overvaluation. Conversely, East and Southeast Asian countries with sustained economic growth consistently avoid overvaluation (Alper & Civcir, 2012).

Furthermore, empirical studies conducted by (Abbasi and Iqbal, 2021; Akram and Rath, 2017; Dubas, 2012; Elbadawi et al., 2012; Iqbal et al., 2023) have also demonstrated that overvaluation adversely affects economic growth, while undervaluation promotes it. Nevertheless, empirical studies by (Hausmann et al., 2005; Zhang and Chen, 2014; Conrad and Jagessar, 2018) have highlighted the potential harm to economic growth caused by undervaluation. Some empirical studies (Terra and Valladares, 2010; Couharde and Sallenave, 2013) have also pointed out the detrimental effects of extreme undervaluation beyond a certain threshold on economic growth. Hence, it is possible to conclude that within the empirical literature on international trade, an apparent dichotomy emerges regarding the effects of exchange rate uncertainties on economic performance.

1.2 The Volatility-Trade Nexus

Exchange rate uncertainty refers to the extent of fluctuations or instability in a nation's currency value relative to other currencies. Since the 1970s, a substantial body of research has investigated the effects of exchange rate uncertainties on trade volumes. This research includes studies conducted by Magee (1973), Branson (1985), Nicita (2013), Baek (2014), and Šimáková (2018). However, the conclusions drawn from these studies have been mixed. Numerous works, including those by Ethier (1973), Hooper and Kohlhagen (1978), Kawai and Zilcha (1986), Gagnon (1993), Poon et al. (2005), Thorbecke (2008), Mukherjee and Pozo (2011), and Haile and Pugh (2013), have observed evidence suggesting that exchange rate uncertainty negatively impacts trade flows. On the contrary, theoretical studies led by De Grauwe (1988), Franke (1991), Viaene and De Vries (1992), and Broll and Eckwert (1999) argue that exporters with a high level of risk aversion might, in the short-term, expand their exports to increase their marginal utility of export earnings[2]. This suggests a direct link between exchange rate uncertainty and trade volumes. Empirical studies conducted by Sercu (1992), Sercu and Vanhulle (1992), Bredin et al. (2003), and Hsu and Chiang (2011) have established a direct link between exchange rate uncertainty and foreign trade flows. Conversely, a few other empirical investigations, such as those conducted by Bailey et al. (1986), Willett (1986), Holly (1995), De Vita and Abbott (2004), and Caglayan and Di (2010), have found no significant connection between exchange rate variability and trade volumes.

[2] These studies provide insight into the behavior of risk-averse exporters and highlight the potential short-term benefits of such an approach.

De Grauwe (1988) posits that the influence of exchange rate volatility on trade flows is contingent on the attitudes of traders and investors toward risk. Traders with risk-averse tendencies are more likely to respond to exchange rate volatility by refraining from trading. On the other hand, risk-seeking traders or investors tend to increase their economic activity to avoid potential future income losses. To determine how exchange rate uncertainty ultimately impacts trade volumes, traders must determine whether their behavior is predominantly risk-averse or risk-seeking. This highlights the significance of individual risk preferences in shaping the connection between exchange rate uncertainty and trade volumes.

Similarly, Abbasi (2021) stated that fixed exchange rates offer predictability and stability, promoting trade. However, flexible exchange rates introduce volatility, creating uncertainty and hindering trade flows. Fluctuating exchange rates elevate risks and create complexities for businesses in planning and making well-informed trade decisions. Market participants with higher risk aversion may be less willing to hedge against exchange rate uncertainties, resulting in higher costs. This exposure to exchange rate fluctuations discourages trade and reduces firms' willingness to engage in international transactions.

These issues become particularly significant for countries that adopt flexible exchange rate regimes, as they tend to experience higher instability associated with exchange rate fluctuations (Brodsky, 1984; Obstfeld & Rogoff, 1995). The higher the exchange rate volatility, the more challenging it becomes to predict and plan for trade activities. This uncertainty hampers investment decisions, as businesses face heightened risk and uncertainty when considering foreign investments. Developing countries, in particular, experience significant repercussions from exchange rate variability, exerting an influence on trade volumes, especially concerning exports, a critical concern. In light of this, making informed decisions regarding exchange rate policies and selecting a feasible system is highly relevant. Adopting favorable policies to manage exchange rate fluctuations effectively can contribute to a stable and conducive environment for trade, investment, and overall economic growth (Abbasi, 2021).

The empirical literature highlights that exchange rate volatility affects investment decisions and economic growth. Uncertainty from exchange rate fluctuations can harm economic performance (Campa & Goldberg, 1995). Therefore, policymakers and economists emphasize stabilizing real exchange rates to enhance economic conditions. Exchange rate volatility can harm short-term and long-term export demand by disrupting price signals and reducing competitiveness. This uncertainty leads to a decline in export demand, affecting overall trade volume. Moreover, market participants reallocate resources among sectors and countries to react to exchange rate fluctuation, which can further influence trade volumes (Arize et al., 2000; Caballero & Corbo, 1989).

More importantly, within the empirical literature, it has been firmly established that studies assessing the influence of exchange rate variability on trade volumes, mainly when based on aggregate-level trade data, frequently exhibit an aggregation bias. As a result, recent empirical research underscores the importance of addressing this concern by investigating the effects of exchange rate fluctuations on foreign trade volumes at the commodity level while considering industry-specific trade data. This approach is considered a means to rectify the aggregation bias and yield empirical results that are more reliable and accurate[3].

1.3 The Misalignment-Growth Nexus

In principle or ideally, a country's exchange rate policy should be grounded on the supply and demand forces determining the value of its currency. Accordingly, exports and imports should be governed by a market-determined exchange rate. However, in developing markets, including Turkey, the exchange rate policy is often influenced by the dynamics of trade flows, global socioeconomic conditions, and, most importantly, the political considerations of the country (Iqbal et al., 2023). Therefore, in most cases, the observed exchange rate of the Turkish lira (TL) deliberately deviates from the desired one (Hagen & Zhou, 2005; Alesina & Wagner, 2006; Evenett, 2010; Nouira et al., 2011).

In the case of Turkey, Atasoy and Saxena (2006) reported that the TL was kept overvalued[4] before the 1994 and 2001 crises. They concluded that persistent overvaluation of the TL led to external imbalances by artificially increasing imports and reducing exports through nominal price effects. In other words, an overvalued exchange rate makes a country's exports more expensive in foreign markets, reducing its competitiveness. This can result in a decline in export volume, negatively impacting export-oriented industries, leading to lower production, job losses, and reduced economic performance. Conversely, an overvalued exchange rate tends to increase the attractiveness of imports as they become relatively cheaper. This can lead to higher import volumes and a trade deficit. A persistent trade deficit can strain the economy as it indicates a net outflow of currency and may require increased borrowing to finance the

[3] Bilateral studies that consider industry-specific trade data offer a more comprehensive understanding of the influences of exchange rate volatility on trade volumes. Various industries may exhibit differing levels of sensitivity to exchange rate fluctuations, influenced by factors such as price elasticity, production costs, and market structure.

[4] An overvalued exchange rate pertains to a scenario in which a country's currency possesses a higher value than its fundamental or equilibrium level. In simpler terms, the currency is considered to be overpriced relative to its economic fundamentals, including inflation, productivity, and trade balance.

imbalance. Maintaining persistently overvalued exchange rates could also destabilize a country's financial system, as a significant misaligned currency could trigger a sharp correction at some point. Similarly, persistent currency misalignments would distort resource allocation as ER misalignments generate false price signals for stakeholders.

It should be noted that an overvalued exchange rate can also have adverse effects on an economy, causing trade imbalances and slower economic growth (EG). Conversely, an undervalued exchange rate[5] can lead to inflationary pressures by making imports more expensive and limiting domestic investment resources, thereby hindering supply-side growth[6]. However, an undervalued exchange rate may also make a country more attractive for foreign direct investment (FDI), attracting more foreign capital inflows, promoting technology transfers, stimulating industrial development, and supporting economic growth. Hence, it can be concluded that the undervaluation and overvaluation of currencies have diverse effects on economic growth.

Given the export-oriented growth policies and trade liberalization reforms in Turkey in the 2000s, exchange rate misalignment can have significant implications for Turkey's export flows and economic growth. The Turkish economy has faced several macroeconomic challenges, including a persistent current account deficit, high inflation, deteriorating exchange rates, high unemployment, and slow economic growth (Atasoy & Saxena, 2006). Furthermore, the economy has been impacted by lower foreign exchange reserves due to underdeveloped financial markets and reduced investor participation caused by ongoing political and economic uncertainties.

Theoretically, the RER is crucial in economic activities for multiple reasons. Firstly, fluctuations in the RER (i.e., real appreciation or depreciation) substantially influence trade patterns, particularly exports and imports. If a country's RER experiences depreciation, its goods and services become relatively more affordable, increasing exports (Sekkat & Varoudakis, 2000). Conversely, an appreciation in the RER leads to higher costs and an upsurge in imports (Salehi-Isfahani, 1989). Secondly, an unstable RER generates uncertainty with unfavorable consequences. Studies (Caballero and Corbo, 1989; Chowdhury, 1993) have

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[5] An undervalued exchange rate refers to a situation where a country’s currency is priced lower than its fundamental value or equilibrium level. This means that the currency is considered to be cheaper or undervalued relative to its economic fundamentals, such as inflation, productivity, and trade balance.

[6] However, an undervalued exchange rate can also enhance the completeness of a country’s exports. It makes domestic goods and services relatively cheaper for foreign buyers, which can lead to increased demand for exports. This boost in export volumes can drive economic growth by stimulating production, creating employment opportunities, and generating export revenues. This policy can also contribute to a reduction in trade deficits and a more favorable balance of trade, which can support economic growth.

concluded that increased RER uncertainty significantly impacts a country's exports. High exchange rate uncertainty reduces investor motivation and confidence, making investment decisions more challenging and riskier (Servén, 2003). In a nutshell, the RER plays a crucial role in economic activities, mainly due to its effects on trade direction and the implications of exchange rate volatility. Variabilities in the RER can shape trade dynamics and significantly impact a country's competitiveness in international markets. Moreover, a stable RER fosters a predictable investment climate, promoting investor confidence and attracting capital inflows.

In the age of financial globalization, where cross-border economic activity is increasingly interconnected, the behavior of the RER is crucial for formulating effective macroeconomic policies (Edwards, 1989). Researchers suggest that maintaining the RER at the *"wrong"* level can negatively impact a country's competitiveness and economic growth (Doroodian et al., 2002). This misalignment can result in misleading signals for economic actors, leading to more significant economic uncertainty (Willet, 1986). Therefore, economists and policymakers must assess the extent of RER misalignment to determine the economy's competitiveness (Alper & Sağlam, 2000; Atasoy & Saxena, 2006). Countries experiencing higher ER volatility are more likely to face currency appreciation and depreciation trends contributing to exchange rate misalignments, which can hinder sustainable economic growth (Nicita, 2013; Ali et al., 2015; Abbasi & Iqbal, 2021).

Numerous empirical attempts have assessed the influence of currency misalignment on Turkey's economic growth, leading to diverse and inconclusive findings (MacDonald & Vieira, 2010; Dubas, 2012; Vieira & MacDonald, 2012; Mamun, 2019; Mamun et al., 2020, 2021). For instance, Mamun et al. (2020) concluded that currency misalignment harms Turkey's economic growth, while MacDonald and Vieira (2010) reported that it promotes long-term economic growth in the country. Similarly, some studies have posited that undervaluation has a positive effect on the economic growth of developing and emerging economies, while others have demonstrated the detrimental effects of overvaluation on the economic growth of different economies (Razin & Collin, 1997; Kaminsky & Reinhart, 1999; Rodrik, 2008; Aizenman & Lee, 2010; Nasim & Hamizah, 2013).

1.4 Central Theme of the Study

1.4.1 The Exchange Rate Volatility and Commodity Trade

Research into the correlation between exchange rate uncertainty, foreign trade, and economic growth has experienced substantial growth in both developing and developed countries. Over the past fifty years, numerous empirical studies have focused explicitly on investigating this relationship in the context of Turkey. The existing empirical literature in this area can be broadly classified into three categories. The first category involves studies that analyze Turkey's overall trade with the global economies utilizing data at the aggregate level.

The empirical attempts such as Caballero and Corbo (1989), Doğanlar (2002), Altintaş et al. (2011), Davis (2014), and Yildirim & Saraç (2022) fall into this category. However, these studies have faced criticism due to the potential aggregation bias they may produce. The second category comprises studies that utilize a panel of aggregate bilateral-level data to explore the influence of ER volatility on trade volumes. Scholars such as Thursby & Thursby (1985), Bahmani-Oskooee and Ltaifa (1992), Demez and Ustaoğlu (2012), Alper (2017), Güngör et al. (2022), and Yildirim and Saraç (2022) have contributed this category. Nonetheless, these empirical studies have also been criticized for potentially generating country-specific results and encountering another aggregation bias.

In the post-2007 era, researchers have increasingly focused on industry-specific trade data to tackle the issues associated with aggregation bias. They have investigated the association between exchange rate volatility and trade volumes at the sectoral level. Notable studies in this domain include those conducted by Bahmani-Oskooee and Durmaz (2016), Bahmani-Oskooee et al. (2017), Bahmani-Oskooee and Aftab (2018), Bahmani-Oskooee and Kanitpong (2019), Chien et al. (2020), Baek and Nam (2021), Iqbal et al. (2022), and Khalid et al. (2023). These studies have yielded industry-specific outcomes, unveiling diverse effects across various sectors. The use of sectoral data offers several advantages in mitigating aggregation bias.

Nevertheless, there remains a gap in empirical research in Turkey, where specific examinations into the impact of exchange rate uncertainty on trade volumes at the sectoral level are lacking. Bahmani-Oskooee et al. (2016) have argued that bilateral studies employing industry-specific data provide valuable insights into both the negative and positive effects of volatility on commodity trade. However, prior studies have predominantly relied on aggregate-level trade flows between a country and the world economies or aggregate trade flows between a panel of major trading partners.

1.4.2 The Third-Country Volatility Risk and Commodity Trade

Recent empirical studies have shed light on a potential hidden association between exchange rate uncertainty and trade volumes, suggesting that positive and negative movements in exchange rates may exert distinct influences on export and import volumes (Fedoseeva, 2016; Bahmani-Oskooee & Aftab, 2017, 2018). Bahmani-Oskooee and Aftab (2017) presented evidence supporting the notion that trade flows display asymmetric responses to exchange rate volatility. They pointed out that traders' expectations undergo significant changes when currency volatility increases compared to when it decreases, resulting in an asymmetric response in trade flows.

The study conducted by Bahmani-Oskooee and Saha (2020) highlights the phenomenon of enhanced optimism among traders regarding the potential for more stable exchange rates in the future. Specifically, the study shows that if a country experiences an increase in exchange rate uncertainty (x%), leading to a corresponding decrease in exports (y%), a subsequent decrease in volatility could result in a more substantial increase in exports, exceeding the initial decline. This finding underscores the significance of comprehending the asymmetric effects of volatility on trade volumes and the possibility that optimism can play a crucial role in driving trade growth.

According to Bahmani-Oskooee et al. (2019), asymmetric effects of exchange rate uncertainty can be attributed to changes in traders' expectations, firms' hedging strategies, and downward price rigidity. Ali (2019) further suggested that traders who emphasize losses over gains from holding foreign exchange hedges may trade differently, leading to an asymmetric response. Recent empirical studies conducted by (Nusair, 2017; Arize et al., 2017; Bahmani-Oskooee and Saha, 2020; Baek and Nam, 2021; Bahmani-Oskooee and Karamelikli, 2022; Lee et al., 2022; Rasaki & Oyedepo, 2023) have provided evidence supporting the presence of nonlinear effects of volatility on trade.

According to the studies conducted by Ethier (1973) and Gotur (1985), risk-averse traders tend to curtail their trading activities when uncertainty increases. This demonstrates that bilateral trade between two trading partners might decrease as volatility rises. However, it is crucial to acknowledge that a country's trade is not limited to a single partner but encompasses multiple trading partners. Moreover, another strand of empirical research has highlighted the concept of a "third-country effect." As proposed by Cushman (1986), risk-averse traders may respond to increased exchange rate volatility between two specific countries by shifting their trade to a third-country. If lira–euro volatility increases, Turkey might shift trade activities to a third-economy (the U.S.), thereby hindering its trade with Germany. Conversely, higher lira-dollar volatility could reduce Turkish trade with the U.S., substituting U.S. markets with German markets.

The designation of the U.S. as a third-country in the current empirical analysis stems from its significant position in Turkey's trade dynamics. Turkey's exports to the U.S. were valued at $10.2 billion in 2020, representing 6 percent of the country's total exports (UN Comtrade database, 2023). Furthermore, being the world's largest economy, the U.S. holds a crucial position in the world economy. In contrast, the imports of Turkey from China have increased gradually in the last decade, but its exports to China have not followed the same upward trend. It is worth noting that China's economic and political system exhibits greater control and authoritarianism than the more capitalist and democratic structure of the U.S. (Usman et al., 2021). This illustrates the diversity of Turkish trading partners' economic structures. Given these realistic grounds, the U.S. is a compelling third-country choice that can contribute to the analysis of Turkish trade with Germany.

Studies investigating third-country risk have consistently shown that external volatility exerts a considerable impact on trade flows between two bilateral trade partners (Choudhry et al., 2014; Bahmani-Oskooee et al., 2017; Soleymani et al., 2017; Khalid et al., 2023; Imane et al., 2023). Consequently, the influence of third-economy variability on trade volumes between two trading partners cannot be neglected. Baek (2014) reports that studies neglecting the third-country effect in their econometric models are likely to be misspecified[7], raising questions about the validity of empirical estimates. Furthermore, Bahmani-Oskooee et al. (2013) argue that an external effect is confirmed when the estimates of bilateral volatility change upon considering the third-country effect. Taking the third-country effect into account offers a more precise understanding of the real-world scenario where multiple countries are involved, and traders from one nation may opt to trade with another nation with lower risks, as trade risks can elevate the prices of goods (Karabulut *et al.,* 2020). As exchange rates are proxy prices for commodities, fluctuations in a specific partner's exchange rate may redirect trade to other countries (Bahmani-Oskooee *et al.,* 2013).

Bahmani-Oskooee and Xu (2012) and Bahmani-Oskooee and Aftab (2018) reported more robust and significant estimates when they incorporated the impact of third-economy risk in their studies. The concept of the third-economy risk was introduced by Cushman (1986) when he analyzed how exchange rate uncertainty impacted multilateral trade involving the U.S. and its largest trading partners. Cushman argues that omitting third-country volatility could influence the original volatility estimates because this determinant is pivotal in shaping trade relationships between the U.S. and its major trading partners. Expanding on Cushman's notion, Choudhry et al. (2014) illustrated the importance of considering the external effect in the context of U.K. imports from the U.S., Japan, and Germany.[8]

[7] Omitted variable bias

[8] When analyzing *ASEAN* countries' bilateral trade with their trading partners, Soleymani et al. (2017) recorded identical results.

In the context of Turkey, there is a lack of empirical research assessing the impact of third-economy risk on export and import volumes between Turkey and Germany at the commodity level. Therefore, this study aims to fill this research gap and assess the influences of external volatility risk on commodity trade between the two countries. To capture the "third-country effect," the analysis incorporates fluctuations in the lira-dollar exchange rate. The study examines 79 export and 93 import industries engaged in Trade with Germany, offering a comprehensive analysis of the potential influences of external uncertainty risk on their trade dynamics.

Notably, previous studies have traditionally operated under the assumption that exchange rate uncertainty impacts trade volumes symmetrically[9]. However, Bahmani-Oskooee and Aftab (2017) challenged this notion by demonstrating that exchange rate variability can exhibit asymmetric effects on trade volumes. Following this doctrine, the current study adopts the same perspective and considers the possibility of asymmetric effects in the measures of exchange rate volatility. Thus, this study aims to investigate whether exchange rate volatility and third-country volatility effects influence Turkey's trade flows symmetric or asymmetric. To achieve this objective, the study utilizes the ARDL and non-linear ARDL methodologies developed by Pesaran et al. (2001) and Shin et al. (2014).

1.4.3 Misalignment-Growth Nexus in Turkey: Unveiling Asymmetric Patterns

The association between currency misalignment and Turkey's economic growth has received insufficient attention from economists, policymakers, and researchers in the existing empirical literature. While there have been some empirical studies investigating this relationship in the Turkish context, such as those conducted by MacDonald & Vieira (2010), Dubas (2012), Vieira and MacDonald (2012), Mamun (2019), and Mamun et al. (2020, 2021), these studies have faced intense criticism for adopting a symmetric approach. Specifically, these studies have assumed that undervaluation and overvaluation of currency have a symmetric impact on economic growth. However, researchers consider the assumption of symmetry too restrictive or oversimplified, which has led to considerable skepticism regarding the reliability and accuracy of the reported findings in these studies.

Recent empirical research has revealed that deviations from the equilibrium real exchange rate (ERER), whether in the form of undervaluation or overvaluation, tend to produce asymmetric effects on economic growth (Rodrick, 2008; Akram & Rath, 2017; Bahmani-

[9] For an increase in volatility to improve trading, the decline in volatility must also have the same effect.

Oskooee et al., 2017; Bahmani-Oskooee & Aftab, 2018; Conrad & Jagessar, 2018; Abbasi & Iqbal, 2021; Iqbal et al., 2022, 2023). Building upon these findings, the present empirical study investigates the symmetric and asymmetric effects of currency misalignment on Turkey's economic growth using ARDL and NARDL methodologies.

The present study makes notable contributions to the existing international macroeconomics literature in three distinct ways. Firstly, given its status as an emerging open economy, Turkey has witnessed a faster economic growth rate in the past decade than other developing and emerging economies. After the 2001 Turkish economic crisis, Turkey transitioned from a fixed exchange rate to a floating exchange rate regime. The country has experienced a growth surge driven by higher capital inflows, mainly from FDI, and significant exchange rate volatility. The instability in the foreign exchange market has prompted Turkish policymakers to deviate the RER from its ERER. Secondly, this study estimates the ERER by considering the long-term macroeconomic fundamentals of the RER, taking into account both internal and external equilibrium. Therefore, investigating the influence of misalignment on growth becomes crucial in this context. Lastly, the study addresses how overvaluation or undervaluation influences Turkey's economic growth.

1.5 Turkey-Germany Trade: Key Highlights

This research investigates the effects of lira-euro volatility and lira-dollar variability on trade volumes between Germany and Turkey. According to the UN Comtrade database (2023), Germany stands as Turkey's top export destination, constituting 8.32% of Turkey's exports to Germany, amounting to $21,144 million in 2022. On the other hand, Turkey's imports from Germany totaled $24,033 million, accounting for 6.61% of overall imports. In particular, Turkey's primary exports include textiles, machinery, road vehicles, boilers, and parts and accessories for motor vehicles. Conversely, the primary imports of Turkey from Germany encompass pharmaceutical products, aircraft parts, road vehicles, boilers, machinery, plastics and products, and parts and accessories for motor vehicles.

The advanced technology industries, such as machinery, textiles, aircraft, telecommunications, and transportation equipment, contribute over 40% of Turkey's total exports (imports) to (from) Germany. In the past two decades, German corporate investment has been one of Turkey's most significant foreign investments, focusing on renewable energy[10], agricultural products and textiles, industrial products, organic chemicals, consumer goods,

[10] German companies have invested a substantial amount of approximately 25 billion euros in the energy sector of Turkey.

transportation, and electrical appliances. Additionally, around 200,000 people are employed by Turkish businessmen's companies in Germany, with an annual turnover of 45 billion euros. Moreover, Germany's foreign direct investment in Turkey reached $14,924 million, accounting for 10.63% of the total German FDI in 2021. Meanwhile, $2,858 million, accounting for 5.55% of Turkey's total FDI, flowed from Turkey to Germany in 2021.

In the 2000s, Turkey undertook structural reforms to establish a conducive business environment for foreign investors, leading to notable advancements in the 2020 ranking of the ease of doing business, where it now holds the 33rd position (Business, 2020). In 2019, the number of German tourists visiting Turkey reached 5 million. Therefore, Germany is the second most important country for Turkey's tourism industry after Russia. Given Germany's importance in Turkey's foreign trade, financial and technical cooperation, tourism, and defense industry, conducting an empirical study on bilateral trade relations between the two countries in the context of bilateral volatility and third-country volatility effects is crucial.

1.6 Objectives of the Study

Given the concerns mentioned above, the objectives of the current study are designed as mentioned: Firstly, the primary objective of this empirical research is to explore the influence of real bilateral exchange rate uncertainty on trade flows between Turkey and Germany at the commodity or industry level. To this end, the study addresses the following sub-objectives:

(a) To assess the symmetric impact of real lira-euro uncertainty on Turkish-German commodity trade flows.

(b) To assess the asymmetric influence of real lira-euro uncertainty on Turkish-German commodity trade volumes.

(c) To assess the impact of trade liberalization reforms on Turkish-German commodity trade flows in the presence of bilateral exchange rate volatility.

Secondly, the primary objective of this empirical research is to explore the effects of third-country uncertainty on bilateral trade volumes between Turkey and Germany at the commodity or industry level. To pursue this objective, the study addresses the following sub-objectives:

(a) To assess the symmetric impact of real lira-dollar exchange rate uncertainty on Turkish-German commodity trade volumes.
(b) To examine the asymmetric influence of real lira-dollar uncertainty on Turkey vs. Germany trade volumes at the industry level.
(c) To examine the impact of trade liberalization reforms on Turkish-German commodity trade flows in the presence of third-country exchange rate volatility.

Thirdly, the primary objective of this empirical research is to explore the impact of currency misalignment on Turkey's economic growth. To this end, the research encompasses the following sub-objectives:

(a) To examine the symmetric impact of currency misalignment on the economic growth of Turkey.
(b) To examine the asymmetric influence of currency misalignment on Turkey's economic growth.
(c) To examine the impact of the 1994 currency crisis on the economic growth of Turkey.

1.7 Research Questions

Given the current economic challenges in Turkey and the potential influence of bilateral and third-country exchange rate risk on Turkey vs. Germany commodity trade volumes and associated economic growth, the present study addresses the following six research questions:

(1) To what extent does lira-euro volatility symmetrically influence commodity trade between Germany and Turkey?
(2) To what extent does lira-euro volatility asymmetrically influence commodity trade between Germany and Turkey?
(3) To what extent does lira-dollar volatility symmetrically influence commodity trade volumes between Turkey and Germany?
(4) To what extent does lira-dollar volatility asymmetrically influence commodity trade volumes between Turkey and Germany?
(5) To what extent is the exchange rate in Turkey misaligned?
(6) Does an asymmetric long-term connection exist between currency misalignment and Turkey's economic growth?

1.8 Significance of the Study

This empirical research investigates the symmetric and asymmetric effects of uncertainty in the real lira-euro exchange rate on export and import commodity flows traded between Germany and Turkey. It also investigates the symmetric and asymmetric effects of uncertainty in the real lira-dollar exchange rate to capture the impact of third-economy risk on both export and import commodity flows traded between the two countries. The study empirically examines the symmetric plus asymmetric effects of real exchange rate misalignment on Turkey's economic growth. To accomplish this objective, the Hodrick-Prescott (H-P) filter method is employed to compute the permanent component of the RER (also known as the ERER). By calculating the difference between the actual RER and the ERER, the research assesses the degree of RER misalignment. Moreover, the study analyzes the effects of undervaluation and overvaluation on Turkey's economic growth. By comprehensively exploring these various aspects, the study aims to provide valuable insights into the complex relationships between exchange rate uncertainty, trade flows, and economic growth for Turkey and Germany.

Historically, the TL has frequently been overvalued due to frequent government intervention. This situation can harm Turkey's competitiveness in international markets, as its exports become less attractive to foreign buyers. Therefore, it is essential to investigate the effects of overvaluation on economic growth to help policymakers understand the potential damage to the country's export-oriented industries and take corrective measures to enhance competitiveness. Furthermore, overvaluation leads to a deterioration in the country's trade balance, with a decrease in exports and an increase in imports. This can strain the economy and necessitate external borrowing to finance the resulting deficit. Therefore, policymakers can develop strategies to address the current account imbalance and reduce vulnerabilities by assessing the impact of overvaluation on economic growth.

On the contrary, an undervalued currency has the potential to enhance a country's export competitiveness. However, it may also introduce certain risks, such as potential inflationary pressures from higher import prices. Therefore, a comprehensive investigation into the impact of currency misalignment on the competitiveness of exports becomes crucial for policymakers. Understanding these dynamics is essential to making informed decisions and supporting export-oriented sectors.

Furthermore, a study examining the effects of currency misalignment and exchange rate uncertainty on Turkey's economic growth will offer policymakers valuable insights. These insights can be vital in designing effective foreign exchange and trade policies to support the country's economic development. This research holds particular significance due to Turkey's less developed financial markets and the implications of flexible exchange rates on both trade volumes and economic growth. By delving into these aspects, the study can contribute crucial information to policymakers to foster sustainable economic growth and address potential challenges related to exchange rate dynamics.

The study's insights into the risk considerations associated with exchange rate misalignment can be instrumental in informing foreign investors about the current situation in Turkey. By understanding and hedging against these risks, investors can make more informed decisions regarding their future investments in the country. Furthermore, the research study highlights the importance of addressing currency uncertainties and misalignment to promote sustainable economic growth in Turkey. By recognizing the potential harm these factors can cause the economy, policymakers can devise appropriate measures to mitigate adverse effects, such as significant price fluctuations. This, in turn, can contribute to stabilizing the economy and fostering an environment conducive to increased economic growth in Turkey.

Turkey and Germany have led strong bilateral trade relations for the last decade. Germany is known for its robust manufacturing sector and exports, while Turkey boasts a diverse range of exports, including textiles, automotive products, and agricultural goods. Therefore, an in-depth analysis of the influence of third-country risk on the USD and bilateral trade volumes between the two countries is essential. The USD is widely acknowledged as the dominant global reserve currency and is pivotal in international trade and finance. As a result, fluctuations in the USD rate can have far-reaching influences on other economies, including Turkey and Germany. By comprehending how changes in the U.S. dollar influence trade between these two nations, valuable insights can be gained into the dynamics of their trade relationship and the broader implications of global economic trends. Such insights can aid policymakers and stakeholders in making well-informed decisions and developing strategies to navigate the complexities of the international economic landscape.

The impact of changes in USD on bilateral trade between the two countries can serve as a valuable tool for businesses and policymakers in identifying potential risks and developing appropriate risk management strategies. These strategies may include measures such as hedging against exchange rate fluctuations or diversifying trade relationships to mitigate risks associated with a specific currency. Moreover, this study’s findings can offer crucial insights for policymakers in both countries. Policymakers can make informed decisions and develop targeted policies and interventions by being aware of the potential effects of U.S. dollar volatility on their bilateral trade. These measures can help mitigate the adverse effects of exchange rate fluctuations, enhance trade stability, and foster stronger trade relations between the two countries. In conclusion, this study's outcomes can contribute significantly to informed decision-making by businesses and policymakers, paving the way for effective risk management strategies and promoting stable and mutually beneficial trade relations between Turkey and Germany.

1.9 Organization of the Study

The current study is organized into ten chapters. Chapter II comprehensively reviews theoretical and empirical literature examining the linkage between ER volatility and trade volumes. The chapter focuses on two main aspects: firstly, it investigates the influence of ER uncertainty on trade volumes between Turkey and Germany at different levels of analysis, including the aggregate, bilateral, and disaggregated trade levels. Secondly, the chapter delves into the empirical literature that explores the influence of third-economy risk on trade flows between the two countries, particularly at the disaggregated trade level. Additionally, this chapter presents a detailed overview of theoretical and empirical studies concerning the relationship between currency misalignment and economic growth, especially within the context of both fixed and floating exchange rate regimes in Turkey.

Chapter III provides the study's theoretical framework, which examines the underlying theoretical relationships between ER volatility, third-country risk, and trade volumes. This chapter discusses the factors responsible for either hampering or promoting foreign trade. Furthermore, it discusses the theoretical framework for exploring the nexus between misalignment and economic growth in Turkey. Additionally, Chapter III presents an overview of the theoretical literature by discussing various approaches researchers utilize to calculate the ERER. It addresses selecting an appropriate approach for determining the ERER within the context of the current empirical analysis. Moreover, the chapter outlines the methodology employed in this study to measure currency misalignment. Finally, this chapter offers an overview of the exchange rate dynamics of the Turkish lira and the historical evolution of different exchange rate regimes and macroeconomic developments in Turkey.

Chapter IV explores Turkey’s economic structure, delving into the multifaceted landscape of its economic development. It navigates through the historical evolution of the Turkish economy, highlighting the pivotal role of trade liberalization and structural change. The chapter discusses the dynamic Turkish-German trade relationship and uncovers challenges and prospects in foreign direct investment trends, sectoral diversification, and the share of export-import partners. The chapter not only explores the advantages and disadvantages of Turkey's global trade participation but also unravels recent trends and identifies major trade partners that shape Turkey's economic landscape. The chapter also covers recent trends in the trade balance and highlights Turkey's top export and import partners. Lastly, the chapter identifies the countries responsible for Turkey's largest trade deficits and surpluses.

Chapter V delves into the underlying relationship between economic growth and international trade. It examines the importance of this relationship, theoretical frameworks, empirical evidence, influencing factors, mechanisms and channels, sectoral dynamics, policy implications, and challenges. This knowledge equips policymakers, researchers, and practitioners to leverage the growth-trade relationship for sustainable and inclusive economic development.

Chapter VI discusses the econometric specifications and empirical methodologies employed in the study. It highlights the drawbacks of the previous estimation methodologies and the recent developments in econometric methodologies.

Chapter VII of the study reports the empirical findings regarding the symmetric plus asymmetric influences of real lira-euro uncertainty on both export and import volumes traded between Turkey and Germany. It also reports the associated diagnostic statistics of all empirical analyses. Moreover, the chapter explains how the measure of bilateral exchange rate volatility is calculated. It also describes the variables, their construction, and the secondary data sources. Lastly, the chapter delves into the transformations made to the variables to ensure their suitability for the empirical analysis.

Chapter VIII of the study reports the empirical findings concerning the symmetric plus asymmetric influences of real lira-dollar uncertainty on both export and import volumes traded between Turkey and Germany. The chapter also reports the corresponding diagnostics of all econometric estimations. Furthermore, the chapter explains how the measure of third-country risk is calculated.

Chapter IX of the study reports the empirical findings concerning the symmetric plus asymmetric effects of currency misalignment on Turkey’s economic growth. The chapter also gives a detailed description of the variables, their construction, and data sources. Lastly, it provides a detailed explanation of the corresponding associated residual and stability diagnostic tests.

Chapter X serves as a summary and conclusion of the entire study. This chapter highlights the major empirical findings and discusses the policy implications derived from those findings. Additionally, this chapter acknowledges the study's limitations and suggests potential directions for future research in this area.

CHAPTER II
Literature Review

2.1 Introduction

Exchange rate volatility is a subject that has attracted significant research attention and policy analysis due to its wide-ranging implications for foreign trade and economic growth. Fluctuations in exchange rates introduce an element of uncertainty, which can disrupt the decision-making process of traders and investors and have adverse effects on international trade and investment. Additionally, the resulting misalignment of exchange rates caused by these fluctuations can yield positive and negative consequences for trade volume and overall economic growth. Thus, understanding exchange rate volatility comprehensively and its influence on foreign trade and economic progress is imperative for economic policymakers, economists, industry stakeholders, and researchers. Such understanding allows for formulating appropriate strategies and macroeconomic policies that foster sustainable economic growth.

The theoretical literature concerning the influence of ER uncertainty on foreign trade can be traced back to various studies, including Ethier (1973), Baron (1976), Hooper and Kohlhagen (1978), Kawai and Zilcha (1986), Bailey et al. (1986), De Grauwe (1988), Edward (1989, 1993), Franke (1991), Viaene and De Vries (1992), and Dellas and Zilberfarb (1993). Subsequent studies conducted by Franke (1991), Viaene and De Vries (1992), Broll and Eckwert (1999), Arize et al. (2003), Clark et al. (2004), De Grauwe (2005), Takaendesa et al. (2006), among others, have provided empirical evidence regarding the connection between ER volatility and trade volumes. This study comprehensively reviews the existing theoretical and empirical literature concerning exchange rate uncertainty, international trade, and economic growth at the aggregate, bilateral, and commodity levels. Additionally, this chapter will provide an extensive review of third-country risk and its impact on commodity bilateral trade flows. The last section provides an overview of the empirical studies examining the impact of currency misalignment on Turkey's economic growth.

2.2 The Theoretical Literature

Theoretical studies exploring the volatility-trade nexus highlight that the impact of ER volatility on trade volumes can be positive, negative, or inconclusive. Positive effects may arise from speculative opportunities and the signaling of price movements, potentially increasing trade flows. Adverse effects can result from increased uncertainty and risk, decreasing trade flows as traders seek stability. The specific influence varies based on factors such as the underlying assumptions employed, capital availability, and the time horizon of traders (Oksuzler, 2003).

Earlier theoretical studies assessing the volatility-trade nexus for world economies can be classified into three broad categories. Several theorists argue that exchange rate volatility could hamper a country's trade flows (Clark, 1973; Ethier, 1973; Baron, 1976; Hooper & Kohlhagon, 1978; Kawai & Zilcha, 1986; Peree & Steinherr, 1989; Gagnon, 1993). Other theorists believe exchange rate volatility could boost a country's trade, particularly export flows (Franke, 1991; Viaene & De Vries, 1992; Sercu, 1992; Sercu & Vanhulle, 1992). Other theoretical studies, such as Bailey et al. (1986), Willet (1986), and Holly (1995), observed that fluctuations in exchange rates have no significant effect on a country's trade activities.

Other research studies investigate risk aversion, hedging opportunities, and the role of forward exchange markets to comprehend the link between exchange rate uncertainty and trade volumes. These factors provide insights into how changes in exchange rates can influence trade.

Firstly, the degree of risk aversion among economic agents plays a crucial role in determining the influence of ER uncertainty on export and import trade. Studies attempted by De Grauwe (1988) and Franke (1991) indicate that firms with higher risk aversion may exhibit greater sensitivity to exchange rate volatility. In exchange rate fluctuations, highly risk-averse economic agents might be less willing to participate in international trade due to the additional uncertainties introduced by such volatility, which can dampen their willingness to engage in cross-border transactions.

Secondly, the availability of hedging or risk management opportunities can influence the nature of the association between uncertainty and trade flows. In this line, Sercu and Vanhulle (1992) highlight the significance of hedging mechanisms and risk management strategies in mitigating the adverse effects of ER uncertainty. When economic agents have access to effective hedging tools like currency derivatives or options, they can offset the risks associated with exchange rate fluctuations and continue engaging in international trade with greater confidence. The presence or absence of such hedging opportunities can thus shape the relationship between ER volatility and trade volumes.

Lastly, the condition of forward exchange markets is one of the crucial factors determining the link between ER uncertainty and trade activities. Carporale & Doroodian (1994) suggest that well-developed and efficient forward exchange markets can reduce uncertainty and facilitate trade. Using forward contracts to secure exchange rates for future transactions, economic agents can hedge against exchange rate fluctuations and minimize the uncertainty associated with volatile exchange rates.

2.2.1 The Theory of Negative Effects of Exchange Rate Uncertainty on Trade Volumes

The established theoretical literature posits that ER uncertainty negatively affects trade volumes. As per this doctrine, risk-averse and risk-neutral exporters tend to curtail their output and trade/export activities due to increased uncertainty. Risk-averse exporters prioritize stability and may withdraw from foreign markets due to uncertainty in pricing and payment. Meanwhile, risk-neutral exporters adjust their strategies by reducing exposure to foreign markets or focusing more on domestic sales. A notable study by Clark (1973) shed light on the impact of ER variability on a representative exporting firm operating in a competitive market. In the absence of effective hedging mechanisms and the firm's inability to adjust its production in reaction to shifts in profit due to exchange rate fluctuations, there is an increase in currency risk. Consequently, the firm adopts a cautious approach by reducing its output and exports to minimize its exposure to the negative consequences of exchange rate volatility.

Ethier (1973) conducted a study investigating the effects of forward cover on trade and analyzed importers' strategies to maximize profits amidst uncertainty. The empirical analysis in this research was based on the assumption of risk aversion, wherein production units could accurately estimate their profits. However, under these assumptions, no significant influence of ER variability on foreign trade was observed.

Another study by Baron (1976) assessed the impact of ER instability on the prices of export commodities. The research assumed that importers face no exchange risk since prices are determined at one point, and their payments and orders are determined in subsequent periods. Additionally, the author noted that in the absence of future markets, investors may still encounter uncertainties regarding the amount of foreign exchange they require.

Combining the findings of both studies, we can deduce that Ethier (1973) examined the role of forward cover in trade, while Baron (1976) explored the influence of ER instability on export prices. Ethier (1973) considered risk aversion and found no significant linkage between ER uncertainty and foreign trade. Meanwhile, Baron (1976) introduced the assumption of no exchange risk for importers and highlighted the potential uncertainties investors face due to the absence of future markets.

Hooper & Kohlhagen (1978) conducted a theoretical analysis to explore the correlation between ER volatility and international trade, mainly focusing on the risk preferences of exporters and importers. Their study revealed a negative relationship between increased uncertainty and trade activities. The authors also explored the influence of ER uncertainty on export prices, considering the distribution of ER risk between importers and exporters. They found that the impact of uncertainty on export prices depends on the party shouldering the predominant ER risk. When importers carry a substantial portion of this risk, heightened uncertainty can result in either a decrease or an increase in export prices. The direction of this effect is contingent on the specific circumstances and the relative risk-bearing capacities of importers and exporters. However, it is worth noting that the findings of this study regarding export prices align with those of Baron (1976).

Kawai and Zilcha (1986) studied how risk-averse firms make trade decisions amidst uncertain exchange rates and commodity prices. The study focused on two primary objectives: testing the Separation Theorem and the Full Double Hedging Theorem and exploring the implications of having both forward foreign exchange and commodity futures markets compared to having only one or none. The researchers sought to identify the conditions for establishing forward-future arrangements to promote international trade. Through their research, they contributed to understanding risk management strategies in international trade, providing insights into the independent decision-making of trade and hedging levels. Moreover, their study highlighted the potential advantages of utilizing both markets for risk management.

Peree and Steinherr (1989) reviewed the available literature concerning exchange rate uncertainty and trade flows. They contended that medium-term uncertainty in exchange rates and competitiveness could incur substantial costs compared to exchange rate risks. The authors developed two measures to quantify medium-term exchange rate uncertainty, considering past exchange rate movements and deviations from perceived equilibrium levels. Their empirical analysis indicated that medium-term ER uncertainty adversely influenced foreign trade in industrial countries, except the U.S. The study emphasized the importance of considering medium-term uncertainty and exchange rate risk to comprehend its influence on trade flows.

Gagnon (1993) assessed the linkage between ER uncertainty and foreign trade. While previous theories pointed out that uncertainty in exchange rates could reduce trade, this study sought to magnify this negative effect between volatility and trade to determine its upper bound. Surprisingly, the study observed that the observed levels of exchange rate uncertainty among industrial countries had an insignificant impact on trade. These results remained consistent across various parameter values and model extensions. Overall, this study provided empirical evidence that challenged the prevailing view and highlighted the limited influence of ER uncertainty on trade volumes.

2.2.2 The Theory of Positive Effects of Exchange Rate Uncertainty on Trade Volumes

Numerous research studies have extensively investigated the connection between ER uncertainty and foreign trade, and a substantial body of research has suggested a positive connection between ER uncertainty and trade volumes. One notable study by De Grauwe (1988) explored this relationship by introducing the expected marginal utility (EMU) concept. The author explained that the nature of the relationship between ER uncertainty and export volume depends on whether the EMU of producers' income is a convex or concave function of the exchange rate. In cases where producers exhibit a high degree of risk-aversion, an increase in exchange rate risk stimulates the EMU of export revenue, prompting an increase in exports to offset potential revenue declines.

Similarly, Baldwin and Krugman (1989) introduced theoretical models of hysteresis in trade and demonstrated that increased uncertainty arising from high exchange rate volatility could influence foreign trade. However, it may be challenging to identify the specific effects on trade, particularly exports. Edison and Melvin (1990) supported this perspective and found a direct association between ER variability and foreign trade volume. These studies treated trade as an option held by firms, suggesting that volatility induces higher levels of trade.

According to the conventional approach, exchange rate uncertainty is perceived as a hindrance to international trade, similar to increased tariffs. Traders are typically assumed to be utility-maximizing individuals who bear undiversified exchange rate risk, leading to reduced trade and investment in export-oriented plants. The model presented by Demers (1991) supports this negative hypothesis by demonstrating that uncertainty resulting from exchange rate risk can decrease production levels and trade volume over time. This uncertainty makes firms hesitant to invest in exports due to uncertain demand and pricing dynamics. However, it is crucial to note that real-world outcomes may vary, and empirical studies are required to comprehensively understand ER variability's implications on international trade.

Franke (1991), Demers (1991), and Sercu and Vanhulle (1992) have all argued in favor of the benefits of ER uncertainty for foreign trade. In Franke's (1991) study, the author utilized the net present value (NPV) concept and option pricing methods to support the claim that risk-neutral exporting firms may increase production to enhance the NPV of expected cash flows.

Demers (1991) explained that risk aversion is unnecessary to demonstrate the adverse effects of ER uncertainty on foreign trade. The findings suggest that increased ER unpredictability exerts negative consequences for trade activities. In Dellas and Zilberfarb's (1993) research, an asset-portfolio model was employed to assess the influences of ER uncertainty on foreign trade. Their results indicated that increased volatility might either enhance or reduce investment (i.e., trade) depending on the shape of the risk aversion function.

Carporale & Doroodian (1994) conducted a study demonstrating that the results remained consistent and reliable even when accounting for forward markets and production with non-zero transaction costs. Building on this research, Doroodian and Carporale (1996) introduced the *"safe haven"* hypothesis, proposing that investors tend to gravitate towards dollar-denominated assets, thus strengthening the dollar as exchange rate volatility increases. Their findings indicated a positive connection between ER uncertainty and trade volumes, and the same results have been supported by De Grauwe (2005).

2.2.3 The Theory of Ambiguous Effects of Exchange Rate Uncertainty on Trade Volumes

The theory of ambiguous effects of ER uncertainty on trade volumes acknowledges that the link between these two variables is not always straightforward and can result in diverse outcomes. This theory posits that the influence of ER uncertainty on international trade can be negative, positive, or ambiguous, depending on various factors and circumstances. One reason for this ambiguity is that ER uncertainty can impact various economic stakeholders differently. For instance, while increased volatility may introduce uncertainty and risk for exporters, it can also create opportunities for speculative activities and potentially boost trade flows. The net effect depends on the relative importance of these opposing forces and the characteristics of the market.

Furthermore, the influence of ER uncertainty on international trade can vary depending on the context and time horizon considered. In the short-term, ER uncertainty exerts price fluctuations and disrupts trade flows. However, in the long-run, firms may adjust their strategies and adapt to the volatile exchange rate environment, minimizing its harmful effects.

Another crucial aspect to consider is the interaction between ER uncertainty and other factors, e.g., the availability of capital and the market structure. The presence of hedging instruments, access to international capital markets, and the level of competition can significantly influence how firms respond to ER uncertainty and its influence on foreign trade. This recognition highlights the complexity of the linkage between ER uncertainty and foreign trade, where various factors come into play.

The theory of ambiguous effects emphasizes that the outcome is not straightforward and can vary depending on these influencing factors. The presence of diverse dynamics makes empirical studies and real-world observations indispensable for a deeper understanding of the influences of ER uncertainty on foreign trade. As such, comprehensive research becomes crucial for informing policy decisions and devising appropriate strategies in the face of ER uncertainties. By considering these multifaceted aspects, policymakers and stakeholders can better navigate the challenges and opportunities posed by ER uncertainty in international trade.

Bailey et al. (1986) argue that the uncertainty of exchange rates can discourage or stimulate trade. They highlighted that answering this question requires more empirical investigation rather than relying solely on theoretical considerations. De Grauwe (1988) developed a simple model to shed light on the matter in response to this issue. In De Grauwe's model, a competitive producer decides to sell domestically or in the foreign market, with the local currency price of exports being the sole source of risk. Producers are assumed to exhibit a slight degree of risk aversion. The reaction of producers to exchange rate risk relies on whether the EMU of export income is a convex or concave function of the ER. Slightly risk-averse producers are likely to reduce their production for exports as higher exchange rate risk diminishes the EMU of export revenues. However, highly risk-averse producers may be concerned about the worst possible outcome, leading them to increase their exports due to increased exchange rate risk.

De Grauwe (1988) acknowledged that introducing a capital market into the analysis could enhance the understanding further. However, the model's fundamental ambiguity associated with uncertainty and trade would remain even with this additional consideration. The model underscores the complexities in determining the connection between ER uncertainty and trade activities, highlighting the importance of empirical research to draw more definitive conclusions.

Viaene and de Vires (1992) conducted a formal test of this perspective by incorporating a mature forward market into their analysis. Their study shows an increased exchange rate reduces exports and imports without forward markets. It is, however, essential to note that a forward market positions exports and imports in opposite directions in the forward market, and their exposure to changes in exchange rates determines the influence of ER uncertainty on trade when a change in ER uncertainty occurs. Therefore, exchange rate risk can positively or negatively affect trade flows, relying on a country's net currency position.

Similarly, Dellas and Zilberfarb (1993) employ a standard asset portfolio model to address the uncertain and ambiguous nature of the influence of ER risk on international trade. They took a different approach to defining volatility compared to most other studies, considering it as the variance of the ER rather than focusing solely on unanticipated fluctuations. The authors examined an individual who consumes, exports, and imports available goods. Their research yielded results demonstrating that an increase in the riskiness of the return on assets could either augment or reduce investment, relying on the assumed level of risk aversion. If risk aversion is modelled as convex, an increase in risk leads to a rise in export levels. Conversely, if risk aversion is concave, the opposite holds. Importantly, these results remained consistent even when considering a forward market with non-zero transaction costs and including production in the analysis.

Willet (1986) highlighted the significance of considering the effects of diversification and firms' characteristics when analyzing the linkage between exchange rate uncertainty and trade. The study suggested that despite a noticeable increase in global risk following the adoption of floating exchange rates, the difference between international and domestic risk may not have expanded significantly. Therefore, the research proposed that exchange rate uncertainty might not act as an autonomous trigger of underlying instability but rather a manifestation of broader economic conditions.

Holly (1995) assessed the impact of ER uncertainty on foreign trade. Utilizing the GARCH model, the research results demonstrated that ER uncertainty significantly influences export supply but did not affect export demand. These results underscored the role of ER uncertainty in shaping export supply, emphasizing its importance in understanding trade patterns.

In summary, the studies mentioned contribute significantly to our understanding of the nuanced effects of ER fluctuations on trade. They shed light on various factors that influence this relationship, including risk aversion, the presence of forward markets, the effects of diversification, the net currency position of a country, and broader economic conditions. These studies emphasize that the impact of ER uncertainty on trade is not a one-size-fits-all scenario, and it can vary depending on multiple factors and circumstances. While the theoretical models and analyses presented in these studies provide valuable insights, empirical analysis remains essential to gain a deeper and more comprehensive understanding of the influence of ER uncertainty on trade volumes. Empirical studies can provide real-world evidence and corroborate or refine the findings of theoretical models, offering policymakers and researchers a more practical foundation for decision-making and further investigations.

2.3 The Empirical Evidence

The increased volatility in exchange rates has generated significant interest among economists, researchers, and policymakers, leading them to investigate the nature as well as extent of the influence of ER uncertainties on trade volumes. Understanding how exchange rate uncertainties affect trade flows is essential for informing policy decisions and facilitating effective trade management. This study is relevant to developing and emerging countries like Turkey, where exchange rate policies are crucial to economic stability and growth. By investigating the influences of ER uncertainties on trade, researchers and policymakers can gain valuable insights to develop strategies and measures that foster favorable trade conditions and enhance economic performance.

The ongoing discussions concerning persistent trade imbalances and the resurgence of non-customary trade barriers have catalyzed researchers to revisit ER volatility's influence on global trade. A wide range of theoretical and empirical studies have been conducted on this subject; however, the actual influence of ER uncertainty on worldwide trade remains an open and uncertain area of investigation. Empirical studies utilizing different datasets have presented mixed findings concerning the effects of ER uncertainty on trade. Conversely, some studies have found minimal or insignificant effects of ER uncertainty on trade. Refined quantitative methods have led to a more cautious approach in exploring the casual association between ER uncertainty and foreign trade (Clark et al., 2004; Teneyro, 2007). More precisely, the link between ER uncertainty and trade largely depends on the long-term credibility of economic policies rather than short-run causality (Klein & Shambaugh, 2006; Qureshi & Tsangarides, 2010). Researchers have also observed reverse causality in the connection between the two variables, where ER fluctuations impact trade flows, contributing to stabilizing RER changes and reducing overall exchange rate instability (Broda & Romalis, 20111; Abbasi, 2021).

The central question when assessing the influence of ER uncertainty on trade revolves around understanding the type and extent of the association between the two variables. Does ER uncertainty have a negative or positive effect on trade? It is crucial to determine whether volatility increases or decreases trade. Numerous empirical studies have been conducted to address this question, aiming to shed light on the direction of the underlying connection between ER uncertainty and trade.

According to the classical review studies conducted by McKenzie (1999) and Bahmani-Oskooee and Hegerty (2007), empirical research on the linkage between ER uncertainty and trade volumes can be categorized into three main strands. The first category encompasses empirical studies that utilize aggregate-level trade data, offering a broader perspective on how exchange rate uncertainty influences overall trade volumes. The second category comprises empirical studies focusing on bilateral trade data, which provide a more nuanced understanding of how exchange rate fluctuations impact trade flows between specific trading partners. Lastly, the third category involves empirical research that considers disaggregated trade data at the industry level, assessing the effects of ER uncertainty on the trade of specific goods. In the present study, we adopt a similar classification approach to analyze the available empirical research concerning the influence of ER uncertainty on trade. We categorized them based on the types of data used and the specific aspects of trade being analyzed.

2.3.1 Studies Utilizing Aggregate-Level Trade Data

The first strand of research examines the association between ER uncertainty and trade volumes for a specific country (i.e., Turkey) with global economies considering aggregate-level trade data. In a pioneering study conducted by Caballero & Corbo (1989), the impact of ER uncertainty on global exports of various economies was investigated. Employing the instrumental variable method, the empirical results indicated that uncertainties in exchange rates led to a significant and adverse effect on the exports of Turkey to developing countries. However, other researchers criticized the research for its exclusive focus on the export side of the trade, neglecting the import side concerning Turkey's major trading partners and failing to consider the integrating properties of the variables involved. It was also highlighted that the choice of instruments used in the analysis could influence the findings.

In a study conducted by Özbay (1999), the focus was on investigating the impact of RER uncertainty on both Turkish imports and exports. To achieve this, the researcher employed the Quasi-maximum likelihood method and analyzed quarterly data between 1998Q2 and 1997Q2. The RER uncertainty was calculated utilizing the GARCH specification. The empirical findings indicated a negative correlation between RER uncertainty and Turkish exports. However, the study did not find a significant connection between RER uncertainty and Turkish imports.

To address the limitations observed in Caballero and Corbo's (1989) study, Doğanlar (2002) conducted a new investigation utilizing the Engle-Granger methodology. The primary objective was to demonstrate the cointegration between the real exports of various developing countries[11], including Turkey, and income level, exchange rate, and RER uncertainty. The empirical findings revealed a significant negative influence of RER uncertainty on exports. However, despite the valuable insights, researchers have criticized using the Engle-Granger methodology in this study. This methodology can identify only one cointegrating relationship among variables in a system and cannot offer information about the number of existing cointegrating vectors. This limitation can potentially overlook the presence of multiple

[11] The list of other developing countries includes South Korea, Indonesia, Pakistan, and Malaysia.

cointegrating relationships among the variables under consideration, which might affect the overall conclusions and interpretations drawn from the analysis.

In their study, Kasman and Kasman (2005) delved into the impact of ER uncertainty on Turkish exports to its major partners. The researchers made notable findings by considering quarterly data from 1982 to 2001 and employing the ARDL cointegration and error correction model (ECM) methodologies. They observed ER uncertainty's significant and positive long-term effect on export volume. This finding highlights firms' challenges in managing ER risk, particularly in a small economy like Turkey. The study emphasizes the importance for policymakers and businesses to actively monitor and mitigate the effects of ER fluctuations, as increased uncertainty can offer potential advantages for export growth. Future research can build on these empirical findings by verifying their robustness and exploring the underlying mechanisms that drive the connection between ER uncertainty and export volumes.

Altintaş et al. (2011) investigated the connection between exports, foreign income, relative prices, and ER uncertainty. The research utilized quarterly data from 1993Q3 to 2009Q4 and employed the ARDL and ECM techniques to explore these relationships. The long-term analysis revealed that foreign GDP and RER uncertainty positively influenced exports. Conversely, RER had a negative long-term effect on exports. Moving to the short-run analysis, the *ECM* specification demonstrated that higher relative prices had a detrimental impact on Turkish exports. Additionally, foreign income showed an insignificant short-term influence on Turkish exports. Despite the valuable insights gained from the study, researchers have raised concerns regarding the limitations of solely considering exports and neglecting the imports side of the trade.

The study conducted by Demez and Ustaoğlu (2012) aimed to examine the potential relationship between exports and currency sale rates in the presence of structural breaks. The researchers utilized unit root tests with one structural break (Zivot-Andrews) and unit root tests with two structural breaks (Lee-Strazicich) to identify potential turning points in the series of exports and currency sale rates. The empirical results revealed that structural turnings in the sale of currencies did not significantly affect the exports in Turkey. In other words, the study indicated that export levels were not sensitive to changes or breaks in currency rates. Therefore, the researchers concluded that exports were not influenced by structural breaks or changes in currency sale rates. The results suggest that fluctuations in currency rates do not substantially impact the export levels of the examined context. This information can be valuable for policymakers, exporters, and market participants, providing insights into the stability of exports in the face of currency market dynamics.

In their empirical study, Yüksel et al. (2012) aimed to explore the influence of ER uncertainty on the aggregate exports of Turkey. The researchers analyzed monthly time-series data from 2003M2 to 2010M12 for their investigation. They used the OLS (Ordinary Least Squares) method to assess the relationship, conducted appropriate tests, and employed time series data and cross-correlation analysis. The findings suggested a negative correlation between exports and exchange rate uncertainty. Nevertheless, it is essential to note that this relationship was not statistically significant. The authors acknowledged the lack of consensus among previous empirical studies on this particular topic and emphasized the limited research available concerning the case of Turkey.

Denaux and Falks (2013) utilized the *OLS* method to assess the influence of ER uncertainty on import demand between the Turkish economy and its major European Union partners. The authors considered quarterly data from 1988Q1 to 2011Q3 for their empirical analysis. The findings revealed that ER uncertainty did not significantly influence import demand. Instead, Turkish import demand was found to be primarily influenced by income levels and currency appreciation. The study suggested that fluctuations in exchange rates did not play a major role in determining import demand during the period. Furthermore, the study found that the global financial shocks and the euro crisis did not substantially impact Turkish imports.

In the study conducted by Davis (2014), a gravity model was employed to explore the influence of ER uncertainty on trade activities involving Türkiye, EU-27, NAFTA, & APEC economies. The empirical findings were based on annual data between 1999 and 2008. The findings indicated that ER uncertainty positively affected trade between Türkiye and its partner countries. Furthermore, the study observed that an increasing distance between importing and exporting countries harmed Türkiye 's trade volumes. This observation aligns with the gravity model’s general premise, which suggests that trade between countries tends to decrease as the distance between them increases. The finding underscores the significance of geographical proximity in enhancing trade between Türkiye and its partner countries.

Alper (2017) assessed the influence of ER uncertainty on trade volumes between Türkiye and 15 European countries. The analysis utilized annual time series data spanning from 2002 to 2013. The author employed the GARCH (1, 0) specification to measure exchange rate uncertainty. The study applied panel methodology to analyze exports and imports models, considering the specific trade relationships. The empirical findings from the Wasterlund co-integration test revealed that ER uncertainty adversely affected export sectors.

In contrast, the impact of exchange rate volatility on import sectors displayed mixed results. These results highlight the importance of exchange rate stability for export-oriented sectors in Turkey. The negative impact on exports suggests that exchange rate volatility can create uncertainty and increase costs for exporters, potentially affecting their competitiveness in the European markets. On the import side, the mixed effects may reflect the diverse nature of imported goods and their varying responsiveness to exchange rate fluctuations.

Bahmani-Oskooee and Durmaz (2021) investigated the asymmetric influences of lira-euro uncertainty on trade between Türkiye and the European Union (EU). They employed the GARCH (1,1) framework to estimate the RER uncertainty. To analyze the short-term and long-term symmetric and asymmetric effects of lira-euro uncertainty in various industries, the authors utilized both the ARDL and NARDL frameworks. The verdicts indicated short-term effects of lira-euro uncertainty on 26 (40) Turkish export (import) industries to (from) the EU. However, these short-term effects persisted into the long-term in 11 (19) Turkish export (import) industries. Using the NARDL model, the study observed short-term nonlinear influences of ER uncertainty on 38 (49) export (import) sectors. These effects were observed in the long-term across 19 export (import) sectors. However, a critique of the study by Bahmani-Oskooee and Karamelikli (2022) pointed out a potential aggregation bias in the empirical findings. The critique specifically mentioned that using industry-level data from the EU might introduce aggregation bias and limit the accuracy of the empirical results. This criticism highlights the importance of carefully considering and addressing potential aggregation bias when conducting empirical studies that utilize industry-level data.

In a nutshell, aggregate-level empirical studies in Turkey that relied on aggregate trade data faced criticism due to their potential "aggregation bias." To address this limitation and gain a more comprehensive understanding of trade dynamics, research shifted its focus towards bilateral analysis, specifically examining Turkey's trade relationships with its trading partners. By adopting a bilateral approach, researchers can better capture the nuances and complexities of specific trade interactions, allowing for a more detailed consideration of factors such as exchange rate uncertainties and their influence on trade between Turkey and its trading partners. This shift towards bilateral analysis provides a more refined and targeted investigation of the influences of ER fluctuations on Turkey's trade, enabling a deeper exploration of the dynamics governing trade relationships with various countries.

2.3.2 Studies Utilizing Bilateral Trade Data

In Turkey, aggregate-level analyses investigating the nexus between ER uncertainty and trade flows posit that increased uncertainty in exchange rates tends to reduce trade flows. However, it is crucial to recognize and address the issue of aggregation bias, which can lead to an inaccurate representation of the volatility effects on bilateral trade relationships at the aggregate level. This bias arises when individual country-level dynamics are overlooked, and the effects of ER fluctuations on trade with different partners are not adequately considered.

In the case of bilateral trade involving multiple partners, the influence of ER fluctuations on foreign trade can vary across different trading partners. The offsetting negative and positive impacts observed at the aggregate level stem from the fact that the effects on trade with one partner may not necessarily align with another partner. To overcome the aggregation bias problem, empirical studies employing a bilateral analysis and utilizing bilateral-level data offer a more appropriate approach. This enables researchers to assess the influence of ER fluctuations on individual trading relationships.

By analyzing fluctuations in ERs between Turkey and its counterparts, researchers can assess the effects on relative prices of goods and services, trade volumes, and competitiveness at a bilateral level. This approach provides more accurate insights into the influence of ER uncertainty on foreign trade, allowing policymakers to make informed decisions on trade policies and strategies that cater to specific bilateral trade dynamics. By adopting this approach, researchers can avoid the pitfalls of aggregation bias and provide more nuanced and relevant findings for policymakers to consider when formulating trade-related decisions.

In a prior empirical study by Thursby and Thursby (1985), the focus was on investigating the impact of ER fluctuations on trade volumes involving Turkey and 19 of its trading partners. They utilized an export specification to analyze Turkey’s exports, aggregating Turkey’s exports to its 19 counterparts, considering annual data from 1973 to 1977. The empirical findings from this study revealed that exchange rate fluctuations did not exert a statistically significant influence on Turkey’s exports to its selected counterparts.

Bahmani-Oskooee and Ltaifa (1992) analyzed the influence of ER uncertainty on the aggregate exports of 19 advanced and 67 developing economies (Turkey was one of them). The empirical outcomes demonstrated that ER uncertainty had a detrimental influence on the bilateral exports of these countries. The results also revealed that developed countries showed lower sensitivity to exchange rate risk than developing countries. This suggests that developed countries may possess better mechanisms to cope with or mitigate the adverse effects of ER uncertainty on their exports. Within the group of developing economies, the study identified that countries that fixed their exchange rates to a major currency experienced less exchange rate risk than other developing countries. This particular empirical finding highlights the potential advantages of adopting a pegged ER system in reducing the negative influence of ER uncertainty on exports. Researchers have criticized the empirical findings for another aggregation bias despite the valuable insights provided. This bias might have arisen because of using aggregated data for groups of countries rather than considering individual country-level dynamics.

Vergil (2002) investigated the influence of RER uncertainty on Turkey’s exports to the U.S., Italy, Germany, and France. Monthly data from January 1990 to December 2000 were utilized for the empirical analysis. The study’s empirical outcomes indicated that increased volatility had a significant adverse influence on Turkey's exports. The study suggests that managing and reducing ER uncertainty positively influences Turkey's export performance, enabling the country to enhance trade relations with other major trading partners.

Asteriou et al. (2016) assessed the influence of ER uncertainty on trade in four economies: Indonesia, Turkey, Mexico, and Nigeria. The analysis incorporated monthly data spanning from January 1995 to December 2012. To measure real exchange rate volatility, the authors utilized the GARCH method. They employed the ARDL approach for the long-term analysis, while Granger causality specifications were employed for investigating the short-term influences of ER uncertainty on export/import demand. The empirical findings proved no significant long-run linkage between ER uncertainty and trade volumes, except for Turkey, where a small effect was observed. However, in the short-term, ER uncertainty exerted a significant causal relationship with primary export/import demand in Indonesia and Mexico. In Nigeria, export demand influenced exchange rate volatility unidirectionally, whereas no causality was detected between ER uncertainty and export/import demand in the Turkish economy.

Doğan et al. (2022) assessed the asymmetric effects of ER volatility on trade volumes between Türkiye and eight EU economies. To achieve this, the researchers utilized monthly data covering the period 2005M1-2021M12. For their analysis, they employed Markov regime-switching models. The empirical findings revealed that increased volatility reduced trade between Turkey, Germany, and Belgium during expansionary situations. In contrast, increased volatility led to a reduction in trade between Turkey and Poland during contractionary periods. Moreover, the study’s results demonstrated that increased RER uncertainty negatively affected trade between Türkiye, Romania, and Italy during economic expansion and contraction, indicating a consistent adverse impact in both economic phases. However, there were no significant effects of volatility on trade volumes between Turkey and France, Spain, and the Netherlands, neither during periods of economic expansion nor economic contraction.

Tarakçi et al. (2022) focused on investigating the effects of ER uncertainty on the exports of Türkiye to Belgium, Germany, the Netherlands, France, the UK, Italy, Spain, Russia, and the USA. Considering annual data over the period 2002-2019, the estimation results revealed that fluctuations in exchange rates significantly influenced Turkey's ability to export goods to its counterparts. The analysis further suggested that the influence of ER uncertainty on exports was asymmetric. Specifically, the study found that ER uncertainty had a higher influence on capital and consumption goods exports than other goods. This implies that industries or sectors relying heavily on capital and consumption goods were more vulnerable to exchange rate fluctuations. In the short-term, decreased and increased volatility tended to expand exports. However, in the long-term, decreased and increased volatility decreased exports. This suggests that uncertainty's short- and long-term influences on export performance may vary due to different adjustment mechanisms and market dynamics.

The study conducted by Yildirim and Saraç (2022) focused on examining asymmetric influences of ER uncertainty on trade volumes b/w Germany & Turkey. The analysis utilized monthly data from 2002:1 to 2020:2. The study employed the Markov Regime Switching model and reported asymmetric effects of ER uncertainty on trade volumes between the two counterparts. Specifically, during periods of expansion in the trade volume, RER fluctuations positively influence the trade balance. However, in periods of contraction in trade volumes, the study did not find statistically significant evidence between the two variables. The analysis also revealed the J-curve phenomenon in the bilateral trade relations between Turkey and Germany. However, Halicioglu (2007) and Cergibozan and Ari (2018) have reached different conclusions, stating that the J-curve phenomenon does not hold for Turkey.

The overall review of bilateral-level studies examining the connection between ER uncertainty and trade volumes involving Turkey and its trading partners has revealed conflicting findings. One common criticism of these studies is the potential presence of an aggregation bias, as their empirical results might be country-specific and may not fully capture the nuances at the individual commodity level. To address this limitation, recent empirical studies have increasingly shifted their focus to analyzing the nexus between ER uncertainty and trade volumes at the commodity level. This approach aims to provide more detailed insights into the effects of ER uncertainty on trade by examining selected industries or products.

By conducting empirical studies at the commodity level, researchers can account for variations in the sensitivity of different commodities to exchange rate fluctuations. Specific industries or products may be more vulnerable or resilient to ER uncertainty, and a commodity-level analysis allows for a more nuanced understanding of these dynamics. Moreover, this approach enables researchers to consider the heterogeneity among trading partners. Different countries may have unique trade patterns, industry structures, and economic characteristics that influence how exchange rate volatility impacts their trade flows. By disaggregating the analysis, researchers can better capture these country-specific factors and avoid the aggregation bias associated with country-level analysis.

2.3.3 Studies Focusing on Commodity Trade Data

To reduce aggregation bias, this strand of research explores the influence of ER uncertainty on the trade of individual goods or commodities. By analyzing commodity trade data, these studies can explore the influence of ER fluctuations on the export or import volumes of specific commodities. The objective is to gain insights into how changes in exchange rates impact trade patterns within particular industries or sectors. This approach enables a focused examination of the association between ER uncertainty and trade for specific goods, allowing for a more detailed understanding of the effects at the microeconomic level.

Türkcan (2005) investigated the intra-industry trade (IIT) between Turkey and OECD countries, examining both final goods and intermediate goods between 1985 and 2000. The author puts forth country-specific and industry-specific hypotheses derived from the existing literature on IIT to explore the determinants of trade between Turkey and selected OECD countries. To test these hypotheses, the author employed three-way fixed effects and random effects models. These models allow for identifying and analyzing the effects of country-specific and industry-specific variables on IIT in both final and intermediate goods. The results indicate that the determinants of IIT for final goods are not significantly different from those for intermediate goods. This suggests that similar factors influence final and intermediate goods trade patterns between Turkey and the selected OECD countries. Furthermore, the findings suggest that country-specific variables are more central in determining IIT in both final and intermediate goods than industry-specific variables. This implies that factors related to individual countries, such as economic conditions, trade policies, and institutional frameworks, have a more substantial influence on the intra-industry trade between Turkey and the OECD countries rather than factors specific to particular industries.

Erkan and Sarıçoban (2014) measured and compared the export competitiveness of Turkey and the EU+13 countries in science-based goods. The researchers analyzed data from 1993 to 2012 and calculated several revealed comparative advantage indices for each country. The study's findings indicated that science-based goods did not significantly impact the increase of Turkey and the EU+13 countries' share in world trade overall. This suggests that the export of science-based goods alone did not significantly boost their trade positions globally. However, the study did observe that the export competitiveness of the EU+13 countries had been increasing after their accession to the EU. This indicates that joining the EU positively impacted their export performance, likely through increased market access and trade facilitation measures. On the other hand, the study found that Turkey's competitiveness in science-based goods was weaker than the EU+13 countries.

Bahmani-Oskooee & Durmaz (2016) examined the influence of ER uncertainty on trade across 61 Turkish export (import) industries. To achieve this, the researchers analyzed 61 industries to provide a detailed understanding of how exchange rate uncertainty impacts their import and export activities. The study utilized monthly time series data from January 1990 to December 2012. The researchers employed the GARCH (1,1) to measure exchange rate volatility. The empirical findings revealed that out of the 61 industries examined, 39 import sectors were significantly influenced by ER uncertainty. Additionally, 23 export sectors were significantly affected by ER uncertainty. The results suggest that ER uncertainty can substantially affect the decision-making processes of firms engaged in international trade. The influence of ER uncertainty on exports and imports may vary across different industries due to variations in their exposure to international markets, supply chains, and pricing strategies.

Bahmani-Oskooee and Karamelikli (2022) investigated the influence of ER uncertainty on trade volumes between Germany and Turkey. The research employed monthly data from January 2003 to October 2018 and focused on 75 industries in trade between Germany and Turkey. The researchers used the GARCH (1, 1) model to estimate exchange rate volatility. The results from the ARDL approach indicated significant short-term effects in 31 (30) Turkish export (import) sectors. However, these effects were found to persist in the long-run across 10 (13) Turkish export (import) sectors. In contrast, the NARDL approach identified significant short-term asymmetric effects on export volumes across 55 (56) Turkish sectors. These short-term asymmetric effects persisted into long-term ones in 10 (25) Turkish export (import) sectors. The findings demonstrated that ER uncertainty adversely influences nearly 25 percent of trade between Germany and Turkey.

Khalid et al. (2023) investigated the influence of lira-euro uncertainty on trade volumes between Germany and Turkey. The investigation utilized annual data from 1980 to 2022 and covered 90 Turkish export and 114 Turkish import industries. The empirical findings of the NARDL model indicated that for 69 Turkish export industries and 86 Turkish import industries, lira-euro uncertainty influenced trade flows differently in the short-term. Moreover, these short-run effects persisted for 49 (52) Turkish export (import) industries in the long-term. The industry-specific outcomes revealed that an increase (decrease) in lira-euro volatility primarily increases Turkish exports (imports) to (from) Germany, both for small and large industries. The empirical findings recommend that export and import industries benefiting from lira-euro volatility may consider expanding their trade activities. In contrast, sectors adversely affected by lira-euro volatility may need to explore alternative strategies.

2.4 The Empirical Literature on Third-Country Volatility and Commodity Trade

Recent research has highlighted the significance of third-economy risk as a crucial factor influencing a country's trade flows. Notable researchers such as Bahmani-Oskooee and Xu (2012), Bahmani-Oskooee et al. (2013, 2016, 2017), Bahmani-Oskooee and Bolhassani (2014), Bahmani-Oskooee and Aftab (2018), Usman et al. (2021), Iqbal et al. (2023), and Khalid et al. (2023) have extensively investigated this topic. A third-economy risk leads those traders to have a risk-averse ability to redirect trade to a third-economy due to increased exchange rate uncertainty between two countries (Cushman, 1986).

Research exploring the third-economy risk has consistently found that external volatility significantly impacts trade flows, as revealed by studies carried out by Choudhry et al. (2014), Bahmani-Oskooee et al. (2017), and Soleymani et al. (2017). This effect is attributed to the fact that the ER of a country serves as a proxy indicator for the pricing of commodities; therefore, fluctuations in the ERs of a specific trading partner result in an S.E., leading to a diversion of trade to other countries (Bahmani-Oskooee *et al.,* 2013). In their analysis, Bahmani-Oskooee and Aftab (2018) observed more robust and significant estimates when they accounted for third-country effects.

Utilizing commodity trade data, Bahmani-Oskooee et al. (2013) investigated the influence of third-economy risk on trade flows between the United States and Hong Kong. Their research revealed compelling evidence of third-economy risk in U.S. import industries. In a separate study, Bahmani-Oskooee and Xu (2012) examined various sectors engaged in trade between China and the U.S. Surprisingly, they found that most of these sectors demonstrate the impact of third-economy effect on trade flows in the long-term.

On the contrary, Usman et al. (2021) focused on the trade relationship between Pakistan and China across 14 (34) export (import) sectors. They discovered that the effect of third-economy risk persisted in the short-term and long-term for the examined sectors. Moreover, their empirical analysis emphasized that solely employing asymmetric analysis was inadequate, and combining it with the third-economy effect was essential for a comprehensive understanding.

Bahmani-Oskooee *et al.* (2017) examined the influence of third-economy risk on trade volumes across 116 (53) U.S. export (import) industries. The research demonstrated that higher uncertainty in rupee-yuan significantly influenced about 1/2 of U.S. export sectors. Recent research attempted by Bahmani-Oskooee and Aftab (2018) focused on the asymmetric impacts of the ringgit-yuan on commodity flows between the U.S. and Malaysia. Their findings highlighted that considering asymmetric effects of ringgit-yuan uncertainty produces more significant outcomes.

Bibi et al. (2020) explored the impacts of bilateral exchange rate uncertainty and third-economy risk on trade among E7 countries (i.e., China, Brazil, India, Russia, Mexico, Turkey, and Indonesia) and developing countries (i.e., Malaysia, Poland, Sri Lanka, and Pakistan). Using annual time series data between 2003 and 2019, the empirical results of the ARDL cointegration approach reported a trade-promoting impact of both bilateral and third-economy exchange rate uncertainties on bilateral trade flows.

Moving one step forward, Khalid et al. (2023) investigated the nonlinear influences of third-economy uncertainty on trade volumes between Germany and Turkey. The empirical findings of the ARDL model revealed that third-economy risk significantly influences 59 (67) export (import) sectors. Furthermore, the results of the NARDL model indicated that third-economy risk had significantly affected more than 1/2 of the import and export sectors in the short-term, which prevailed in about 50% of the sectors in the long-term. The empirical results stressed the importance of considering the asymmetric assumption and the influence of third-country risk in understanding the trade dynamics between Turkey and Germany. The study highlighted that traders and investors should be mindful of how policy changes and ER uncertainty in the third-economy can significantly influence cross-country trade.

2.5 The Exchange Rate Misalignment and Economic Growth

2.5.1 The Theoretical Literature

Scholars have extensively investigated the connection between exchange rate misalignment and Turkey's economic growth. This theoretical literature delves into understanding the intricate relationship between currency misalignments and their impacts on Turkey's overall economic growth. Researchers have explored diverse economic theories and models specifically tailored to analyze this relationship within the unique context of Turkey.

It is essential to highlight that the existing theoretical literature concerning the nexus between misalignment and growth in Turkey lacks a clear consensus on the precise magnitude and direction of their relationship. Different models and assumptions in these studies lead to diverse and sometimes conflicting results. Empirical investigations within the Turkish context have been conducted to explore the intricate association between misalignment and growth, considering crucial macroeconomic factors such as trade openness, expenditure dynamics, financial sector development, inflation dynamics, saving potentials, trade dynamics, debt patterns, and the policy environment. These empirical studies aim to furnish more robust evidence concerning the specific dynamics and policy implications of currency misalignment on Turkey's economic progress.

In summary, the theoretical literature concerning currency misalignment and economic growth in Turkey concentrates on comprehending how fluctuations and misalignments in the exchange rate may impact the country's economic growth. While this literature offers valuable insights, additional empirical research is necessary to establish a more definite understanding of the relationship within the specific context of Turkey. Such empirical studies can aid in informing policy decisions that address the potential mechanisms through which exchange rate fluctuations influence the economy's growth.

2.5.2 The Empirical Evidence

Numerous studies have assessed the impact of currency misalignment on Turkey's economic growth (Achy, 2001; Atasoy & Saxena, 2006; MacDonald & Vieira, 2010; Dubas, 2012; Vieira & MacDonald, 2012; Mamun, 2019; Nasir & Jackson, 2019; Wang, 2019; Mamun et al., 2020, 2021). Empirical studies on misalignment-growth nexus in Turkey can be divided into two categories. The first category analyzes the nexus between misalignment and growth during the fixed ER regime until the 2001 economic crisis. In contrast, the second category of studies explores the linkage between currency misalignment and economic growth under both fixed and floating exchange rate regimes in Turkey. These two categories of research aim to shed light on the influence of misalignment on growth across different exchange rate regimes.

2.5.2.1 Misalignment-Growth Nexus Under the Fixed Exchange Rate Regime. This category of empirical studies includes those conducted by Telatar & Kazdagli (1998), Alper & Sağlam (1999), Sarno (2000), Achy (2001), Doroodian et al. (2002), Berument & Pasaogullari (2003), Civcir (2003, 2004), Kibritçioğlu & Kibritçioğlu (2004), Özlale & Yeldan (2004), Dubas (2012), Terra & Valladares (2010), and so on. These studies' empirical results conclude that Turkey's RER was misaligned during the fixed ER regime.

The study attempted by Telatar and Kazdagli (1998) investigated the hypothesis of long-run PPP employing cointegration techniques for Turkey considering monthly time series data covering the period 1980M10-1993M10. They examined the bilateral exchange rate-price relationships between Turkey and its major trading partners, including Germany, France, the USA, and the UK. However, the study's empirical findings did not support the existence of any long-run bilateral exchange rate-price relationship between Turkey and its trading partners.

Alper and Sağlam (1999) estimated Turkey's ERER considering quarterly data from 1987Q1 to 1999Q1. The study's estimation findings indicated that Turkey's RER was highly misaligned and overvalued before the 1991 Turkey crisis. The overvaluation of the RER of Turkey before the 1991 crisis suggests that the currency was not in line with its fundamental macroeconomic factors and the long-term equilibrium level.

Sarno (2000) revisited the research of Telatar and Kazdagli (1998) by assessing the long-run PPP hypothesis for Turkey and its major trading counterparts. The study covers the period from 1980 to 1997 and introduces nonlinear modeling techniques to investigate the mean reversion in RERs and the validity of long-run PPP. However, in the case of the RERs of Turkey and its counterparts, the conventional unit roots tests did not indicate significant evidence of mean reversion. This implies that the conventional analysis would suggest rejecting the long-run PPP hypothesis for the given sample. However, Sarno employed recently developed nonlinear modeling techniques to examine the data further. The results obtained from these nonlinear models strongly support the validity of long-run PPP for Turkey and its counterparts. The findings were consistent with previous evidence suggesting that PPP holds more closely in countries that have experienced unusually high inflation. Turkey is known for its history of high inflation rates, and this particular characteristic might have contributed to the more vital adherence to PPP in the long run. High inflation can create more pronounced deviations from PPP in the short term but might facilitate mean reversion and a return to PPP over an extended period.

Achy (2001) focused on estimating the equilibrium real exchange rate for MENA (Middle East and North Africa) countries using the single equation approach proposed by Edwards (1989) and Elbadawi (1994). The study covered the period from 1970 to 1997. The empirical analysis suggested that the TL exhibited some level of overvaluation before the crisis of 1991 and during the last years of the sample period.

The study attempted by Doroodian et al. (2002) examined the external competitiveness of Turkey by estimating the equilibrium real effective exchange rate considering annual time series data spanning from 1987 to 1998. The authors found that Turkey's RER exhibited different valuation patterns during sub-periods. According to their empirical estimates, the RER of Turkey was undervalued before 1989Q2. However, between 1989Q2 and 1994Q2, the study revealed that the RER of Turkey was typically overvalued. Notably, the analysis indicated that the misalignment in the RER tended to correct its short-run disequilibrium in the long-term. Moreover, the empirical estimates revealed that macroeconomic fundamentals were significantly associated with changes in ERER.

The study by Kibritçioglu and Kibritçioğlu (2004) focused on assessing the misalignment of the RER for the Turkish lira. The authors utilized 16 measures of RER misalignment and analyzed quarterly data from 1987 to 2003. The estimation outcomes indicated that all 16 measures of RER misalignment consistently showed that the TL was significantly misaligned throughout the sample period. The significant and persistent misalignment of the RER for the TL throughout the sample period examined in the study suggests that various factors might have contributed to this phenomenon. These factors can include economic imbalances, such as inflation, fiscal deficits, changes in trade patterns, shifts in market expectations, and external shocks.

Özlale and Yeldan (2004) focused on calculating the misalignment of the RER for the TL between January 1992 and December 2001. They employed a model with time-varying parameters to estimate the RER misalignment during the sample period. The study's empirical findings suggested that the TL was overvalued after the 1994 crisis, and this overvaluation persisted until 1998. After the 1994 crisis, the TL was overvalued, signifying a misalignment between the exchange rate and the prevailing macroeconomic factors and market conditions. The 1994 crisis was a significant event in Turkey's economic history, characterized by severe macroeconomic imbalances, including high inflation and fiscal deficits. These imbalances could have contributed to the overvaluation of the RER.

Civcir (2003) examined the PPP hypothesis to determine whether Turkey's RER was overvalued before the 2001 crisis. Using the Johansen approach to cointegration and monthly data spanning from Jan-1987 to Dec-2000, the study found that the bilateral RER based on CPI (Consumer Price Index) and the trade-weighted RER based on the WPI (Wholesale Price Index) were overvalued. In contrast, the WPI-based bilateral RER was undervalued before 2001.

To confirm whether the TL was overvalued before the 2001 crisis, Civcir (2004) aimed to explore the validity of the monetary model of ER determination in explaining the relationship between the TL and the U.S. dollar. The study covered the period from 1987:1 to 2000:12 and utilized the Johansen approach to cointegration. The empirical results of the analysis indicated that a single cointegrating vector was identified, which supports the interpretation of the monetary model as describing a long-term equilibrium association between the exchange rates and monetary fundamentals. Moreover, the study calculated misalignment by estimating the long-term connection between the exchange rates and monetary fundamentals. The calculated misalignment figures indicated a substantial overvaluation of the Turkish lira before the eve of the 2001 financial crisis in Turkey. This suggests that the lira's exchange rate was higher than its fundamental value, making exports relatively more expensive and imports cheaper during that period.

Terra and Valladares (2010) investigated episodes of RER appreciations and depreciations across 85 countries using annual time series data covering 1960-1998. To analyze RER misalignment, the authors employed a Markov Switching Model, which characterizes the misalignment series as stochastic autoregressive processes governed by two states corresponding to different means and variances. The analysis revealed that certain countries did not exhibit clear patterns of distinct misalignment regimes. This implies that the RERs of these countries did not experience significant shifts between appreciations and depreciations during the analyzed period. For certain countries, the study found that one of the identified misalignment regimes showed no evidence of misalignment. This suggests that the RERs of these countries remained relatively close to their equilibrium values during that regime. The study revealed that among the countries that demonstrated two distinct misalignment regimes, the appreciated regime exhibited higher persistence than the depreciated regime.

2.5.2.2 Misalignment-Growth Nexus Under the Fixed and Flexible Exchange Rate Regimes. This category of empirical studies includes those conducted by Atasoy and Saxena (2006), Dağdeviren et al. (2012), Tipoy et al. (2018), Nasir and Jackson (2019), Wang (2019), Mamun (2019), Mamun et al. (2020, 2021), and more. These empirical studies examine and compare the link between currency misalignment and Turkey's economic growth, considering both fixed and floating exchange rate regimes.

Atasoy and Saxena (2006) estimated the ERER for Turkey, and it was determined that the TL was overvalued before the currency crises in 1994 and 2001. This suggests that the exchange rate was not aligned with its equilibrium level during those periods, which could have contributed to the vulnerability of the Turkish economy and the occurrence of the crises. However, the study emphasized that the actual RER in Turkey at present is close to its equilibrium rate. This finding challenged the notion propagated by Turkish exporters that the overvaluation of the TL is the leading cause of Turkey's uncompetitive exports. In other words, the study suggests that the current RER level is not a significant factor hindering the competitiveness of Turkish exports. Instead, the study highlighted the importance of fiscal adjustment in achieving macroeconomic stability. The study suggested that addressing fiscal imbalances and achieving sustainable fiscal policies are crucial in maintaining macroeconomic stability rather than solely focusing on exchange rate misalignment.

Dağdeviren et al. (2012) estimated Turkey's equilibrium real exchange rate, calculated the misalignment, and identified potential structural breaks in the misalignment series using data between 1998 and 2011. The findings reveal that the TL was significantly overvalued during the fixed ER regime. However, during the flexible ER regime, the TL did not exhibit the same level of overvaluation. These results confirm that overvalued currencies, particularly in fixed exchange rate regimes, are a more serious concern and can be associated with financial crises. The inflexibility of fixed exchange rate regimes may make it challenging to correct misalignments, leading to sustained overvaluation and potential vulnerabilities in the economy. Notably, the study also identified that rather than overvaluation, volatility has become a significant problem for Turkey in recent years. High volatility in exchange rates can introduce uncertainties and challenges for economic stability. The authors suggested that Turkey's observed dangerously large and rising current account deficits during that period may be more attributable to volatility rather than overvaluation of the TL.

Tipoy et al. (2016) evaluated the growth effect of currency misalignment in a panel of 14 emerging economies, including Turkey, using annual data from 1970 to 2014. According to the study, before the most severe financial breakdown in Turkey's history, the RER of the Turkish currency was highly misaligned. However, the study found that the situation improved after Turkey transitioned to a floating ER regime in 2001. This transition allowed market forces to determine the value of the Turkish currency, reducing the influence of government interventions and speculative pressures. As a result, the currency misalignment that was prevalent before the regime change became more manageable. Turkey's floating exchange rate regime remained relatively stable until the 2008 global financial crisis. Many countries experienced significant economic challenges, including exchange rate volatility during this crisis. The study suggests that the RER of Turkey became more susceptible to misalignment during this period, likely due to the global economic turmoil.

The study by Ulaşan (2018) explored the link between RER misalignment and EG, using annual data from 1990 to 2014 for various countries, including Turkey. The empirical findings indicated a positive correlation between RER misalignment and EG in low and middle-income countries, while no significant relationship was observed for more prosperous countries. The study highlights the impact of financial liberalization, capital inflows, and lending boom, which often lead to the appreciation of RERs in these economies. This appreciation can have consequences for long-term growth. Additionally, the study points out the role of private debt denominated in foreign currency. An overvalued exchange rate can encourage borrowing in foreign currency, making the economy more vulnerable to external shocks. In the event of a sudden and significant real depreciation, often during a downturn or crisis, the contractionary balance sheet effects can negatively impact output and growth. This highlights the significance of maintaining exchange rate stability and effectively managing the risks associated with currency misalignment.

Mamun (2019) analyzed the RER of Turkey, considering annual data spanning from 1980 to 2016. The author employs a single-equation approach to assess the misalignment of the RER in Turkey, considering the contrasting characteristics observed during the fixed and floating ERs. During the fixed ER era, the study found more episodes of RER appreciation in Turkey. This suggested that the RER was more likely to be overvalued during this period. Conversely, the study observed the opposite pattern during the floating exchange rate regime. The RER of Turkey experienced more episodes of depreciation, indicating a tendency towards undervaluation. The findings suggested that the misalignment of the RER in Turkey exhibited opposing characteristics depending on the ER regime in place. The fixed ER regime was associated with a higher likelihood of RER appreciation and overvaluation. In contrast, the floating ER regime was linked to more frequent RER depreciation and undervaluation.

The study by Nasir and Jackson (2019) focused on investigating the role of exchange rate misalignment as a determinant of trade imbalances in selected major trade surplus and deficit countries (including Turkey). The authors utilized a structural vector auto-regressive model to analyze quarterly data from these trade surplus and deficit countries. The analysis period spanned from the first quarter of 2000 to the first quarter of 2016. The empirical findings revealed that misalignment could have specific implications for the current account balance in both surplus and deficit countries. However, the observed effects were relatively mild and short-lived in nature. The study also highlighted heterogeneity in the reaction to the current account position to exchange rate misalignment in each country. This means that different countries exhibited varying reactions to exchange rate misalignment, indicating that other factors influence trade imbalances beyond the exchange rate. Based on these findings, the study suggested that exchange rate misalignment should not be solely attributed as the responsible factor for global trade imbalances. While it may have some influence, other factors such as domestic policies, economic fundamentals, and structural factors likely play significant roles in determining trade imbalances.

According to Wong (2019), real exchange rate misalignment tends to be more extensive in a fixed ER regime than in a flexible one. This observation is because market forces are crucial in quickly bringing the RER back to its equilibrium level in a flexible ER regime. At the same time, this adjustment process is not as efficient under a fixed ER regime. Empirical studies comparing the behavior of RER of Turkey between fixed and floating ER regimes have also found similar patterns. For instance, RER misalignment was significant and persistent during a fixed ER regime. However, when Turkey transitioned to a floating ER regime, the degree of RER misalignment softened. This can be attributed to the increased flexibility and the ability of market forces to respond quickly to imbalances and bring the RER closer to its equilibrium level.

Mamun et al. (2020) examined the influence of currency misalignment on the EG of Turkey. Using a single-equation approach, the authors employed the Johansen cointegration technique to measure currency misalignment. Additionally, the study utilized the ARDL approach to assess how misalignment affects economic growth. The sample period for the analysis covers from 1980 to 2016. The empirical estimates revealed that several critical factors, including relative productivity differences, terms of trade, net foreign assets, trade openness, and investment, determine the equilibrium REER of Turkey. The analysis identified that Turkey's currency was substantially misaligned. The ARDL results suggested that higher currency misalignment hurt economic growth. However, the NARDL results revealed that the undervalued TL had a detrimental effect on growth. In contrast, overvaluation of the currency promotes economic growth. However, Söylemez (2013) concluded that the high level of overvaluation of the TL is not a risk factor for economic growth.

Mamun et al. (2021) analyzed the influence of misalignment on the EG of 21 emerging markets spanning the period from 1980 to 2016. The study employed a single-equation approach to measure the RER misalignment series for these emerging markets. To estimate the influence of RER misalignment on EG, the research utilized a dynamic panel system generalized method of moments (GMM) approach. The findings indicated that the RER of emerging markets was significantly misaligned. Contrary to conventional expectations, the study found that currency undervaluation also affected economic growth. The study suggested that this undervaluation may have negative consequences for economic growth, potentially due to factors such as reduced investment incentives or distortions in resource allocation.

Mamun et al. (2023) investigated the growth effects of RER misalignment and capital flight in Turkey, covering the period from 1981 to 2019. They utilized the World Bank's residual method to analyze the prevalence of capital flight in Turkey. They adopted the single equation approach to assessing the series of RER misalignments, finding significant misalignment throughout the sample period. The findings of the ARDL methodology indicate that RER misalignment has a detrimental influence on per capita output growth in Turkey. The study also highlights the presence of growth faltering capital flight in Turkey, taking into account policy variables alongside currency misalignment. The verdicts underscore the significance of ER stability and effective policies to address currency misalignment and mitigate capital flight.

2.6 Conclusion

This chapter presented an overview of the theoretical plus empirical studies concerning the influence of ER uncertainty on trade. However, the existing literature concludes that the debate surrounding this issue remains inconclusive. Despite the accumulation of research in this domain, the ambiguity regarding the influence of ER uncertainty on trade volumes continues to persist.

At the theoretical level, scholars have developed a range of models that present differing perspectives on how ER uncertainty can influence trade. These theoretical frameworks shed light on the potential mechanisms through which ER volatility may influence exporters' and importers' competitiveness, pricing dynamics, and decision-making processes. Nonetheless, the resolution of this issue lies predominantly within the empirical realm, necessitating a meticulous examination of the available evidence. However, empirical literature assessing the connection between ER uncertainty and trade has produced mixed outcomes. Previous studies analyzing global trade data have presented conflicting findings, contributing to this topic's ongoing ambiguity. The lack of consistent results emphasizes the empirical nature of the challenge at hand.

Nevertheless, recent empirical investigations have begun to offer more substantial evidence concerning the influence of ER uncertainty on trade volumes. These research studies place a notable emphasis on the econometric specifications employed to measure exchange rate volatility. Researchers pay careful attention to the underlying assumptions inherent in trade data and, when necessary, employ error correction frameworks to mitigate potential biases.

Moreover, recent research has focused on utilizing disaggregated trade data (or commodity trade data) and incorporating novel econometric techniques to better understand the connection between ER uncertainty and trade flows. By examining trade flows at a disaggregated level, these empirical studies aim to capture the heterogeneity across industries, countries, and periods, factors that may have contributed to the conflicting findings observed in prior research. The utilization of refined data sets and advanced methodologies holds promise in yielding more definitive evidence concerning the correlation between ER volatility and trade volumes.

In addition, the review of the existing literature on the misalignment-growth nexus suggests that misalignment significantly impacts Turkey's economic growth. Researchers have employed various exchange rate measures and macroeconomic policy variables to capture global cost and price competitiveness. Most empirical studies indicate a negative association between misalignment and economic growth.

Moreover, some research studies suggest that undervalued exchange rates are the primary driver of economic growth in developing countries. These studies argue that when a country's currency is undervalued, its exports become cheaper, increasing competitiveness in international markets. This, in turn, can stimulate economic growth. On the other hand, overvalued exchange rates are believed to have adverse effects on economic activity, indicating that variation in empirical study results may arise from using different regressors, econometric estimation techniques, and models. However, the apparent dichotomy regarding the influence of undervaluation and overvaluation on EG is unresolved.

Table 1. The Selected Empirical Research on the Nexus Between Exchange Rate Uncertainty and Trade Volume in Turkey[12]

Study (year)	Sample/Countries	Period	Trade Data	Methods	Exchange Rate Volatility Measure	Assumption	Remarks/Results/Major Findings
Abbasi & Iqbal (2020)	Pakistan vs. Top 5 trading partners	1982-2017	Bilateral	ARDL and ECM modelling	The S.D of 12 monthly REER series	Symmetry	The *TCV* effect should be assessed when analyzing the impact of bilateral *ERV* on export flows.
Alper (2017)	Turkey vs. 15 EU countries	2002-2013	Disaggregated	Westerlund cointegration test	GARCH (1,0)	Symmetry	*ERV* harms export sectors, while it impacts import sectors positively and negatively.
Altintaş et al. (2011)	Turkey	1993Q3-2009Q4	Aggregate	The ARDL and ECM modelling	Moving average of the standard deviation of REER	Symmetry	*ERV* has a positive and significant impact on Turkish exports.
Asteriou et al. (2016)	Mexico, Nigeria, Turkey, Indonesia	1995M1-2012M12	Bilateral	ARDL, Granger causality and ECM modelling	GARCH	Symmetry	*ERV* does not have a significant *LR* relationship with trade volume, except for Turkey, which has a small effect.

[12] The existing body of empirical studies primarily focuses on examining the symmetric and asymmetric effects of exchange rate volatility on trade flows specifically in the context of Turkey. However, there is relatively a smaller portion of empirical studies that have investigated this relationship in other developing and developed countries as well.

Bahmani-Oskooee & Aftab (2018)	Malaysia vs. China	2001M1-2015M15	Disaggregated	ARDL & NARDL	The RER series	Asymmetry	The largest industry benefits from ringgit depreciation while remaining hurt by appreciation.
Bahmani-Oskooee & Bolhassani (2014)	The U.S. vs. Canada	1962-2006	Disaggregated	ARDL and ECM modelling	The S.D of 12 monthly REER series	Symmetry	In the *SR*, trade flows of 2/3 of the industries were affected by *ERV*. However, less than 1/3 of the trade flows were affected in the *LR*.
Bahmani-Oskooee & Durmaz (2016)	Turkey vs. the world	1990M1-2012M12	Disaggregated	ARDL & NARDL	GARCH (1,1)	Asymmetry	*ERV* had a significant *SR* influence on the imports (exports) of 39 (23) sectors.
Bahmani-Oskooee & Durmaz (2021)	Turkey vs. EU countries	1997M1-2018M12	Disaggregated	ARDL & NARDL	GARCH (1,1)	Asymmetry	*ERV* hurts both export and import industries, with import industries mainly being affected.
Bahmani-Oskooee & Karamelikli (2021)	Turkey vs. the U.S.	2003M1-2018M10	Disaggregated	ARDL & NARDL	Changes in the RER series	Asymmetry	Depreciation exhibits a significant effect, while appreciation exhibits no significant effect. However, in some industries, the opposite was true.
Bahmani-Oskooee &	Tunisia vs. 17 bilateral trade partners	1987-2016	Bilateral	ARDL & NARDL	The S.D of 12 monthly RER series	Asymmetry	The analysis demonstrated that Tunisia's trade flows to each trading

Nouira (2020)							partner were asymmetrically affected in the *SR* but not in the *LR*.
Bahmani-Oskooee & Xu (2012)	The U.S. vs. China	1978-2006	Disaggregated	ARDL and ECM modelling	The S.D of 12 monthly RER series	Symmetry	A more significant *TCV* effect is found in the *SR* compared to the *LR*.
Bahmani-Oskooee et al. (2016)	Japan vs. the U.S.	1983-2013	Disaggregated	ARDL and ECM modelling	The S.D of 12 monthly RER series	Symmetry	The *TCV* effects were significant in most sectors. Many large U.S. industries observed that exports increased due to *TCV* risk, indicating that *TCV* risk encourages traders to realign their trade markets through substitution.
Bahmani-Oskooee et al. (2017)	Pakistan vs. the U.S.	1980-2014	Disaggregated	ARDL and ECM modelling	The S.D of 12 monthly RER series	Symmetry	The effect of *TCV* was significant for most large U.S. exporting industries compared to large U.S. importing industries.
Bahmani-Oskooee et al. (2020)	The U.S. vs. Germany	1999M1-2018M7	Disaggregated	ARDL & NARDL	GARCH (1,1)	Asymmetry	Both small and large industries were significantly affected by *ERV*.
Bahmani-Oskooee et al. (2020)	Asian countries	1980Q1-2018Q4	Bilateral	ARDL & NARDL	GARCH (1,1)	Asymmetry	The nonlinear models yielded more significant results than the linear models.

Bahmani-Oskooee et al. (2023)	G7	1980Q1-2020Q4	Bilateral	ARDL & NARDL	GARCH (1,1)	Asymmetry	In the *LR*, *ERV* benefits Italian and French exports but harms German exports. Conversely, decreased *ERV* reduces French and Italian exports. Regarding G7 imports, higher *ERV* negatively affects imports of Canada, Italy, Germany, the UK, and France in the *LR*, while lower volatility boosts their imports.
Bahmani-Oskooee et al. (2013)	The U.S. vs. Hongkong	1978-2006	Disaggregated	ARDL and ECM modelling	The S.D of 12 monthly RER series	Symmetry	There is significant evidence of a *TCV* effect, particularly for import industries.
Caballero & Corbo (1989)	Chile, Peru, Thailand, Colombia, Philippines, Turkey	1965Q1-1983Q4	Aggregate	Instrumental variable and simulation analysis	Quarterly standard deviation	Symmetry	*ERV* has a negative and significant effect on *X*.
Chien et al. (2020)	Taiwan vs. Indonesia	2003M1-2017M12	Disaggregated	ARDL & NARDL	GARCH	Asymmetry	In the *LR*, *ERV* has a more significant impact on Taiwan's exports to Indonesia compared to Taiwan's imports from Indonesia. Additionally, in the *SR*, *ERV*'s asymmetric effect leads to unstable trade amounts

							changes for most of Taiwan's export and import industries with Indonesia.
Davis (2014)	Turkey vs. EU-27, NAFTA, APEC	1999-2008	Aggregate	Gravity model	Moving standard deviation	Symmetry	*ERV* has a positive and significant effect on trade flows.
Demez & Ustaoğlu (2012)	Britain, Italy, the U.S., Germany, Russia, Turkey	1992M1-2010M12	Aggregate	Zivot-Andrews and Lee-Strazicich unit root tests	---	Symmetry	Exports were insensitive to changes in currency rates.
Denaux & Falks (2013)	Germany, France, Italy, Spain, the UK, Turkey	1988Q1-2011Q3	Aggregate	OLS	Moving standard deviation of the RER	Symmetry	*ERV* has no significant effect on Turkish imports.
Doğanlar (2002)	South Korea, Indonesia, Pakistan, Malaysia, Turkey	1980Q1-1996Q4	Aggregate	Engle-Granger cointegration	Moving standard deviation of the RER	Symmetry	*ERV* has a negative and significant effect on *X*.
Güngör et al. (2022)	Turkey vs. EU	2005M1-2021M12	Bilateral	Markov Regime Switching Models	GARCH (1,1)	Asymmetry	*ERV* has diverse effects on bilateral trade, depending on economic conditions.

Iqbal et al. (2023)	India vs. the U.S.	1980-2020	Disaggregated	ARDL and ECM modelling	The S.D of 12 monthly REER series	Symmetry	The *TCV* effect significantly impacted the trade volume in selected sectors.
Kasman & Kasman (2005)	Germany, the U.S., Italy, France, the UK, Belgium, the Netherlands, Greece, Spain, Turkey	1982Q1-2001Q4	Aggregate	Johansen-Juselius and ECM Modelling	Moving standard deviation of the RER	Symmetry	*ERV* has a positive and significant effect on *X* in the *LR*.
Khalid et al. (2023)	Turkey vs. Germany	1980-2022	Disaggregated	ARDL & NARDL	GARCH (1,0)	Asymmetry	The *ERV* has short-run asymmetric effects on trade flows for 69 (86) Turkish export (import) industries, which persisted for more than 50% of the total export and import industries in the *LR*.
Khalid et al. (2023)	Turkey vs. Germany	1980-2022	Disaggregated	ARDL & NARDL	GARCH (1,1)	Asymmetry	The empirical analysis suggested that incorporating the *TCV* effect is necessary to obtain more reliable estimates, as relying solely on asymmetric analysis is insufficient.
Lee et al. (2022)	The U.S. vs. China	2003M1-2020M6	Disaggregated	ARDL & NARDL	GARCH	Asymmetry	The nonlinear analysis showed that the nonlinear volatility adjustment had a

							more significant impact than the symmetric model on U.S. exports (imports) to (from) China in the *LR*. Additionally, increased volatility boosted U.S. imports (exports) from (to) China.
Özbay (1999)	Turkey	1988Q2-1997Q2	Aggregated	Quasi-Maximum Likelihood Method	GARCH	Symmetry	*ERV* negatively affects Turkish exports, but no significant relationship was found with imports.
Rasaki & Oyedepo (2023)	Nigeria	1995Q1-2020Q4	Aggregated	ARDL & NARDL	GARCH	Asymmetry	The non-linear analysis indicated that *ERV* doesn't have asymmetric effects on exports in the *SR* or *LR*. However, significant asymmetric effects of *ERV* on imports were observed in both the *SR* and *LR*. The analysis revealed that an increase in *ERV* reduces imports, while a decrease in *ERV* boosts imports.
Tarakçi et al. (2022)	Belgium, Italy, France, the Netherlands, Germany, the	2002M1-2019M12	Bilateral	ARDL & NARDL	EGARCH (1,1) and TGARCH (1,1)	Symmetry	Both low and high *ERV* increase (decrease) Turkey's exports in the *SR* (*LR*).

	UK, Spain, Russia, the U.S., Turkey						
Usman et al. (2021)	Pakistan vs. China	1980-2018	Disaggregated	ARDL & NARDL	The S.D of 12 monthly RER series	Asymmetry	*ERV* has a nonlinear impact on both export and import industries in both the *SR* and *LR*. It is advisable to incorporate the *TCV* effect into the analysis to obtain more significant estimates.
Vergil (2002)	Germany, Italy, Turkey, France	1990M1-2000M12	Bilateral	Johansen-Jeselius and ECM modelling	The S.D of the percentage change in RER	Symmetry	*ERV* has a negative and significant effect on Turkish real exports.
Vo et al. (2019)	Vietnam vs. 26 trade partners	2000-2015	Bilateral	Panel Dynamic Ordinary Least Squares	GARCH (1,1)	Symmetry	The findings indicated that a currency depreciation strategy in Vietnam boosts manufacturing exports in the *SR*. However, the resulting *ERV* clearly negatively affects exports in the *LR*.
Yildirim & Saraç (2022)	Germany vs. Turkey	2002Q1-2020Q2	Bilateral	Markov Regime Switching model	---	Asymmetry	Fluctuations in the *RER* positively impact the *TB* during the expansion period. However, no significant

							evidence exists of such an impact during the contraction period.
Yüksel et al. (2012)	Turkey	2003M2-2010M12	Aggregate	OLS	Moving S.D of the RER	Symmetry	*ERV* has a negative but insignificant effect on *X*.

Notes: ERV = exchange rate volatility; X = exports; LR = long-run; SR = short-run; REER = real effective exchange rate; S.D = standard deviation; TB = trade balance; and TCV = third-country volatility.

Source: Author's compilations (2023)

CHAPTER III

Theoretical Framework

3.1 Theoretical Framework

Since the breakdown of the Bretton Woods system in the 1970s, the impact of floating exchange rates on international trade has been a subject of ongoing debate. Liberal economists generally viewed the transition from a fixed to a floating exchange rate system favorably, while opponents expressed concerns about its potential adverse effects on trade. The conventional perspective posited that increased exchange rate volatility would lead risk-averse traders (exporters) to reduce their output (exports). This view argued that higher exchange rate volatility could increase uncertainty and risk, thus discouraging international trade (De Grauwe, 1988). Even if traders could hedge against foreign exchange risk, the associated costs might act as barriers to trade, similar to an increase in tariffs.

On the contrary, an opposing view suggested a positive relationship between ER uncertainty and trade volume. Theoretical arguments supporting this perspective considered trade as an option held by firms, with the value of this trade option rising with increased volatility (Frankle, 1991). In other words, higher exchange rate volatility might create more profit opportunities through speculative trading or adapting business strategies to take advantage of market fluctuations. Since the 1970s, the debate has triggered significant theoretical and empirical research in international economics, but the results have remained inconclusive (Öksüzler, 2003).

Theoretical advancements made by De Grauwe (1988) and Dellas and Zilberfarb (1993) propose arguments related to the response of exporters to an increase in ER risk, contingent upon the shape of the expected marginal utility (EMU) of the export income curve. When producers/exporters exhibit only a slight degree of risk aversion, they are likely to reduce their production for export when faced with higher exchange rate risk. This reduction occurs because higher exchange rate risk diminishes the EMU of export revenues, with the substitution effect (S.E) dominating the decision-making process. In this scenario, firms tend to avoid risky activities.

On the other hand, when producers are highly risk-averse, their primary concern revolves around the worst possible outcome. Consequently, an ER risk increase may elevate the EMU of export revenues. This is because highly risk-averse producers aim to export more to mitigate the potential severe decline in revenue, thereby minimizing potential losses. In this case, the income effect (I.E) takes precedence, motivating firms to increase their export activities to compensate for the expected revenue decline. The total effect (T.E) of an increase in risk encompasses both the S.E and the I.E. The S.E encourages firms to avoid risky activities. In contrast, the I.E operates in the opposite direction. As risk increases, the expected utility increases, prompting firms to expand their export activities to counterbalance the anticipated revenue decline.

Empirical investigations assessing the connection between ER uncertainty and trade have resulted in inconclusive findings. Some empirical studies, such as those conducted by Akhtar and Hilton (1984), Kenen and Rodrik (1986), Franke (1991), Pozo (1992), Chowdury (1993), and Arize (1987, 1995), have provided empirical evidence suggesting that ER uncertainty has a detrimental influence on trade. In contrast, other empirical studies, including De Grauwe (1988) and Asseery and Peel (1991), have found empirical evidence supporting a positive link between ER uncertainty and trade. Additionally, empirical attempts by the IMF (1984) and Gotur (1985) have concluded that ER uncertainty does not significantly influence trade. The conflicting outcomes of these empirical studies contribute to the ongoing uncertainty surrounding the link between ER uncertainty and trade.

The lack of consensus among studies regarding the influence of ER uncertainty on trade can be attributed to various factors. Firstly, differences in estimation procedures and methodological choices across studies may lead to divergent results. Researchers often use different models, data sources, and statistical techniques, which can introduce variations in findings. Secondly, using various proxies to measure exchange rate uncertainty contributes to the inconclusive evidence. Empirical studies may employ measures like standard deviation, variance, or models such as ARCH or GARCH, which capture different aspects of ER uncertainty and influence the outcomes.

Moreover, the time horizon of the analysis plays a crucial role. Effects of ER uncertainty on trade are more likely to emerge in the long-term rather than the short-term. Firms may have limited options to mitigate foreign exchange risk in the short term, primarily resorting to forward markets or hedging strategies. However, in the long-run, firms can adjust production and investment decisions, shifting away from risky foreign markets towards more stable domestic markets. Many studies have focused on analyzing the short-run effects, potentially contributing to the inconclusive nature of the findings (Öksüzler, 2003).

In a two-country trade model, researchers emphasized examining ER uncertainty's influence on trade between two countries; however, they did not focus on other critical factors affecting bilateral trade. These factors include the existence of forward or futures markets, the degree of risk aversion, risk management practices (such as hedging), market knowledge and awareness, exchange controls implemented by monetary authorities, risk diversification strategies adopted by firms, and adjustments in factor inputs. Some of these factors are argued to have adverse effects on international trade. For instance, the absence of forward or future markets and the presence of high risk and risk management costs can negatively impact foreign trade (Ethier, 1973; Bailey et al., 1987; De Grauwe, 1988; Edwards, 1989, 1993; Sercu & Vanhulle, 1992; Dellas & Zilberfarb, 1993; McKenzie, 1999; Arize et al., 2000). These factors introduce uncertainty and additional costs for traders, discouraging international trade.

On the other hand, proper knowledge and awareness of the market among investors and traders and exchange controls implemented by monetary authorities can facilitate trade flows (McKenzie, 1999; Clark et al., 2004; De Grauwe, 2005). According to these studies, investing firms employ risk diversification strategies and factor input adjustments, which can positively affect trade. However, in recent empirical studies, the concept of "third-country effect" has emerged as a critical variable that influences trade flows (Cushman, 1986; Kumar & Dhawan, 1991; Baek, 2014; Berg & Mark, 2015; Bahamni-Oskooee and Aftab, 2017, 2018; Abbasi & Iqbal, 2020; Usman et al., 2021; Khalid et al., 2023).

3.2 Some Aspects Under Theoretical Discussions

3.2.1 Factors Hampering Foreign Trade

Several crucial factors have been identified in the international trade literature that can adversely affect foreign trade flows. These factors, as discussed by Ethier (1973), De Grauwe (1988), Edwards (1989, 1993), Sercu and Vanhulle (1992), McKenzie (1999), and Arize et al. (2000), include the absence of forward or futures markets, the extent of risk and risk management (hedging), and the costs associated with risk management. It is important to note that these factors were initially discussed in a two-country trade model and were later expanded upon in the literature.

3.2.1.1 Forward/Future Markets. In the case of a simple two-country model of international trade, Ethier (1973) and McKenzie (1999) discuss the significance of forward markets and their impact on trade between two countries. They analyze a scenario where a firm in country-A produces and sells a product to country-B and its own country. When forward markets exist, the firm can enter into contracts that determine the price of its product in the future. This provides a level of certainty regarding future revenues. However, in the absence of forward or futures markets, the firm faces exchange rate risk when converting its future revenue from country-B's sales into country-A currency.

Ethier (1973), Clark (1973), and McKenzie (1999) further emphasize that in the absence of forward markets, differences in expectations about prices and costs can hinder trade between the two countries. If people hold different expectations regarding future exchange rates, which differ from the actual exchange rate, it introduces uncertainty and risk. This discrepancy between forward exchange rates and expected future rates may discourage trade activities. In contrast, when forward markets exist, and people hold the exact expectations about exchange rates, differences in forward exchange rates below the expected future rate can create a premium. However, it is essential to note that the brokerage cost or spread of future transactions is typically lower than that of spot transactions. Consequently, increased exchange rate uncertainty leads to higher brokerage costs, negatively impacting trade flows (McKenzie, 1999).

3.2.1.2 Degree of the Risk-Aversion/Risk-Neutral. In one of the earlier theoretical studies, Ethier (1973) investigated the hypothesis of the negative impact of ER uncertainty on world trade. Ethier specifically defined ER uncertainty as the standard deviation of the spot exchange rate and constructed a model to analyze the decision-making process of risk-averse importers concerning the volume of goods to be imported and the extent of forward exchange rate cover.

Ethier's argument suggested that the amount of ER uncertainty is pivotal in determining the degree of forward cover. He posited that firms are unlikely to have access to perfect profit information, which leads to a negative influence of ER uncertainty on trade. The absence of precise profit information makes it challenging for firms to effectively manage and control ER volatility's influence. Consequently, trading volumes are expected to be adversely affected. Furthermore, Ethier observed that this outcome remains consistent regardless of the currency denomination specified in the export contract. Whether the contract is denominated in the exporter's or the importer's currency, the negative influence of ER uncertainty on trade persists.

Ethier's model, based on risk aversion, demonstrated specific results. However, Demers (1991) presented similar findings by assuming a risk-neutral trader. Demers argued that the demand for a perfectly competitive firm becomes uncertain due to price variability caused by exchange rate volatility. In this uncertain environment, the irreversibility of investment in physical capital leads to a decline in output and trade over time. Thus, under the assumption of risk neutrality, Demers's model also supports the negative hypothesis concerning the impact of ER uncertainty on trade. Nevertheless, Franke (1991), who also assumes risk neutrality, presented a contrary view. Franke's analysis showed that exchange rate risk could positively affect trade flows.

In addition, De Grauwe (1988) conceptualizes exchange rate volatility as a "risk" and highlights that its impact on foreign trade depends on the extent to which investors and traders are willing to manage the risks associated with exchange rate uncertainties. Edwards (1989, 1993) supports this perspective by asserting that greater exchange rate volatility results in higher expected costs for risk-averse investors. The heightened uncertainty and potential losses stemming from exchange rate fluctuations contribute to an increased perceived risk, which can deter investors from participating in international trade.

Arize et al. (2000) draw attention to the possibility of hedging or risk management to mitigate the severity of ER uncertainty on trade. Nevertheless, they also acknowledge that hedging comes at a cost. The expenses associated with implementing risk management strategies, such as utilizing forward contracts or derivatives to hedge against exchange rate risk, can diminish the potential gains from engaging in international trade. Consequently, the level of international trade may be reduced due to the costs incurred in managing foreign exchange risk. When traders enter into contracts for future deliveries, they typically make payments based on the ER prevailing at the time of actual delivery. However, as exchange rate risk increases or individuals display risk aversion, unexpected changes in exchange rates introduce uncertainty regarding the future profitability of those deliveries. This uncertainty, in turn, diminishes the potential benefits of participating in international trade, ultimately reducing trade volume.

3.2.1.3 Hedging and Suppliers/Traders' Responses. The availability of costless hedging instruments, as demonstrated by Ethier (1973), suggests that ERV would not influence firms' output and exports. This theoretical result, called the separation theorem, forms the basis of the hedging hypothesis. However, the influence of ERV on foreign trade has evolved over the past three decades with the rapid proliferation of hedging instruments.

Frankel and Wei (1994) examined data from earlier and more recent periods and found a negative coefficient indicating a negative effect of ERV before the mid-1980s. Since then, however, this negative effect has weakened. Wei (1999) argues that this pattern is consistent with the hedging hypothesis because currency hedging products were not as advanced in the 1970s and early 1980s as today. It is hypothesized that the increasing availability of hedging instruments is responsible for the reduced impact of ERV volatility on trade.

Nevertheless, Wei (1999) also recognizes several dimensions of the hedging hypothesis. First, using hedging instruments is not costless, and the cost increases with higher volatility. Second, increased volatility can indirectly affect trading through its impact on the forward price, often causing a depressive effect. Third, hedging instruments are usually available for shorter periods (one month to one year), which may be shorter than the planning horizon of many exporters and importers. Fourth, traders may be concerned about real exchange rate risk, while existing hedging instruments are primarily designed to hedge nominal exchange rate risk.

Adam-Muller (1997) developed a model that examines optimal export and hedging decisions of a risk-averse firm facing hedgeable exchange rates and unhedgeable earnings risks abroad. In this circumstance, the firm's ER risk is itself random. The firm must make decisions regarding exports and forward hedging of its foreign currency earnings. When there is a forward exchange market and no revenue uncertainty, optimal production decisions can be separated from the firm's utility function and the distribution of exchange rates. However, this separability property breaks down when unhedgeable risks are introduced, as Adam-Muller (1993) has shown in two exceptions.

Despite the ability to hedge exchange rate risk using forward contracts, optimal output tends to be smaller than the deterministic revenue due to additional uncertainty arising from random foreign exchange revenue. Even with a forward position, the firm remains exposed to unhedgeable revenue risk, and the distribution of risk and risk aversion impacts output decisions. Moreover, revenue uncertainty generally affects the forward position, and even if the forward market is unbiased, the firm may not fully hedge its expected foreign currency revenue due to the existence of revenue uncertainty effects.

According to De Grauwe (1988), Edwards (1989, 1993), and Sercu and Vanhulle (1992), exporting firms typically face additional costs to mitigate the risk associated with exchange rates. If these firms are risk-averse, they would be willing to bear the cost of hedging to avoid the risk, often referred to as the "cost of hedging." In some cases, this cost can be pretty high and act as an implicit cost for the exporting firms. Mckenzie (1999) and De Grauwe (2005) further argue that when exporters are exposed to exchange rate risk, their supply of exports will be smaller at a given price compared to firms that do not face such risk. This implies that the supply curve for each firm is expected to shift to the left, indicating a reduction in supply. Consequently, foreign trade flows are anticipated to be adversely affected by exchange rate risk.

Additionally, Clark et al. (2004) suggests that other costs, such as transportation, can influence trade between countries. When hedging becomes impossible or costly, the overall trade costs are expected to increase. This, in turn, reduces the expected profit from sales for traders, resulting in decreased export activity. The increased costs associated with hedging and transportation can be barriers that discourage exporting firms from engaging in foreign trade.

3.2.2 Factors Promoting Foreign Trade: Counter Arguments

The international trade literature also provides the counter-arguments that there are factors that can help boost foreign trade (McKenzie, 1999; Clark et al., 2004; De Grauwe, 2005). In the sub-section, we discuss all these factors in detail.

3.2.2.1 Knowledge and Awareness of Investors/Traders. In the two-country trade model, the argument suggests that if investors (exporters) have knowledge and awareness about their investment goods and trading relations, it can be advantageous for them to anticipate future ER movements in the foreign exchange market. This information can serve as a basis for making informed decisions that have the potential to raise profitability and mitigate anticipated exchange rate risks.

According to De Grauwe (2005), instead of relying solely on the forward exchange market, traders can hedge their investments and transactions in the long-run by borrowing and lending in local currency. By doing so, traders and investors can reduce the risk of exchange rate fluctuations in their initial investments. This approach involves using local capital to finance production plants in foreign countries. In this context, if a firm engages in trade with multiple countries, the exchange rate movements may perform to boost trade between those countries.

Clark et al. (2004) and De Grauwe (2005) argue that diverse trading relationships allow firms to take advantage of exchange rate uncertainties and potentially enhance their trade activities. For example, if a firm's exports become more competitive due to a favorable exchange rate variability, it can increase demand and trade with other countries. The underlying premise is that knowledge, awareness, and the ability to hedge investments and transactions can enable firms to control the uncertainties of the foreign exchange market more effectively. By leveraging this understanding, firms may be able to anticipate and respond to exchange rate movements in ways that enhance profitability and reduce associated risks, ultimately facilitating increased trade between countries.

3.2.2.2 Risk Diversification. Tobin's q theory suggests that firms are fully aware of their investment portfolio and make decisions accordingly to diversify the risk associated with exchange rates. By maintaining a diversified asset portfolio, firms aim to mitigate the potential impact of ER fluctuations on their trade activities. It is important to note that ERV cannot solely measure the effect of foreign currency holdings on a firm's portfolio. The impact is influenced by the ER's variance and its covariance with the prices of the firm's other assets. In other words, the correlation between exchange rate movements against the home currency and movements in other currencies plays a role in determining the overall risk exposure.

Firms often maintain a portfolio of multiple foreign currencies to diversify the risk. By holding a diversified currency portfolio, the volatility of exchange rates for individual currencies may be reduced if an inverse correlation exists between the movements of the exchange rates against the home currency and the movements of other currencies. This diversification strategy can help firms minimize ER fluctuations' potential negative impact on their trade activities. It is worth noting that measuring exchange rate risk solely based on variance may not capture the full extent of the risk. The variability of exchange rates alone does not provide a complete picture of the potential impact on a firm's portfolio. By diversifying the exchange rate risk, firms can reduce their vulnerability to adverse exchange rate uncertainties, contributing to increased international trade flows.

3.2.2.3 Factor Inputs Adjustments. When firms diversify their exchange rate risk, they often adjust their factor inputs in response to fluctuations. Increasing exchange rate volatility can create opportunities for firms to enhance their profitability. In this context, exchange rate movements are considered risks and potential rewards. By adjusting their factor inputs to price changes caused by exchange rate uncertainties, firms aim to optimize their average expected profits. Higher volatility in exchange rates can lead to higher expected profits if firms effectively manage their inputs and respond strategically to price fluctuations. Consequently, one would expect an increase in international trade flows.

According to the standard trade theory, firms tend to sell more of their products at higher prices and fewer products at lower prices. Therefore, when exchange rate volatility increases, causing price variability, firms may increase their production and exports to maximize the potential for higher profits. This response is particularly relevant for firms with relatively lower risk aversion. Furthermore, the concept of export goods being viewed as options, as proposed by Edison and Melvin (1990) and De Grauwe (2005), highlights the value of volatility in exchange rates. Exporting firms can exercise the option to export when they observe exchange rates becoming more favorable, stimulating trade flows and contributing to economic growth.

3.2.2.4 Exchange Controls. Another argument in the international trade literature suggests that if fundamental factors influence exchange rate volatility, simply targeting volatility may not be a sustainable solution. Instead, alternative measures need to be specified. Monetary authorities may intervene through exchange controls over trade and payments to counteract the increased observed exchange rate volatility. This intervention can enhance foreign trade rather than relying solely on exchange rate uncertainties. However, it is essential to note that such interventions may also have limitations and potential disruptions.

3.2.2.5 The Inclusion of a Third-Country Risk. Cushman (1986) introduced the term "third-country effect" in his study, which explored the influence of ER risk on multilateral trade between the U.S. and its counterparts. Cushman argued that excluding the volatility of third countries could influence the original volatility estimates since the variable plays a pivotal role in determining trade b/w the U.S. and its major trading partners. Therefore, incorporating a third-country effect into a two-country trade model has garnered attention in recent empirical literature.

Kumar and Dhawan (1991) discovered that including third-country risk as an additional explanatory variable in conventional two-country trade models can substantially enhance their explanatory power. Studies conducted by Cheung et al. (2005) and Berg and Mark (2015) have provided evidence supporting the importance of the third-country risk, demonstrating that omitting it can lead to low R-squared (or adjusted R-squared) values.

The argument for including the third-country effect in a two-country model is as follows: Shocks originating in the third-country can lead to substantial instability in exchange rates between country-A and country-B and affect bilateral trade between these two countries. Numerous research studies, including Cushman (1986), Kumar and Dhawan (1991), Cheung et al. (2005), Bahmani-Oskooee and Xu (2012), Bahmani-Oskooee and Bolhassani (2014), Berg and Mark (2015), Bibi et al. (2020), Usman et al. (2021), and Khalid et al. (2023), have incorporated the effect of third-economy uncertainty in their econometric specifications to understand how shocks in the third-country (country-C) impact the exchange rates between two bilateral trade partners.

There are generally two ways to capture the effect of the third-country risk. The first approach involves a country (let us call it country-B) devaluing its currency against the currency of the third-country under a managed float exchange rate regime. As a result, the interest rate in country-B becomes dependent on the RER between country-B and the third-country (C). Any shock originating in the third-country leads to divergences in interest rates and consumption growth rates between country-A and country-B, inducing uncertainties in their bilateral exchange rates. The second approach to capturing the third-country effect focuses on cross-country differences. This occurs when firms' price levels and adjustment abilities differ in countries A and B. A positive shock (demand/supply) in the third-country causes firms to initially decrease export prices to countries A and B, raising export demand. To meet the increased demand, firms in country-B initially raise their domestic sale prices and export prices to country-A. This indirect approach captures the third-economy uncertainty. A shock in a third-economy generates a wedge between country-A's and country B's price levels or inflation rates, leading to differences in interest rate levels and consumption/investment levels between the two countries. These divergences subsequently cause movements in bilateral exchange rates between countries A and B and impact trade between the two counterparts.

3.3 The Theoretical Framework: Currency Misalignment

The theoretical framework concerning the nexus between misalignment and growth revolves around RER misalignment and its computation. This framework elucidates the process of deriving the ERER using various measurement techniques and calculating the misaligned RER based on the determination of the equilibrium rate. The choice of measurement approach for computing the "equilibrium real exchange rate" may vary depending on the specific research context and data availability. Typically, it involves a combination of economic models, econometric techniques, and empirical analysis. For the current study, the approach adopted is based on thoroughly examining previous methodologies to ensure their robustness and relevance.

3.3.1 The Concept and Measurement of Currency Misalignment

The concept of currency misalignment refers to the situation where the actual or observed RER consistently deviates from its equilibrium position. The computation of real exchange rate misalignment (*RERMIS*) involves comparing the ERER with the observed RER. The difference between the two values represents the extent of misalignment. This calculation can be performed using econometric models or statistical techniques considering relevant macroeconomic variables and their relationships with the RER. The theoretical framework aims to investigate the impact of *RERMIS* on EG by analyzing how deviations from the ERER can influence trade flows, investment decisions, and overall economic performance. In our study, we estimate Turkey's RERMIS as the difference between the natural logarithm of the RER and the natural logarithm of the estimated ERER. Symbolically,

$$RERMIS_t = lnRER_t - ln\widehat{ERER}_t$$

In this expression, $RERMIS_t$ represents the degree of misalignment, $lnRER_t$ represents the actual/observed real exchange rate and $ln\widehat{ERER}_t$ represents the predicted or estimated ERER. The Turkish currency (TL) is overvalued (undervalued) if the values of the *RERMIS* are positive (negative).

3.4 Modeling the ERER: Alternative Approaches

The ERER is a concept used in macroeconomics to determine the long-term ER that is consistent with internal and external economic balances. It represents the ideal/consistent/sustainable exchange rate that would prevail in an economy without short-term price rigidities, distortions, and frictions. In other words, the concept of the ERER is based on the idea that an exchange rate value is associated with sustainable growth and development while achieving both internal and external balance in an economy (Edward, 1988; Williamson, 1985, 1994). Internal balance refers to a situation where the non-tradable goods market clears in the current period and is expected to remain balanced. It implies that there are no imbalances or distortions within the domestic economy. On the other hand, external balance refers to a desirable balance of payments position and an adequate level of foreign reserves contributing to macroeconomic stability. It means that the economy's international transactions, including trade in goods and services, capital flows, and foreign investments, are in equilibrium.

To determine the connection between *RERMIS* and *EG*, the first step is to establish the ERER (Abbasi, 2021). In the academic literature, various approaches used for modeling the ERER can be broadly categorized into two major categories: traditional and modern equilibrium exchange rate models. Traditional ERER models include purchasing power parity (PPP), uncovered interest rate parity, and monetary models. In contrast, the modern equilibrium exchange rate models[13] include the fundamental equilibrium exchange rate (FEER), the behavioral equilibrium exchange rate (BEER), the natural rate exchange rate (NATREX), and the permanent equilibrium exchange rate (PEER)[14]. A detailed explanation of each measurement procedure used to determine the ERER can be found below:

[13] These are the models based on the estimation of a reduced-form ERER regression.
[14] For detailed explanations, refer to Siregar and Rajan (2006).

3.4.1 The Purchasing Power Parity (PPP) Method

This approach is grounded on the principle that the long-term ER should equalize the purchasing power of different currencies. It states that the ratio of price levels between two countries should be equal to the ratio of their exchange rates. The PPP approach involves comparing the relative price levels of commodities in different countries to estimate the equilibrium ER. Civcir (2003), Gala & Lucinda (2006), Rodrik (2008), Nacita (2013), and Ibrahim (2016) employed the PPP-based RER approach, which is a three-step procedure. The RER is defined as the nominal exchange rate (NER) multiplied by foreign price levels (P_f) and divided by domestic price levels (P_d). The weighted real exchange rate or PPP-based RER can be written as below:

$$RER = NER * \left(\frac{P_f}{P_d}\right)$$

In empirical studies, Edward’s (1989) suggestion to use the same price index (e.g., the CPI, the WPI, or GDP deflator) for both foreign and domestic countries aim to ensure consistency and comparability in the analysis. This allows for meaningful comparisons between different countries or regions. In a compact form, we can write the expression as follows:

$$\ln\,(RER)_{kt} = ln\left(\frac{NER_{kt}}{PPP_{kt}}\right)$$

In this expression, *k* denotes the country, and *t* denotes the analysis period. When the RER exceeds one, the currency is undervalued relative to its PPP. To assess the degree of misalignment, the RER is compared to the country's level of development, as indicated by per capita GDP (GDPPC). This step considers the Balassa-Samuelson effect, which suggests that the price levels of non-traded goods are related to the country's level of development. The misalignment is calculated by regressing the RER on GDPPC, and the deviation from the predicted/estimated exchange rate represents the degree of misalignment. The econometric equation can be formulated as follows:

$$ln(RER)_{it} = \alpha_{it} + \beta_{it} ln(GDPPC)_{it} + \varepsilon_{it}$$

In this econometric specification, *i* stands for the country, *t* stands for the time, and ε is the white noise error term. If the actual/observed exchange rate is higher than the Balassa-Samuelson-adjusted rate, it suggests that the currency is overvalued. In contrast, if the actual exchange rate is lower than the Balassa-Samuelson-adjusted rate, it indicates an undervalued currency (Abbasi, 2021). The individual degrees of misalignment are summed to capture the overall undervaluation or overvaluation between two countries. This variable, denoted as *RERMIS*, represents the cumulative misalignment between countries.

Despite the advantages of this equilibrium real exchange rate measure, such as incorporating PPP and considering the Balassa-Samuelson effect, it has some limitations. One limitation is that it relies on GDP per capita as the sole indicator of a country's level of development, and other variables may also be relevant (MacDonald, 2000). Furthermore, this measurement model has faced significant criticisms from researchers due to its limited explanatory power (Alper & Civcir, 2012). For example, MacDonald (2000) points out that PPP is a restrictive approach as it disregards crucial determinants of the RER, such as relative economic activity, net foreign assets, and capital inflows. Achy (2001) further highlights that the PPP approach may yield biased empirical estimates as it fails to capture RER changes caused by factors beyond price differences between home and foreign economies.

Additionally, Rogoff (1996) notes that PPP is a long-run concept that requires a wide range of data for accurate calculation, as it assumes the absence of trade barriers, which is rarely the case. MacDonald (2000) states, "PPP is based on arbitrage, enforcing the law of one price for the prices of goods entering the aggregate price measure; it also assumes no barriers to international trade." MacDonald (2000) further argues that "PPP is not a particularly good measure of whether currencies are misaligned." This methodology also neglects other fundamental variables and does not provide insights into exchange rate changes driven by global imbalances (Béreau et al., 2012). This approach assumes a constant equilibrium ER under PPP, which may not hold in practice.

3.4.2 The Fundamental Equilibrium Exchange Rate (FEER) Method

Modern equilibrium exchange rate models have emerged in the empirical literature to avoid the issues associated with the PPP approach, offering more sophisticated approaches to estimating the ERER by incorporating macroeconomic fundamentals. One of the prominent modern approaches to modeling the ERER is the FEER. The FEER method was proposed by Williamson (1994) and considers a broader set of economic fundamentals, including factors like productivity, terms of trade, government expenditures, and savings rates. This approach represents the ER that simultaneously achieves both external and internal balance (Williamson, 1994). Internal balance means achieving an output level consistent with full employment and stable prices. In contrast, external balance is identified with a sustainable and appropriate current account balance when the economy is in internal balance. The FEER approach focuses on persistent economic fundamentals over the medium-run, disregarding short-term cyclical and temporary factors. It measures the economic conditions affecting the equilibrium ER by assessing medium-run factors.

The macroeconomic equilibrium principles underlying the FEER approach closely align with the equilibrium concepts proposed by (Artis & Taylor, 1995; Bayoumi et al., 1994), Stein's Natural Real Exchange Rate (NATREX) approach (1990, 1994), the Debt Adjusted Real Exchange Rate (DARER) approach introduced by Fabella (1996) and Frait & Komárek (2002, 2008), and the Fundamental Real Exchange Rate (FRER) approach by Bulíˇr & Smídková (2005).

In contrast to the PPP approach, which presumes a constant equilibrium exchange rate (Rodrik, 2008), the FEER allows for changes in the equilibrium ER. This feature of the FEER recognizes the dynamic nature of economic conditions and acknowledges that the equilibrium ER can change over time. By incorporating these changes, the FEER aligns the ER with the desired monetary conditions that foster macroeconomic equilibriums or balances (Siregar, 2011).

In addition, Driver and Westaway (2005) highlight that even when internal and external balance is achieved, changes in asset stocks may still occur. This implies that while internal and external equilibrium are essential determinants of the FEER approach, they may not fully capture all the dynamics in the exchange rate market. Building upon this, Jeong et al. (2010) argues that the FEER approach comprehensively depicts an economy's international trade relations by linking ER fluctuations to internal and external balance.

3.4.3 The Behavioral Equilibrium Exchange Rate (BEER) Approach

The BEER approach is a well-known measurement methodology for determining the equilibrium ER. This approach, introduced by MacDonald (1997) and further developed by Clark and MacDonald (1998), models the RER as a function of various macroeconomic factors, such as net foreign assets (NFA), trade balance, capital flows, and relative productivity[15]. The relationship between these macroeconomic variables and the real exchange rate is analyzed using cointegration techniques[16]. In other words, the BEER approach can be considered a predominantly empirical approach for estimating the ERER based on the long-term econometric association between the RER and its macroeconomic fundamentals.

In this approach, the econometric estimation procedure comprises two phases: In the first phase, researchers identify a long-term connection among the variables under analysis and estimate the ERER by substituting the actual or long-term values of the explanatory variables into that relationship. In the second phase, the researchers calculate both the short-term and

[15] Refer to Alper and Civcir (2012) for details.
[16] Refer to Alper and Sağlam (2000), Atasoy and Saxena (2006), Alper and Civcir (2012) for details.

long-term real exchange rate misalignments. To determine the short-run misalignment, they compare the actual values of the RER with the adjusted values derived from the long-term relationship. However, unlike the long-run misalignment that uses long-run values of macroeconomic fundamentals, the short-run misalignment relies on the actual values of these variables during the short-run period (Alper & Civcir, 2012).

One key aspect of the BEER approach is the computation of *RERMIS*. This is determined by calculating the difference b/w the observed RER and its equilibrium level. If the RER deviates from its equilibrium rate, it suggests that it is misaligned and not in line with the desired equilibrium (Alper and Civcir, 2012).

Notably, the BEER and FEER approaches rely on the concept of balance of payments equilibrium. However, they make different assumptions regarding regressors' behavior and ability to reach steady levels. Despite these differences, both approaches aim to provide reliable estimates of the equilibrium ER.

It is worth noting that the BEER approach, like the FEER, is subject to certain limitations and challenges. One of the limitations of the BEER approach is its heavy reliance on econometric estimation. The accuracy and reliability of the estimated ERER depend on the quality of data, the choice of variables, and the assumptions made in the econometric model. In practice, the BEER approach may face challenges in accurately capturing all the relevant macroeconomic factors and their long-term association with the RER.

Another drawback of the BEER approach is its sensitivity to short-term fluctuations and noise in the data. The short-run misalignments computed by the BEER approach may be subject to significant volatility, making it difficult to distinguish between temporary deviations and persistent exchange rate misalignments. Additionally, the BEER approach may struggle to account for sudden shocks and structural economic changes that can affect the equilibrium exchange rate (Abbasi, 2021).

3.4.4 The Natural Real Exchange Rate (NATRER) Approach[17]

The NATREX method, introduced by Stein (1990, 1994), focuses on determining the ERER that aligns the current account (CA) with risk-free savings and investments. The NATREX approach aims to achieve medium-run equilibrium associated with an economy operating at its full employment level while effectively addressing inflation concerns. The NATREX framework is commonly applied to industrialized nations, with its initial use focused on

[17] It is an extension of the BEER approach.

establishing an equilibrium rate for the U.S. economy. However, this approach can also be extended to developing countries, as demonstrated by recent studies on economies such as Pakistan and Malaysia (Abbasi, 2021).

The estimation of the ERER using the NATREX approach begins by identifying the underlying determinants of the RER, such as the ratio of government expenditure to GDP and productivity levels. For instance, You and Sarantis (2012) employed the NATREX approach to estimate the ERER for the Chinese Renminbi, focusing on the terms of trade, government investments, and liquidity constraints as the critical determinants of the RER. The NATREX equilibrium was constructed using long-run relationship estimates and variables without trends. Similarly, Nasim and Hamizah (2013) employed the NATREX approach for estimating the RER of Malaysia utilizing quarterly data between 1991Q1 and 2009Q4. Utilizing the ARDL cointegration approach, they estimated the long-term connection between the RER and productivity, government expenditures, the terms of trade, and the interest rate differentials.

The NATREX approach has several advantages. It focuses on capturing medium-run equilibrium, aligning with full employment levels, and offering insights into the long-term factors influencing exchange rates. By considering macroeconomic fundamentals like government expenditure, productivity, terms of trade, and interest rate differentials, it provides a comprehensive framework for analyzing equilibrium ERs. The NATREX approach acknowledges currency misalignments caused by various factors, providing a realistic assessment of the equilibrium rate. It applies to both industrialized and developing economies, allowing for broader analysis. However, estimating the NATREX model requires accurate and reliable data, which can sometimes be limited or unreliable. The complex econometric techniques may pose challenges, and the model relies on certain assumptions that may not always be true. The results are sensitive to model specification, making consensus and comparisons difficult (Bouoiyour & Rey, 2005).

As for the NATREX approach, one of its drawbacks is the complexity of its underlying theoretical framework. The NATREX approach incorporates various factors, e.g., productivity differentials, terms of trade, and capital flows, to determine the equilibrium ER. However, the complexity of the model and the underlying assumptions may introduce uncertainties and challenges in accurately estimating the equilibrium ER. Moreover, the BEER and NATREX approaches rely on the assumption of cointegration between the RER and its determinants. This assumption may not always hold in practice, leading to potential biases in the estimation results and misinterpreting the equilibrium exchange rate.

3.4.5 The Permanent Equilibrium Exchange Rate (PEER) Approach

Most empirical studies conducted in Turkey have been limited to determining the ERER using either the PPP or BEER approach, taking into account different macroeconomic fundamentals (Telatar & Kazdagli, 1998; Alper & Sağlam, 2000; Doroodian et al., 2002; Civcir, 2003, 2004; Atasoy & Saxena, 2006; Alper & Civcir, 2012). However, to overcome the problems associated with the previous measurement approaches, the present study uses the PEER approach to calculate the ERER (MacDonald, 2000; Abbasi, 2021).

The PEER approach is an extension of the BEER approach that considers macroeconomic fundamentals' long-run "sustainable" levels[18]. It involves decomposing the RER into temporary and permanent components, a crucial step in the PEER framework (MacDonald, 2000; Clark and MacDonald, 2004). Several measurement techniques, such as those introduced by Beveridge and Nelson (1981), Clarida and Gali (1994), Stock and Watson (1988), Gonzalo and Granger (1995), and Hodrick-Prescott (1997), are commonly used to perform this decomposition. In comparison with other commonly used techniques, such as Baxter and King's (B-K) (1999) filter and Hamilton's (2018) filter, the H-P filter estimates the trend component of a time series for the most recent periods (Abbasi, 2021).

In the current research, we employ the H-P filtering procedure[19], following the approach used by Edwards (1989) and Alberola (2003) to estimate the permanent components of the fundamental macroeconomic factors. This filter is a popular detrending method widely utilized in recent empirical macroeconomic analysis, as noted by (Berument & Pasaogullari, 2003; Akram & Rath, 2017; Conrad & Jagessar, 2018; Mamun et al., 2020; Abbasi, 2021; Abbasi & Iqbal, 2021; Iqbal et al., 2023). One of the key advantages of the H-P filter approach is its ability to separate a time series into its underlying trend and cyclical components (Bloechl, 2014). This decomposition helps in understanding the long-term behavior of the variable (trend) and the short-term fluctuations around that trend (cyclical component).

The H-P filter smooths the data by eliminating high-frequency fluctuations or noise, thereby enhancing the visibility of the underlying trend. This is particularly useful when dealing with noisy or volatile time series data, as it provides a more precise and interpretable representation of the overall pattern. By estimating the cyclical component, the H-P filter enables the quantitative analysis of business cycles. It helps identify and measure the periodic

[18] The PEER represents a long-run equilibrium concept that helps determine exchange rate misalignment through a filtered series (Driver & Westaway, 2005; Abbasi, 2021). McDonald and Clark (1998) and Kucsera (2007) state that this method ensures smoother ERER than the BEER approach and is better interpretable.

[19] We have also employed the Hamilton (2018) approach for comparison purposes.

ups and downs in the time series, providing insights into the amplitude, duration, and frequency of economic fluctuations. This information is valuable for understanding the cyclical behavior of various macroeconomic variables.

The H-P filter approach is relatively simple and does not require intricate theoretical assumptions or complex modeling techniques (Abbasi, 2021). Its straightforwardness and flexibility make it accessible to researchers and practitioners across different fields. Moreover, it can be applied to various time series data, including macroeconomic indicators, financial variables, and social or environmental metrics. By extracting the cyclical component through the H-P filter, policymakers can gain insights into the current business cycle phase, helping them make informed decisions regarding monetary policy, fiscal policy, and other economic interventions. It provides a quantitative measure of economic fluctuations, aiding policymakers in understanding the state of the economy and formulating appropriate responses (Abbasi, 2021).

Finally, decomposing the time series into trend and cyclical components allows for improved forecasting and trend analysis. The filtered trend component obtained from the H-P filter approach provides a more stable representation of the long-term behavior of the variables (i.e., real exchange rate), making it helpful in predicting future values and identifying underlying trends and structural changes.

The decomposition of the RER into temporary and permanent counterparts allows for a more nuanced analysis of RER dynamics. The temporary component captures short-term fluctuations caused by business cycles, speculation, or policy shocks. In contrast, the permanent component reflects the long-term equilibrium driven by fundamental macroeconomic factors. The difference between the current/actual/observed RER and the estimated ERER is called the RERMIS in the PEER approach. This misalignment indicates whether the ER is overvalued or undervalued relative to its sustainable or equilibrium level.

The PEER approach gives economic policymakers insights into whether a country's currency is overvalued or undervalued relative to its fundamental value. An overvalued currency suggests that the ER is higher than its long-term equilibrium level, which may hinder export competitiveness and lead to trade imbalances. Conversely, an undervalued currency indicates that the exchange rate is lower than its fundamental value, potentially boosting exports and raising the risk of inflationary pressures.

Comparisons between the BEER and PEER approaches have been made in various empirical studies. For example, Clark and MacDonald (2000) and Maeso-Fernandez et al. (2002) examined the equilibrium REER of the euro from 1975 to 1998. They found that the

PEER approach yielded smoother and less volatile results than the BEER approach. Both approaches indicated that the euro was close to its equilibrium value in the 1970s and the first half of the 1990s but undervalued in the 1980s. In contrast, Clark and MacDonald (2000) estimated the equilibrium REER of the U.S. dollar, Canadian dollar, and U.K. pound. They observed a close alignment between the BEER and PEER approaches. This suggests the temporary component was relatively small, indicating less short-term variability in economic fundamentals.

The comparison between the BEER and PEER approaches highlights that they may deviate substantially from each other when economic fundamentals exhibit significant short-term variability. Considering long-term sustainable levels, the PEER approach provides a smoother and less volatile assessment of the equilibrium exchange rate (Kucsera, 2007). In contrast, the BEER approach may reflect more short-term fluctuations in economic fundamentals (Driver & Westaway, 2005). The choice between these measurement approaches depends on the specific context and objectives of the analysis.

3.5 An Overview of the Historical Exchange Rate Dynamics of the Turkish Lira

Turkey has historically experienced fluctuations in its nominal[20] and real exchange rates[21]. Over the past decade, the Turkish lira (TL) has faced significant depreciation against major currencies, particularly the U.S. dollar and euro. Various factors, including high inflation rates, current account deficits, political uncertainty, geopolitical tensions, and economic imbalances, have driven this depreciation of the TL against these foreign currencies. In recent years, Turkey has also faced bouts of currency volatility and depreciation, which have had implications for both the nominal and real exchange rates. The country's high inflation, inconsistent monetary policy, and geopolitical tensions have contributed to these fluctuations.

During the pre-World War II period, the Turkish lira had various pegs, including the British pound and the French franc. These pegs aimed to stabilize the exchange rate and maintain stability in the Turkish economy. Following World War II, the Bretton Woods

[20] In the case of Turkey, the NEX refers to the value of the Turkish lira (TRY) against other major currencies like the U.S. dollar (USD) or the euro (EUR).

[21] The REX takes into account the NEX and the relative price levels between two countries. It measures the purchasing power of a currency in terms of goods and services, considering the inflation rates in both countries. The REX provides insights into the competitiveness of a country's goods and services in the international market.

Agreement established a new international monetary system, with major currencies pegged to the U.S. dollar, which, in turn, was pegged to gold. The Turkish lira was pegged to the U.S. dollar at a fixed rate of 2.8 lira per dollar. This peg helped stabilize the Turkish economy in the early post-war period.

The Turkish government devalued the Turkish lira in 1960, changing the exchange rate to 9 lira per dollar. This devaluation was a response to economic pressures and imbalances, aiming to improve competitiveness and address trade issues. More importantly, the global monetary system transitioned to floating exchange rates in 1973, abandoning the fixed ER regime of the Bretton Woods system. Consequently, the ER of the TL was allowed to fluctuate based on market forces. By this time, the exchange rate stood at 13 lira per dollar.

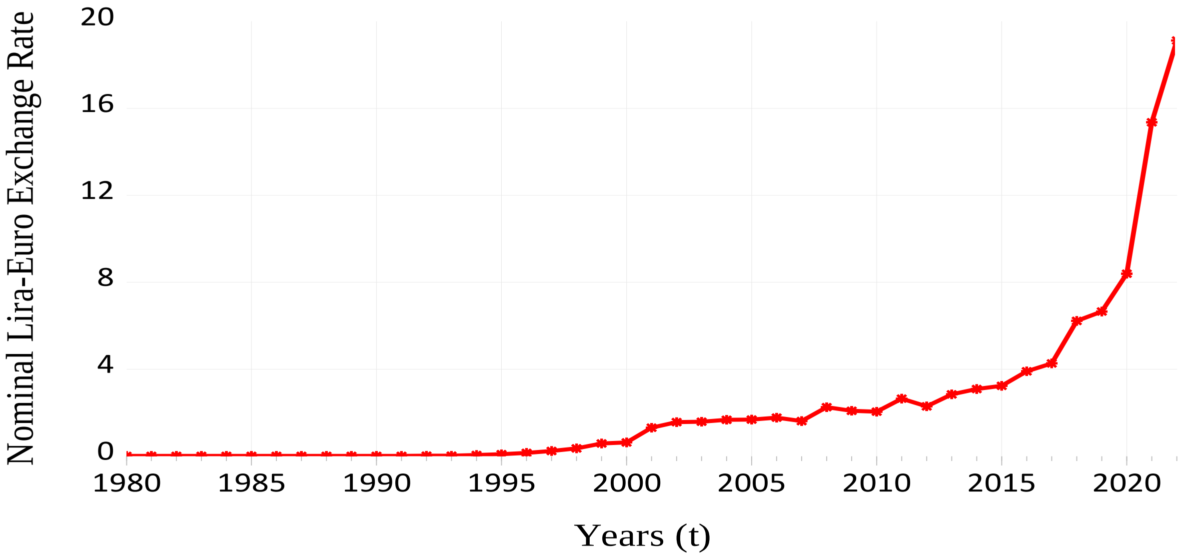
After the shift to floating rates, the TL experienced significant depreciation against major currencies due to inflationary pressures. Inflation eroded the lira's value, leading to a continuous loss in its exchange rate. This depreciation trend persisted for several decades, with the lira losing value against various major currencies. In the 1970s, the average annual inflation rate was around 20%, increasing to 30-40% in the early 1980s and 60-65% in the late 1980s and early 1990s. In 1999, inflation reached approximately 69%. However, with the implementation of an IMF-supported program in 2001, the Turkish economy began to recover, resulting in a significant drop in inflation from 68.53% in 2001 to 29.75% in 2002. In subsequent years, inflation declined rapidly, reaching 9.35% in 2004.

Despite the economic recovery and the decrease in chronic inflation, the Turkish currency remained under pressure. In 2005, due to extreme inflationary pressure, the Turkish authorities decided to introduce currency reforms. One million old lira was replaced by one new lira, effectively removing six zeros from the currency. This reform aimed to simplify transactions and restore confidence in the lira. As a result, the exchange rate shifted from approximately 2.4 million old lira per dollar to 2.4 new lira per dollar. Furthermore, foreign exchange arbitrage activities also affected other major currencies, including the euro (Bahmani-Oskooee & Durmuz, 2016).

Figure 1 displays the nominal bilateral lira-euro (TL/EUR) exchange rate during our sample analysis period, 1980-2022. We can see a rising upward trend in the nominal bilateral exchange rate, revealing that the TL has continuously depreciated against the EUR due to rampant inflation, rising current account deficits, macroeconomic imbalances, political instability, and investor flight.

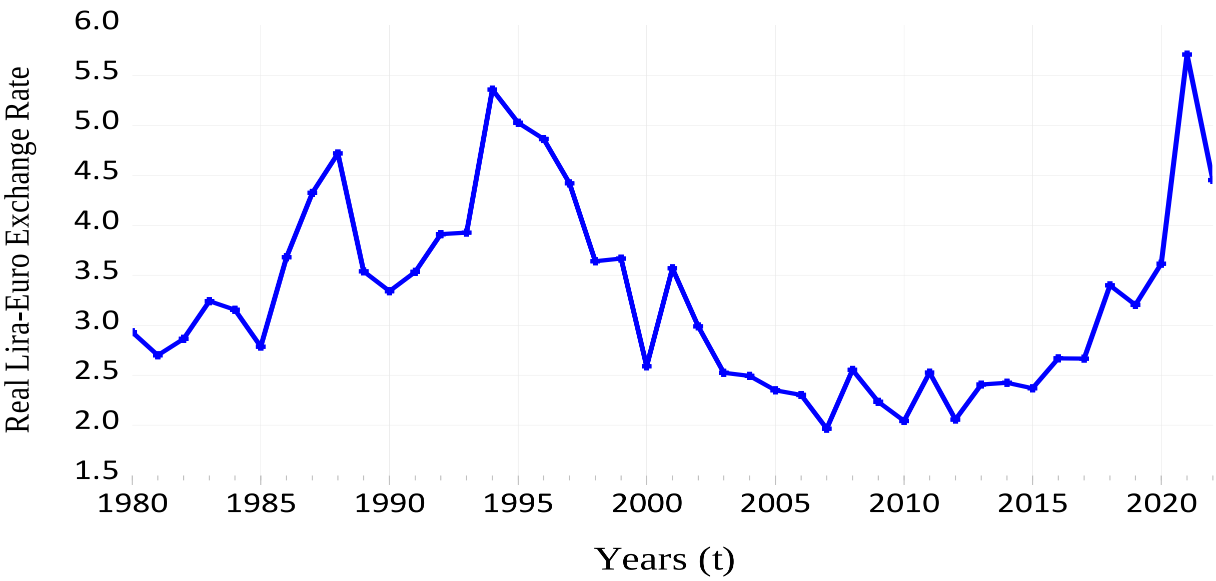
Figure 2 plots the real bilateral lira-euro rate over the sample period, where an increase in the RER value signifies a real depreciation of the TL against the EUR. The depiction of real lira-euro exchange rate volatility[22] in Figure 3 allows us to assess the degree of instability in the value of TL against the EUR over the sample period. Frequent depreciation of the TL against the EUR, occasionally followed by periods of appreciation, suggests a dynamic and turbulent currency relationship. This volatility in the real lira-euro rate can have significant implications for various economic factors, trade competitiveness, inflationary pressures, investor sentiment, and economic performance (Khalid et al., 2023).

Figure 1. The Nominal Lira-Euro Exchange Rate over the Sample Period, 1980-2022



Source: Author's own construction (2023)

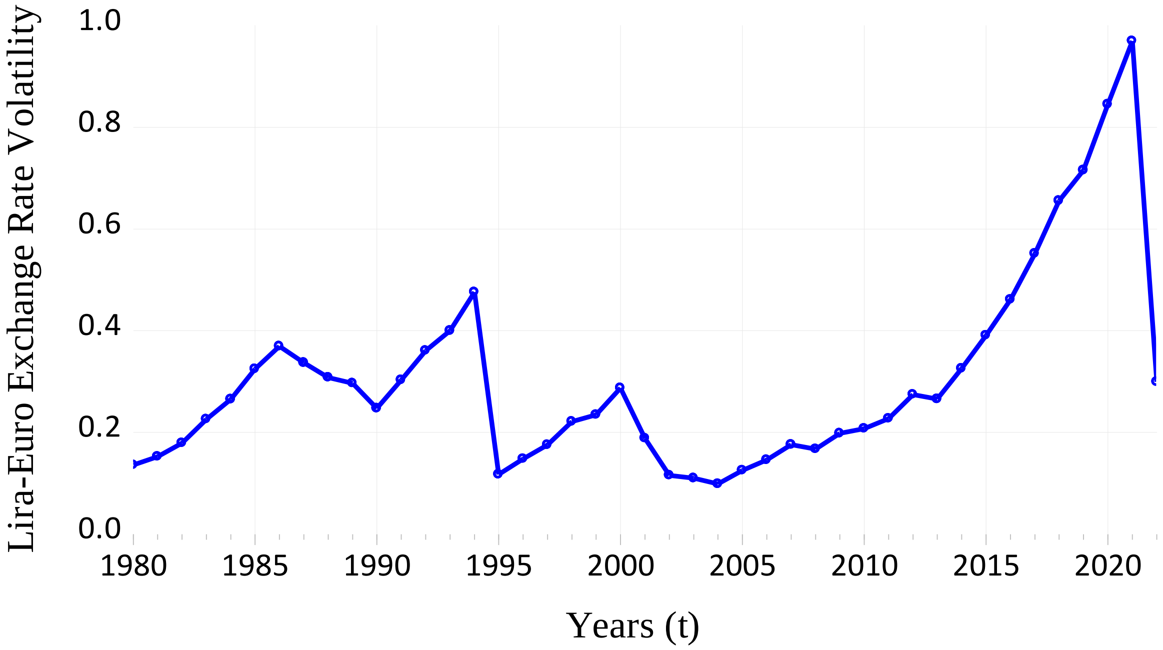
Figure 2. The Real Lira-Euro Exchange Rate over the Sample Period, 1980-2022



Source: Author's own construction (2023)

[22] Bahmani-Oskooee and Durmaz (2016) emphasized that any volatility measure relevant to macroeconomic analysis is based on the real exchange rate volatility.

Figure 3. The Real Lira-Euro Exchange Rate Volatility over the Sample Period, 1980-2022



Source: Author's own construction (2023)

3.6 The Evolution of Exchange Rate Regimes in Turkey

Turkey has experienced several shifts in its exchange rate regime throughout its history. During the 1961-1980 period, Turkey adopted a fixed ER regime where the value of the TL was pegged to a specific foreign currency, primarily the U.S. dollar. This regime aimed to provide stability and promote export-oriented industrialization. The central bank intervened by buying and selling foreign currency reserves to maintain the fixed ER. This policy was aligned with the export-led growth strategy that dominated economic policy during that era.

In the 1980s, Turkey transitioned to a crawling peg exchange rate regime (Yeldan, 2001). Under this system, the exchange rate could fluctuate within a predetermined range periodically adjusted to account for inflation differentials. The central bank managed the crawling peg by conducting regular interventions in the foreign exchange market. This regime aimed to balance export competitiveness with inflation control. It facilitated export-led growth and trade liberalization, allowing the TL to depreciate realistically (Boratav et al., 1994). The depreciation of the TL made domestic goods more competitive in international markets.

The liberalization of the economy in the 1980s, coupled with foreign trade reforms and export subsidies, led to an expansion of the foreign trade sector in Turkey (Halicioglu, 2007). The share of total exports in GDP increased by 9 percent during the 1980s, and GDP grew by 6 percent in that period (Halicioglu, 2007, 2008). The trade liberalization policies and depreciating exchange rates made domestic goods more competitive in international markets, contributing to the growth of exports. The export-led growth strategy benefited from the expanding trade volume in Turkey. Furthermore, capital flows were liberalized in 1989, allowing for increased borrowing from domestic and international markets. This economic policy change aimed to accelerate growth performance by controlling inflation and attracting capital with high-interest rates. The trade liberalization policies initially aimed to decelerate the depreciation of the TL, but despite these efforts, the TL continued to appreciate (Yildirim & Saraç, 2022).

From the 1990s onwards, Turkey shifted to a managed floating ER regime. In this regime, the central bank allowed the ER to be determined by market forces to a certain extent. Still, it intervened when necessary to smooth out excessive volatility or address uncontrolled movements. However, during this period, the overvaluation of the TL resulted in three significant recessions in Turkey in 1994, 1999, and 2001, with a decline in GDP by about 7 percent. These major recessions were triggered by substantial increases in real exchange rates, indicating that the overvaluation of the TL made Turkish exports less competitive and imports more attractive. This led to a deterioration in the trade balance. However, the negative influence on the trade balance was temporary. Towards the end of the 1990s, the Turkish economy recovered from the trade balance deterioration, thanks to the policies implemented by international organizations (Halicioglu, 2008).

In 2001, Turkey faced a severe financial crisis, prompting a major ER regime reform. The country adopted a floating ER system, where market forces primarily determined the value of the TL. The CBRT shifted its focus to managing overall monetary policy and intervened in the forex market to address excessive volatility or speculative attacks. The transformation to the floating ER regime occurred in 2002, marking a significant change in the Turkish economy. The value of the domestic currency began to be determined under free-market conditions. This shift allowed market forces to play a more significant role in shaping the exchange rate, enabling greater flexibility in responding to economic conditions and external shocks. On the positive side, this transition provided more flexibility in adjusting to market conditions and external shocks. However, it also introduced greater exchange rate volatility, which could lead to challenges such as increased inflationary pressures and uncertainties for businesses engaged in foreign trade.

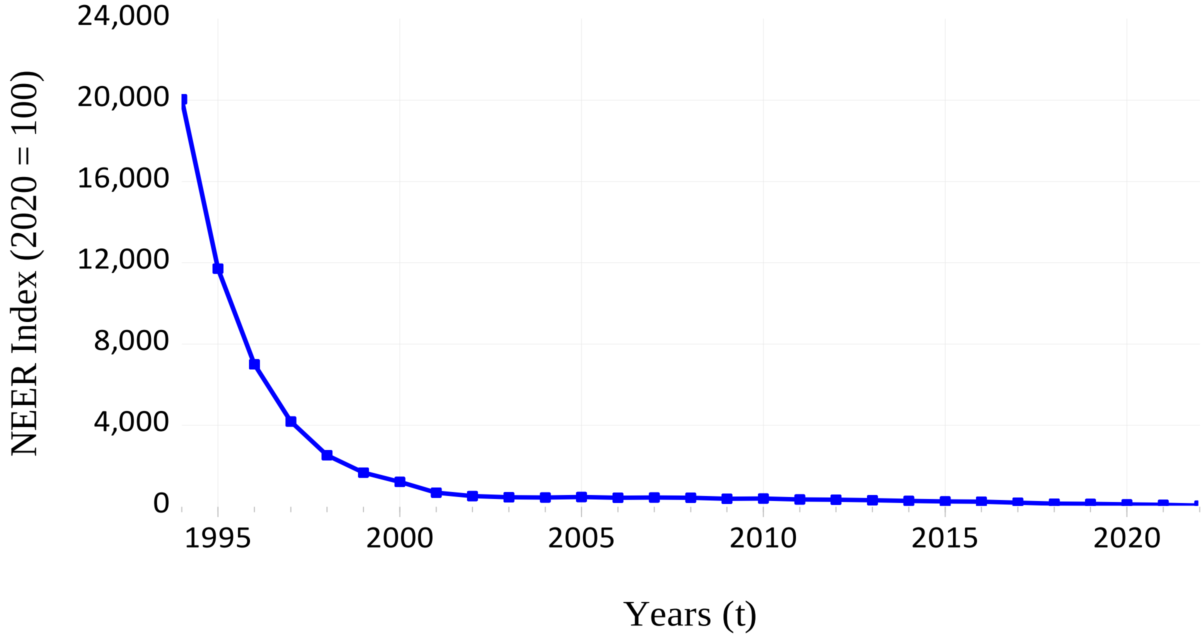
After the 2008 global financial crisis, Turkey adopted a policy of exchange rate stabilization. To achieve this objective, the country's central bank intervened in the forex market to restrict ER fluctuations and uphold relative stability in the value of the TL against other major currencies. This intervention aimed to mitigate the adverse effects of ER uncertainty on the domestic economy and foster an environment conducive to economic growth and stability. However, despite the intervention of the CBRT, criticisms arose regarding these measures' effectiveness in maintaining macroeconomic stability. Exchange rate pressures persisted, indicating the challenges faced in stabilizing the currency. The global economic landscape and domestic economic factors posed difficulties in achieving long-term exchange rate stability.

Turkey gradually moved towards a more flexible exchange rate regime in response to increasing economic challenges and the limitations of exchange rate stabilization. Since 2018, the TL has been allowed to float freely, with limited intervention from the Central Bank of Turkey. This shift towards a more flexible regime aimed to embrace market forces in determining the exchange rate. However, transitioning to a more flexible exchange rate regime has inevitable consequences. The TL has experienced significant fluctuations in its value against other currencies, particularly the U.S. dollar and euro. The increased volatility in the exchange rate has posed challenges for businesses, investors, traders, and market participants, creating uncertainties in planning and decision-making processes.

Additionally, the fluctuations in the exchange rate have contributed to increased inflationary pressures in the Turkish economy. A depreciating currency can lead to higher import costs, which, in turn, can contribute to inflation. The central bank has now faced the challenge of balancing the need for price stability to maintain exchange rate flexibility. Figures 4 and 5 plot the trends of Turkey's nominal effective exchange rate (NEER) and real effective exchange rate (REER) indices between 1994 and 2022.

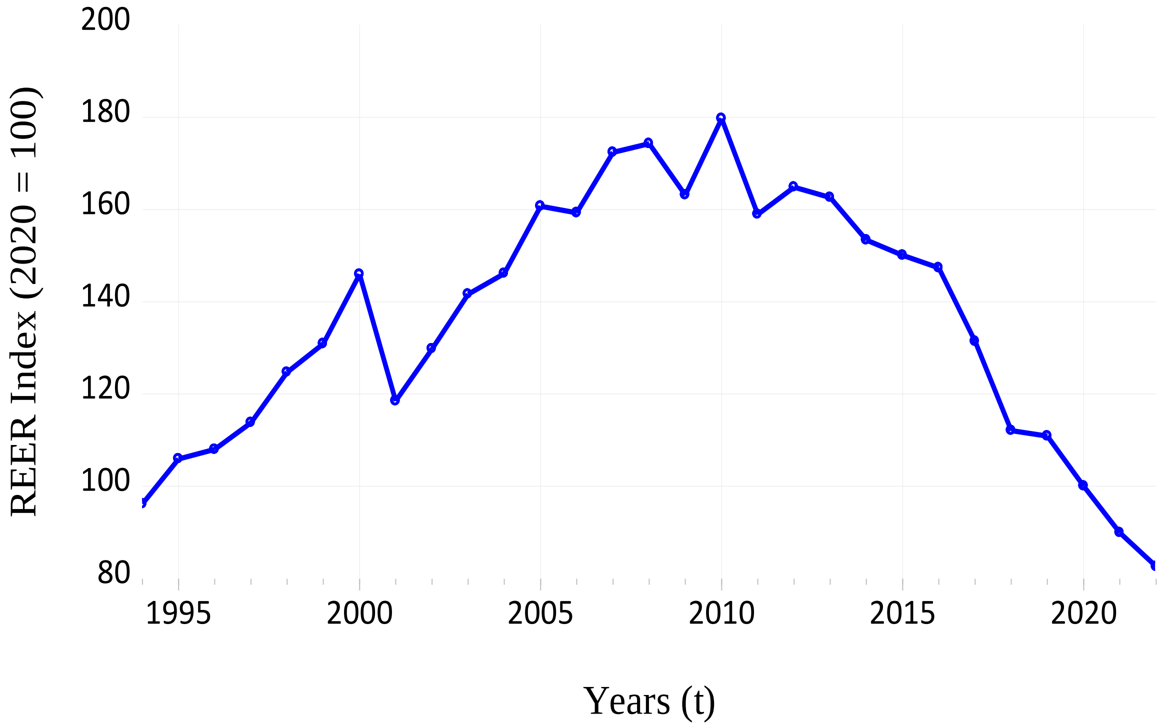
As shown in Figure 4, in NEER terms, the relative value of the TL has been steadily weakening since adopting the floating exchange rate regime in 2001. This indicates that Turkish traders would pay more units of TL to purchase German products. In other words, the TL has been consistently losing value against the euro, suggesting that the Turkish economy is experiencing a decline in competitiveness in the global market. As depicted in Figure 5, in REER terms, Turkey's real effective exchange rate has been deteriorating or declining, particularly since 2010. This suggests a steady depreciation of the TL against a broader basket of currencies, notably the U.S. dollar and euro.

Figure 4. CPI-based NEER Index (Base Year: 2020 = 100) over the Period 1994-2022



Source: Bank for International Settlement (BIS) (2023)

Figure 5. CPI-based REER Index (Base Year: 2020 = 100) over the Period 1994-2022



Source: Bank for International Settlements (BIS) (2023)

CHAPTER IV

The Economic Structure of Turkey

4.1 Introduction

In the realm of international economics, Turkey stands as one of the emerging economies in the 21st century, where challenges and opportunities intertwine within the intricate fabric of economic growth and transformation. This chapter embarks on a comprehensive journey into the economic structure of Turkey, delving into the multifaceted landscape of Turkish economic development. From the macro perspective of economic growth and volatility trends, the chapter navigates through the historical evolution of Turkey's economy, highlighting the pivotal role played by economic liberalization and structural change. As we zoom in on the microcosm of international trade, our focus narrows to the dynamic Turkish-German trade relationship, where the chapter uncovers challenges and prospects in foreign direct investment trends, sectoral diversification, and export-import partner shares. Furthermore, the chapter discusses the trade balance dynamics in Turkish-German trade. The chapter not only explores the advantages and disadvantages of Turkey's global trade participation but also unravels the recent trends and identifies major trade partners that shape Turkey's economic landscape. Lastly, the chapter spotlights Turkey's trade deficit champions and top trade surplus partners, shedding light on the intricacies that define Turkey's position in the global marketplace.

4.2 Turkish Economic Growth Trends: Challenges and Opportunities

After a global economic slowdown post-1980, nations that sustained or increased their economic growth rates typically expanded their trade and bolstered their financial systems. Economic growth faced obstacles when countries could not resolve competing claims on fiscal resources, leading to increased fiscal volatility, elevated inflation, and escalating levels of external debt. In contrast, countries with favorable economic conditions, particularly in Asia, East Asia, and Egypt, experienced remarkably swift economic growth. Turkey, too, reaped the benefits of entrepreneurship facilitated by trade and the liberalization of its financial sector in 1980. However, its rapid economic growth was constrained by fiscal policy uncertainty and high inflation (McGettigen et al., 2005).

The average growth in real GDP per capita in Turkey[23] from 1971 to 1980 was 1.91% per annum, while the average growth in real GDP per capita for the world increased at a rate

[23] The GDP per capita of the Turkish economy increased by 2.3% per annum from 1960 to 1980 (UN data, 2023).

of 1.97% during the same period. However, the global economy's real GDP per capita growth rate decreased from 0.09% in 1980 to -1.40% in 1982. In contrast, the Turkish economy continued to grow, albeit at a slower pace, from -4.44% in 1980 to 1.38% in 1982, thereby improving its performance relative to the world's average real GDP per capita growth rate. More significantly, the Turkish economy implemented significant trade liberalization reforms on January 26, 1980. These reforms were introduced to stabilize the economy by tackling the high inflation rate, shifting away from an import substitution economic model to an export-oriented one, and adopting a more market-oriented approach (Krueger, 2004).

At the outset, these trade liberalization reforms positively impacted the Turkish economy. Nevertheless, long-standing policy instability and macroeconomic uncertainty resurfaced and reached a new severity level. Consequently, while the Turkish economy initially achieved robust economic growth, it also faced increasing uncertainty, leading to the erosion of hard-earned output gains during frequent and severe crises.

Economic growth received a significant boost from the liberalization of trade and the financial sector, signifying a necessary departure from previous practices and allowing Turkish entrepreneurship to flourish. The early introduction of export subsidies succeeded by reducing tariff and non-tariff barriers, culminating in the customs union with the European Community in 1996. In the financial sector of Turkey, the deregulation of interest rates was followed by enhancements in accounting standards and the opening up of the capital account in 1989. Since 1980, trade expansion and increased access to credit made possible through liberalization, have stood as Turkey's primary drivers of economic growth. Nevertheless, as the 1990s unfolded, the growth dividend began to experience diminishing returns.

Turkey's growing dependence on manufactured exports had the advantage of reducing its vulnerability to external[24] fluctuations. In contrast, concerns persisted regarding vulnerabilities in the financial sector. Nevertheless, the primary source of economic instability stemmed from the stop-go pattern of economic management, characterized by high discretionary fiscal spending, persistent high inflation, and a mounting external debt burden. While inflation briefly decreased in the early 1980s, it surged to new heights, accompanied by increased volatility in fiscal expenditures. The fiscal position deteriorated sharply during the 1990s, and the ongoing rise in debt levels eventually culminated in an economic crisis and contraction in 2001. In such an environment of economic uncertainty, domestic investment and productivity growth were impeded (McGettigen et al., 2005).

[24] Terms of trade

4.3 Economic Growth and Volatility Trends

Over the past few decades, the Turkish economy has faced challenges in achieving a real GDP per capita growth rate above the global average. Turkey came close to reaching the global average income level around 1976-77 during a brief period of growth expansion, but these efforts were derailed by the debt crisis of 1979–80 (refer to Figure 6). Specifically, Turkey's real GDP per capita growth was negatively impacted, experiencing a decline of -2.68% in 1979 and -4.44% in 1980.

The nation embarked on a more sustained trajectory aimed at narrowing the growth gap with the global economy by implementing a series of significant economic reforms, particularly trade liberalization. Turkey's average growth rate in real GDP per capita reached 2.97% in 1981-1986, whereas the global economy's average growth rate in real GDP per capita was 0.93% during the same timeframe. In 1987, Turkey's real GDP growth substantially outpaced the global average per capita income[25] growth rate for the first time, ultimately surpassing the global average GDP per capita by 7.29%[26].

In 1993, Turkey's real GDP per capita growth rate reached 6.17%, surpassing the global income growth rate of 0.24%. However, due to the 1994 currency crisis in Turkey, real GDP per capita decreased by -7.10 %[27]. This recession was triggered by significant increases in real exchange rates, indicating that the overvaluation of the Turkish lira made Turkish exports less competitive and imports more attractive, leading to a deterioration in the country's trade balance position. Nevertheless, the adverse impact on the trade balance was temporary. From 1995 to 1998, Turkey's real per capita income growth averaged approximately 4.49%, surpassing the average global economic growth rate of 1.91%.

Unfortunately, in 1999, the Turkish economy faced another currency crisis, negatively impacting its per capita income growth by -4.71%. However, in 2000, the Turkish economy swiftly rebounded from the currency crisis and trade balance deterioration, thanks to the policies implemented by international organizations (Halicioglu, 2008)[28]. Regrettably, this brief period of growth resurgence ended with another economic downturn in 2001 due to

[25] The global income level grew by 1.84% in 1987.
[26] A similar pattern of growth can be observed in Turkey's economy in 1990. Specifically, the growth in real GDP per capita of Turkey was 7.21%, while the growth in per capita real income for the world economy was 1.09%.
[27] The real income per capita of the world economy grew by 1.76% in 1994.
[28] The real income per capita of the Turkish economy was 5.39%, which was exceeded the world's real income growth of 3.05%.

another currency crisis in Turkey. This crisis reduced real GDP per head by approximately 7.14% and brought it back to nearly the global average level[29].

After the 2001 currency crisis, Turkey faced a severe financial crisis, prompting a major exchange rate regime reform. In such circumstances, the country transitioned from a fixed exchange rate system to a floating exchange rate system. The CBRT shifted its focus to managing overall monetary policy and intervened in the forex market to address excessive volatility or speculative attacks. Turkey's average real income per capita (5.75%) exceeded the global economy's average growth in income per capita (2.49%) from 2002 to 2007. In the years following the 2001 currency crisis, particularly from 2002 to 2005, the Turkish economy experienced a remarkable turnaround. During this period, the Turkish economy flourished, witnessing a substantial drop in inflation from 70% at the end of 2001 to single-digit levels. Nominal and real interest rates also decreased significantly, and the government debt ratio declined, enhancing the outlook for debt sustainability (McGettigen et al., 2005).

After the 2008 global financial crisis, Turkey implemented an exchange rate stabilization policy. To achieve this goal, the country's central bank intervened in the forex market to limit exchange rate fluctuations and maintain relative stability in the value of the Turkish lira compared to other major currencies. This intervention aimed to mitigate the adverse effects of ER uncertainty on the domestic economy and create an environment conducive to economic growth and stability. However, despite the CBRT's efforts, criticisms emerged regarding the effectiveness of these measures in maintaining macroeconomic stability. Exchange rate pressures persisted, highlighting the challenges of stabilizing the currency in the face of the global and domestic economic landscape. Turkey's real GDP per capita decreased by 0.39% in 2008, remaining below the per capita real income of the world economy (0.80%) during the same period[30]. Nevertheless, the Turkish economy rebounded quickly after the global financial crisis, and its average per capita real GDP grew by approximately 5.59% from 2010 to 2015[31].

Notably, the 2016 coup attempt created economic uncertainty and disruption that adversely affected Turkey's economy and, consequently, the real GDP per capita income for a certain period following the event. Economic recovery efforts and government policies also

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[29] The per-head GNP of the Turkish economy was $6,033 in 2001, compared to a world average of $6,049 (Maddison, 2001).

[30] In 2009, both Turkey and the global economy had real GDP per capita figures below the zero-threshold line. However, the decline in growth in Turkey (-6.02%) was severe compared to the global's economy growth level (-2.54%).

[31] This increase in average real income per capita in Turkey exceeded the world's real income growth, which was approximately 2% for the same period.

influenced the trajectory of per capita income in the years that followed. Specifically, Turkey's real GDP per capita income decreased by 1.57% in 2016, making the beginning of a more sustained trend toward closing the growth gap with the global economy (1.51%).

The Turkish government adopted expansionary fiscal and monetary policies to stabilize the economy after the 2016 coup attempt, including stimulus measures. As a result, Turkey's real GDP per capita income increased by approximately 6.10% in 2017 and 2.09% in 2018[32]. While these policies may have prevented a more severe economic downturn, they raised concerns about the country's fiscal sustainability.

Finally, like many countries worldwide, Turkey experienced an economic contraction in 2019-20 due to the COVID-19 pandemic. Lockdowns, travel restrictions, and disruptions to supply chains led to a decline in economic activity. Turkey's real GDP per capita income growth was 0.03% in 2019, whereas the world economy's GDP per capita income growth was 1.42% during the same period[33].

Over the last half-century, Turkey has achieved above-average growth compared to the world's average growth, albeit with a notable degree of uncertainty. On average, Turkey's per capita real GDP grew at approximately 2.88% per annum, somewhat faster than the world's real GDP growth from 1971 to 2021. During the same period, the world economy's average real GDP per capita experienced growth at a rate of about 1.60%.

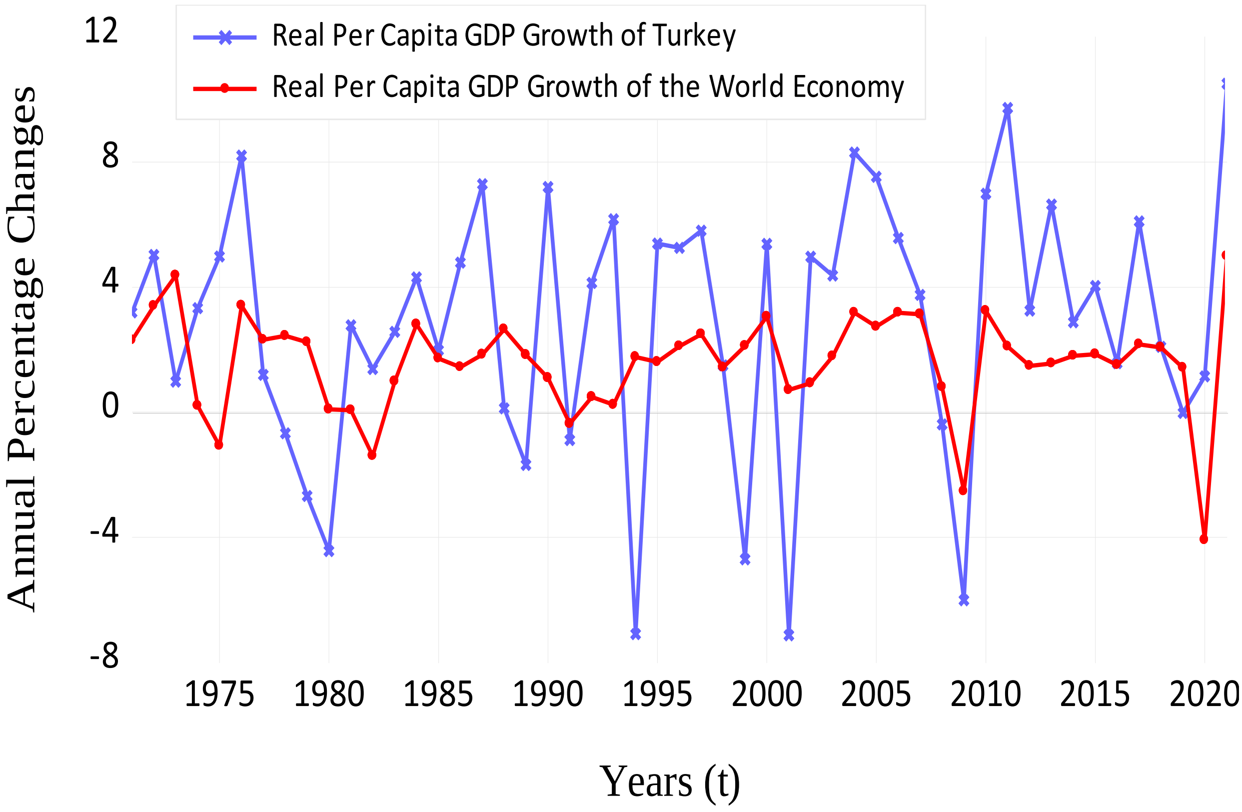
Turkish economic growth significantly outpaced that of Sub-Saharan Africa, where the average real GDP per capita grew at approximately 0.47% between 1971 and 2021. However, Turkey fell behind Eastern Asia, where the average real GDP per capita growth was recorded at 4.06%, reflecting a higher growth rate of more than one percentage point (refer to Table 2). Similarly, Turkey's economic growth significantly outpaced Argentina, Brazil, Eastern Africa, Eastern Europe, Europe, Germany, Greece, Israel, Japan, Mexico, Middle Africa, North Africa, North America, North Europe, South Africa, South America, South Europe, the USA, Western Africa, Western Asia, and Western Europe, where the average real GDP per capita grew at rates of 0.69%, 1.78%. 1.18%, 2.54%, 1.95%, 1.74%, 1.18%, 2.14%, 1.90%, 1.18%, -0.43%, 1.74%, 1.69%, 1.76%, 0.49%, 1.17%, 1.52%, 1.71%, 0.94%, 1.39%, and 1.64%, respectively, between 1971 and 2021. In contrast, Turkey's economic growth significantly trailed that of Asia and Egypt, where the average real GDP per capita growth was recorded at 3.30% and 3.19%, respectively, between 1971 and 2021.

[32] The world economy's real GDP per capita income growth stood at 2.07% in 2018, closing the gap with Turkey.
[33] The real GDP per capita of the world economy contracted by 4.09% in 2020.

The Turkish economy maintained an average growth rate of 2.88% per annum from 1971 to 2021, including during the 20-year subperiods (1971–90 and 1991–2010). Specifically, Turkey's average real GDP per capita income grew at 2.49% between 1971 and 1990 and 2.45% between 1991 and 2010. However, the average real GDP per capita income surged at a high rate of approximately 4.36% between 2011 and 2021, marking Turkey's most substantial income growth over the past fifty years.

While Turkey's real GDP per capita growth rate remained relatively stable in absolute terms from 1971 to 2010, its relative growth improved as the world economy's real GDP per capita growth slowed down between 1991 and 2010 (refer to Figure 6). Because Turkish real GDP per capita output growth was relatively high from 1981 to 1990 (with an average income growth of 3.07%), its real GDP per capita output surpassed the global average per capita real GDP in 1988 (although that gain was lost in the 2001 crisis).

Figure 6. Real GDP Per Capita Growth of Turkey and the World Economy, 1971-2021



Source: United Nations Statistics Division (UN Data, 2023)

Table 2. Real GDP Per Capita Growth (Annual Percentage Changes), 1971-2021

S. No.	Country (s)	Average Value (%)[34]
1	Argentine	0.69
2	Asia	3.30
3	Brazil	1.78
4	Eastern Africa	1.18
5	Eastern Europe	2.54
6	Egypt	3.19
7	Europe	1.95
8	Germany	1.74
9	Greece	1.18
10	Israel	2.14
11	Japan	1.90
12	Mexico	1.18
13	Middle Africa	-0.43
14	North Africa	1.74
15	North America	1.69
16	North Europe	1.76
17	South Africa	0.49
18	South America	1.17
19	South Europe	1.52
20	The United States of America	1.71
21	Western Africa	0.94
22	Western Asia	1.39
23	Western Europe	1.64

Source: The United Nations Data (2023) - Author's calculations (2023)

Turkey experienced significant economic growth from 1971 to 2021, with high real GDP per capita growth rates. However, one prominent feature of this growth trajectory was a notable increase in economic uncertainty (see Figure 7). It is important to note that increased

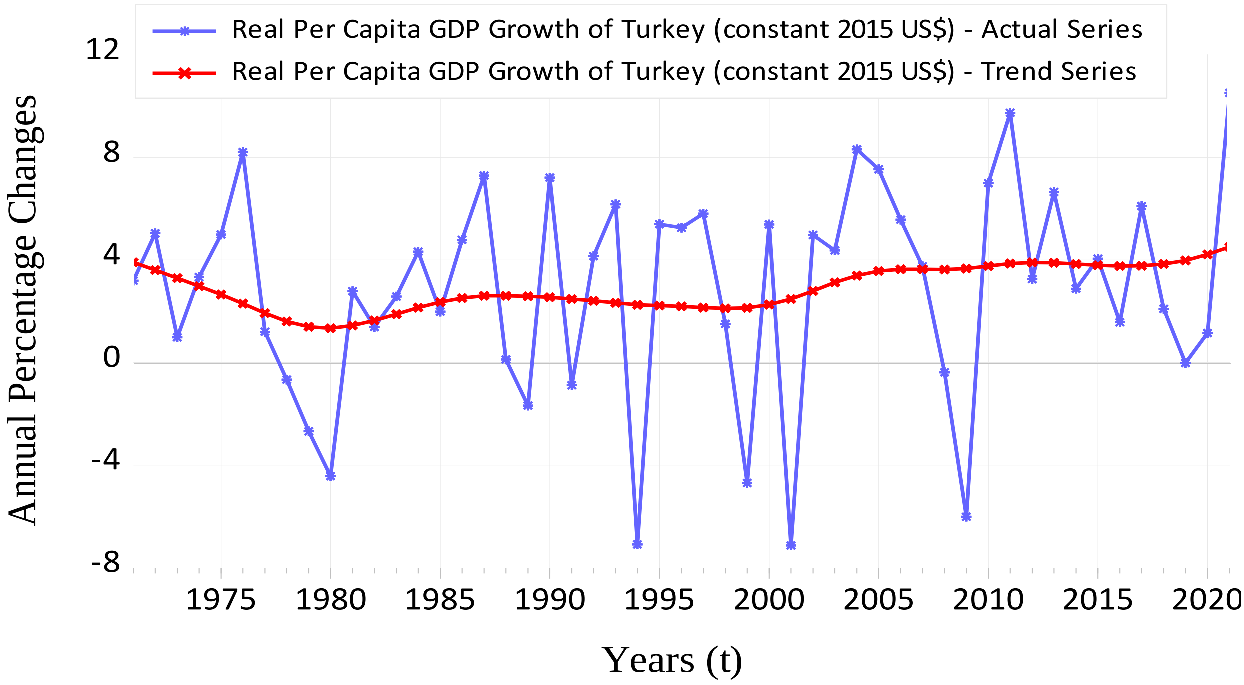
[34] The author has calculated the average growth values by considering real-world data for the countries reported in Table 2.

uncertainty in an economy does not necessarily raise immediate concerns, as several East Asian nations have encountered similar situations. This uncertainty[35] can positively and negatively impact economic growth (Tornell et al., 2004).

On the one hand, it can be argued that deregulating the financial sector is necessary to support higher long-term economic growth. However, it is crucial to acknowledge that a fragile financial sector can also lead to financial crises in the country. In this context, uncertainty might be considered an unavoidable cost for achieving sustained economic growth. Nevertheless, Ramey and Ramey (1994) suggested a different perspective by highlighting that uncertainty may not have any redeeming qualities. This raises a pertinent question: Could Turkey have achieved better economic growth if measures had been taken to contain this uncertainty?

Figure 7 reveals that the increased uncertainty in the Turkish economy was closely linked to instability in fiscal and monetary policies. These policy uncertainties had a detrimental impact on Turkey's economic growth; as such, addressing this uncertainty becomes a crucial consideration for economic policymakers aiming to enhance Turkey's long-term economic growth.

Figure 7. Real Per Capita GDP Growth Volatility of Turkey, 1971-2021



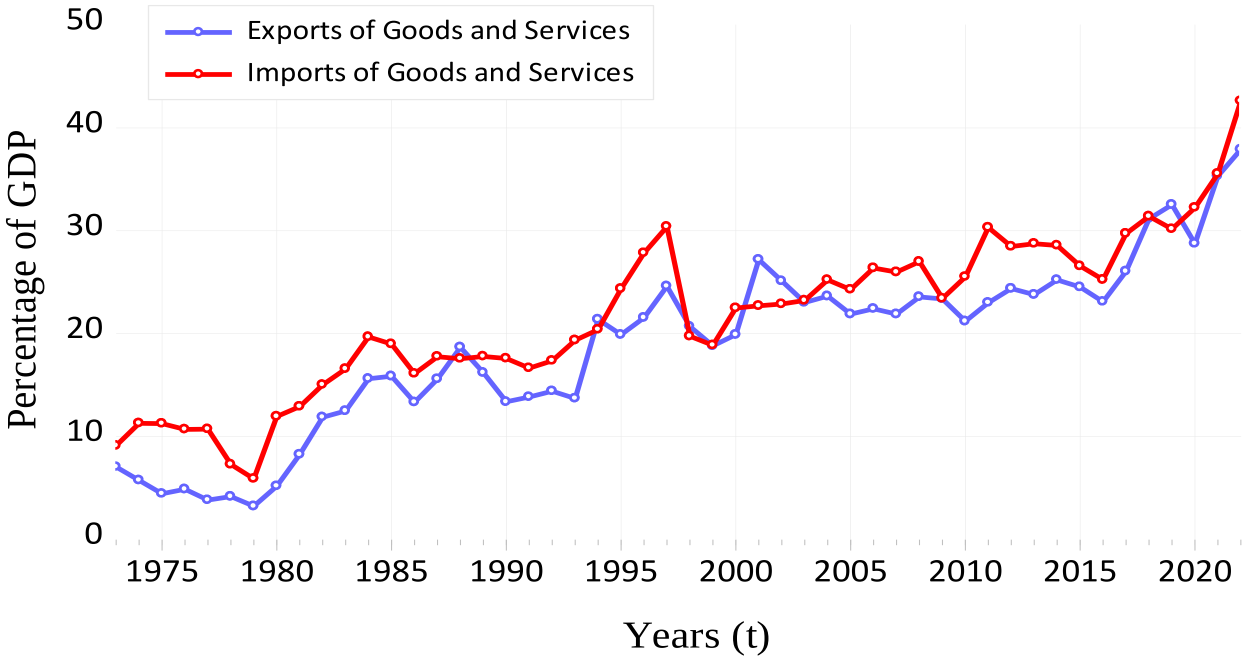
Source: United Nations Statistics Division (UN Data, 2023)

[35] volatility

4.4 Turkey Transformation: Economic Liberalization and Structural Change

Until the 1970s, the Turkish economy operated as a predominantly closed system. From 1973 to 1979, Turkey's exports, on average, constituted approximately 4.75% of its nominal GDP, while imports averaged around 9.45% during the same timeframe. However, by 1980, a notable shift occurred, with Turkey's total exports to the global economy accounting for merely 5.16% of its nominal GDP[36]. This shift was accompanied by a situation where trade and foreign exchange controls distort the relative prices of various commodities (refer to Figure 8).

Figure 8. Trends in Exports and Imports of Turkey (% of GDP), 1973-2022



Source: World Development Indicators (2023)

Only the affluent citizens of the country had the means to acquire illicit luxury products. In stark contrast, the average consumers and businesses in the country were compelled to contend with subpar domestic quality products. However, a significant transformation occurred in the prevailing consumption patterns following the trade liberalization reforms introduced by Turgut Özal[37]. These reforms ignited a surge in trade activities within the Turkish economy, registering a growth rate approximately 50% higher than that of global trade over the past

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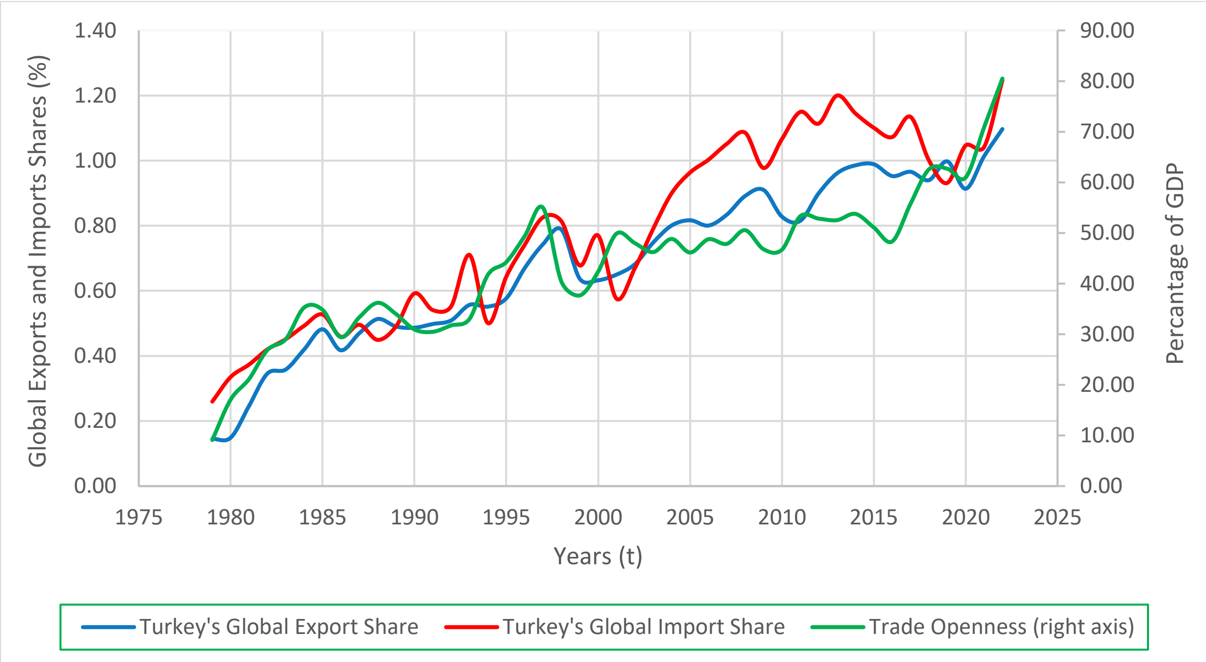
[36] Imports of Turkey from the rest of the world accounted for 11.93% of the nominal GDP in 1980.

[37] In the 1980s, Turkey faced economic challenges characterized by high inflation, a growing public debt burden, and significant state involvement in the economy. In response to these issues, the country initiated various reforms to liberalize and open up its economy. Under the leadership of Turgut Özal, Turkey adopted a market-oriented approach known as the *"Özal Doctrine."* This doctrine emphasized free-market principles, trade and investment liberalization, and reduced state economic intervention. The government implemented structural reforms, including deregulation, privatization of state-owned enterprises, and fiscal discipline.

decade. Consequently, Turkey's share of imports in the global market has more than tripled since 1980, and its share of exports has increased quadrupled in global exports (World Bank, 2014).

To provide specific figures, on average, Turkey's global exports increased from a mere 0.15% in 1980 to a noteworthy 0.42% during the 1981-1990 period, while its global imports expanded from 0.34% in 1980 to 0.48% during the same time frame (refer to Figure 9)[38]. Similarly, the average exports of Turkey reached 14.12% of its GDP from 1981 to 1990, while its average imports accounted for 16.99% of its GDP during the same period (refer to Figure 8).

Figure 9. Rising Global Presence of Turkey, 1979-2022



Source: World Development Indicators (2023) - Author's Calculations (2023)

The fundamental driving forces behind this remarkable economic transformation were the trade liberalization reforms implemented during the 1980s, the Customs Union agreement of 1995, and a strategic focus on commercial diplomacy to broaden Turkey's presence in emerging markets in the 2000s. During the 1980s, the abolition of import licenses and the withdrawal of government support for exporters served as powerful incentives for businesses

[38] Turkey's average export share in the global economy stood at 0.62% per annum during 1991-2000, while its average import share in the global economy stood at 0.68% per annum during the same period. In addition to the undertaken reforms and structural changes, Turkey also adopted currency reforms in 2005. As a result, we have observed that Turkey's average export share in the global economy increased to 0.89% between 1991 and 2022, while its average import share in the world economy reached 1.01% during the same period.

to target international competitiveness. These reforms also opened doors for many companies, enabling their entry into foreign markets for the first time.

The Customs Union agreement played a pivotal role by pegging Turkey's external tariffs to the levels set by the European Union (EU). Furthermore, it substantially reduced non-tariff trade barriers by aligning technical standards and regulations with EU standards. This alignment facilitated trade and encouraged the integration of Turkish firms into European production networks. Importantly, it eliminated the need for costly rules of origin, streamlining the process of participation in European markets (World Bank, 2014).

The implementation of the Customs Union agreement also acted as a catalyst for a comprehensive modernization of Turkey's customs administration. In tandem with this, the public and private sectors invested heavily in enhancing the country's transportation, communication, and logistics infrastructure. As a result, Turkey presently holds a position among the top 30 countries worldwide regarding the quality of its logistics. Furthermore, Turkey's exporters have reaped the benefits of substantial government support to identify and access new target markets while bridging information gaps. The government took proactive measures to bolster export finance and insurance as part of these efforts.

As a result of these substantial economic reforms and structural transformations, the Turkish economy achieved an average annual growth rate of approximately 6% during the periods spanning from 1980 to 2000. This impressive economic growth was underpinned by a dynamic expansion of the manufacturing and services sectors and a notable reduction in the agricultural sector (Morgil, 2001). During this transformation period, Turkey’s share of exports relative to its GDP experienced remarkable growth. In 1981, this share stood at 8.24%, but it had surged to 19.88% by 2000. Conversely, the proportion of Turkish imports to GDP increased significantly, from 12.90% in 1981 to 22.47% in 2000.

After the implementation of the IMF-supported program in 2001, Turkey’s transition to a floating exchange rate system in 2001-02, currency reforms in 2005, and other necessary economic measures, Turkey’s average share of exports to its GDP further accelerated and accounted for 25.86% between 2001 and 2022, while its average share of imports to its GDP reached about 28% during the same period (refer to Figure 8)[39]. However, despite introducing several reforms and structural changes, the Turkish economy has grappled with challenges over the past two decades. One of the primary macroeconomic issues that continues to require

[39] Turkey’s share of exports in its GDP accounted for 35.30% in 2021, while its share of imports accounted for 35.53% in the same year.

attention is the persistent current account deficit, which remains a significant hurdle to achieving higher economic growth.

Turkey’s growing global presence is undoubtedly impressive, but it has a considerable journey ahead to match the export performance observed in regions like Eastern Europe and East Asia. Turkey’s trade openness does not exhibit a substantial advantage compared to larger emerging economies such as Brazil and India. Notably, there has been a significant surge in FDI inflows in nominal terms since 2009[40]. However, in the context of global flows to emerging markets, Turkey’s current position has not improved significantly compared to a decade ago.

While Turkey has made efforts to adjust its product mix towards medium-technology products, it is essential to highlight that high-technology products remain underrepresented in its export portfolio[41]. This underscores the opportunities for Turkish producers to ascend within global value chains, consequently augmenting Turkey’s presence in the global economy. In simpler terms, adopting more predictable and robust regulatory frameworks and investments in skills development would play a pivotal role in attracting more significant FDI and enhancing the quality of Turkey’s exports (Morgil, 2001).

4.5 The Dynamics of Turkish-German Trade: Challenges and Prospects

Historically, Germany has been pivotal as one of Turkey's most significant trade partners and investors. The connections between these two nations trace back to the Turkish migration to Germany in the 1960s, forging a relationship that extends beyond the conventional trade realm[42]. German investors have played a vital role in Turkey, creating essential employment opportunities, introducing cutting-edge technology, and sharing valuable expertise.

Nevertheless, both countries grapple with a set of growing challenges. A prominent illustration of this is the globalization of the world economy. The epicenter of economic growth is shifting, international competition is intensifying, innovation is accelerating, and structural transformations are occurring at an ever-faster pace. In addition to these economic dynamics, new societal challenges are emerging, encompassing issues like ageing populations, mobility, and the imperative of addressing climate change. Furthermore, foreign policy developments,

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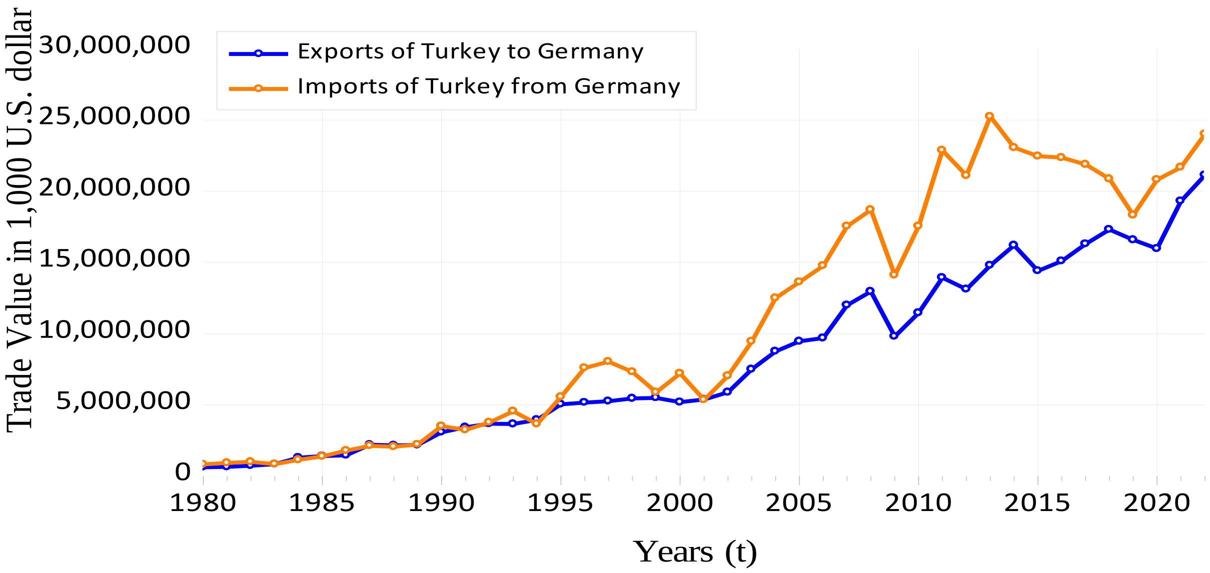
[40] The inward FDI of Turkey accounted for 13,177 million U.S. dollars in 2022, which is equivalent to 1.54% of its GDP (OECD Statistics, 2023).
[41] According to TurkStat (2023) figures, the ratio of high-technology products in manufacturing industries’ exports was 2.2% in July 2022. Similarly, the ratio of medium-high-technology products in manufacturing exports was 33.6% during the same period.
[42] Germany accounts for a quarter of total EU trade with Turkey.

including events such as the Ukraine crisis, the situation in Syria, and the global threat of terrorism, are compelling Turkey and the EU to navigate new decisions (Tolksdorf, 2016).

Over 7,000 German companies operating in Turkey underscore the critical role of German corporate investment in economic growth and long-term prosperity. In the year 2022, the trade volume between these two nations amounted to a substantial $45 billion and $177 million. This trade partnership stands as a mutually beneficial arrangement[43]. Comparing the figure to the previous year[44], there was an impressive 8.67% increase in exports, a 9.59% increase in imports, and an overall growth of 9.16% in the bilateral trade volume (CBRT, 2023). It is worth noting that while Turkish exports to Germany have maintained a consistent upward trajectory, Turkish imports from Germany have shown greater fluctuations over time, with a declining trend observed in recent years (specifically between 2013 and 2019). Figure 10 visually represents these historical trade trends between the two countries.

Figure 10. Trends in Trade Flows between Turkey and Germany, 1980-2022



Source: World Integrated Trade Solution (2023)

More importantly, Turkey's youthful population is a valuable asset to Germany, particularly in light of its relatively older human resources. Additionally, the cost-effectiveness of operations in Turkey is a compelling incentive that attracts German business activity. Furthermore, the Turkish market is an indispensable asset for Germany, representing its largest export market (Selcuki & Tulan, 2021).

Additionally, German investment has played a pivotal role in generating employment opportunities and attracting FDI. In the face of a substantial economic downturn, the support

[43] It is a win-win trade relationship.
[44] 2021

from Europe's most influential economic powerhouse, boasting a GDP exceeding $4 trillion, becomes indispensable for Turkey's economic recovery (refer to Figure 10). However, it is essential to note that Turkish-German trade relations and investment initiatives have been witnessing a negative trend since 2019. In the previous year, German exports to Turkey experienced a significant decline, dropping from 20.4 billion euros to 18 billion euros, mainly attributable to the deteriorating economic climate. In 2018, Turkey was ranked at the lowest level of trust as a partner among Germany's eight key allies.

The dynamics of tourism relationships between the two countries have also felt the impact of this economic shift. Over the past decade, the number of Turkish citizens travelling to Germany has nearly doubled. In contrast, the number of Germans visiting Turkey has remained relatively stagnant, with a decline noted in 2016 (Szabo, 2018). Furthermore, Germany's tourism revenue from Turkish visitors has increased, coinciding with a decline in Germany's tourism expenditure directed towards Turkey.

4.5.1 FDI Trends and Investment Opportunities: Asymmetric Pattern

Foreign Direct Investment (FDI) plays a pivotal role in the global economic integration of nations, underscoring the significance of the relationships formed and the balance of power between them. Analyzing the FDI relationship between Turkey and Germany reveals an inherent asymmetry (Vatandaş, 2019). Germany holds a position of paramount importance for Turkey, serving as a vital partner in business, trade, investment, and tourism. However, this relationship is not reciprocated to the same extent. In particular, Germany has made substantial FDI contributions to Turkey, totaling approximately $11.147 billion during 2005-2022. In stark contrast, Turkish investments in Germany over the same period amounted to a significantly lower figure of $3.4 billion (CBRT, 2023)[45]. This asymmetry in FDI flows illustrates the relative strengths and weaknesses of the economic relationship between Turkey and Germany.

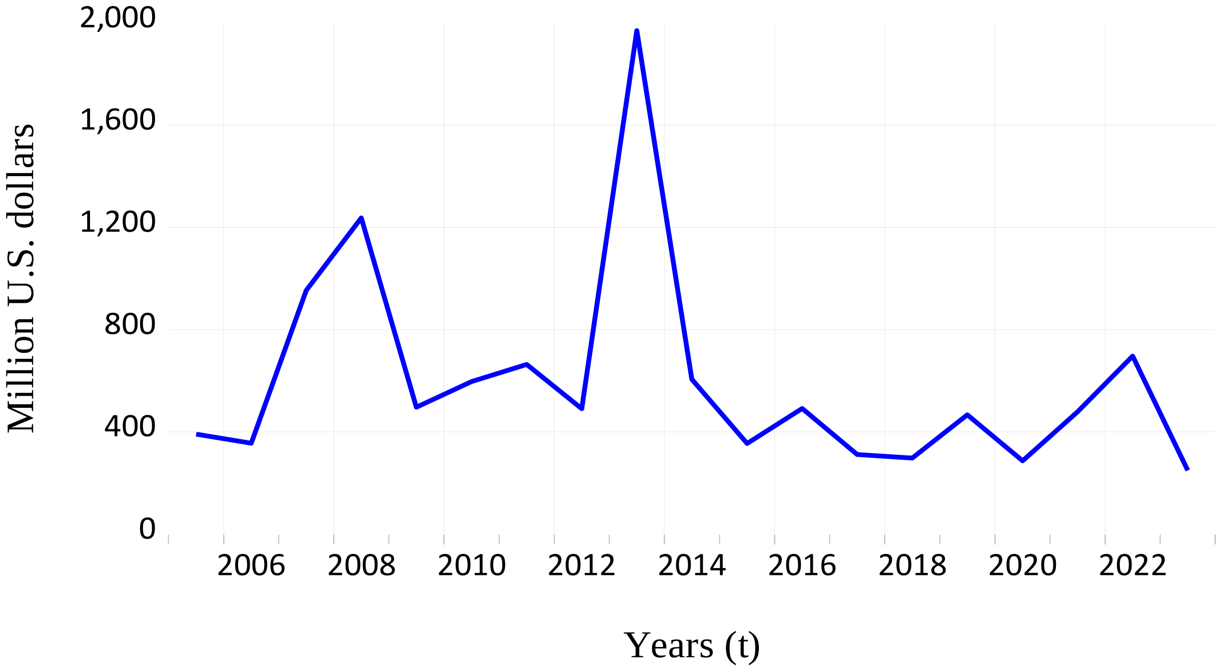
Approximately 80,000 Turkish-German enterprises are actively operating within Germany, collectively generating an annual turnover of approximately $52 billion. This significant economic presence provides employment opportunities for nearly 500,000 individuals across a diverse range of 50 sectors. In parallel, there are 7,640 German companies actively engaged in business operations within Turkey. Furthermore, in 2022, Turkey welcomed an impressive 5,679,194 German tourists (CBRT, 2023).

[45] German FDI accounted for $250 million to Turkey in 2023 (CBRT, 2023).

Despite the robust economic ties, Germany aims to bolster and expand this relationship through new investments. Notably, the flow of investments from Germany to Turkey has not remained static over time. Historically, from 1990 to 2013, Germany held a prominent position as one of the leading investors in Turkey. However, there were periods of decline in FDI inflows from Germany, notably from 2008 to 2012 and again from 2013 to 2020 (refer to Figure 11). Fortunately, the phase of reduced investments has concluded, witnessing a noteworthy resurgence in investments from various global players, including Germany, Europe, the Netherlands, Italy, Azerbaijan, Japan, and the USA (refer to Figure 12).

CBRT (2018) statistics reveal that the Netherlands is Turkey's foremost investment partner, contributing approximately $833 million in FDI, constituting around 13% of Turkey's total FDI. During the same period, Turkey reciprocated with investments in several countries, including $516 million in Azerbaijan, $509 million in Italy, and $446 million in the USA[46]. These figures underscore the dynamic nature of the investment landscape between Turkey and its international partners.

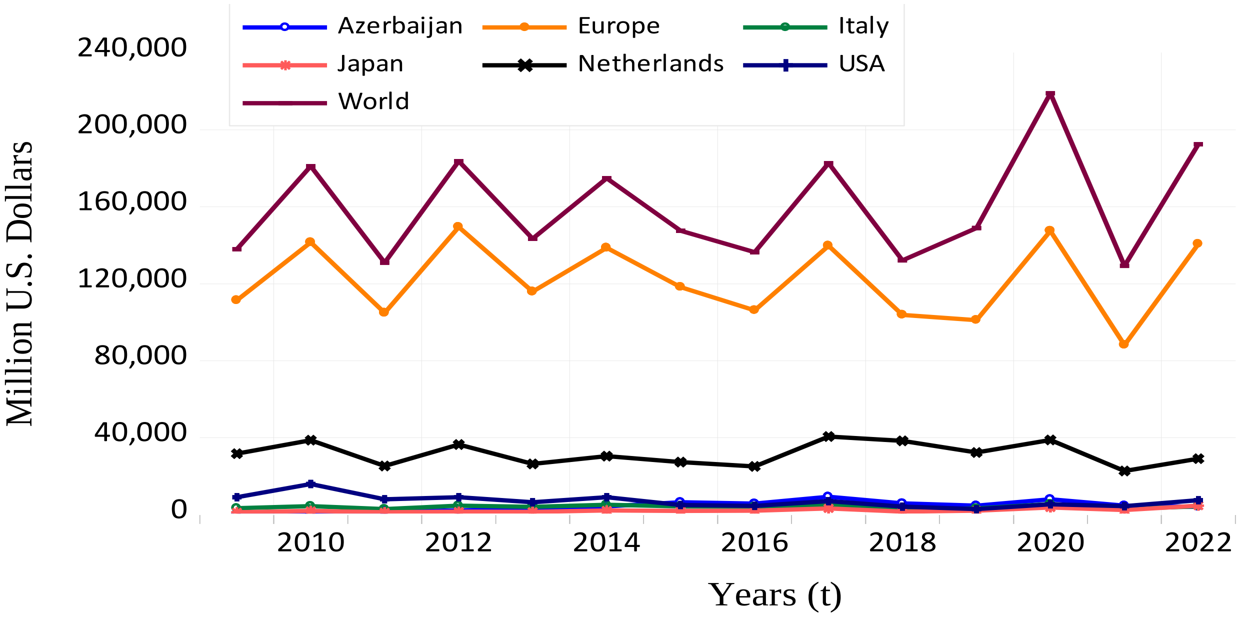
Figure 11. Foreign Direct Investment in Turkey by Germany, 2005-2023



Source: Central Bank of the Republic of Turkey (2023)

[46] The largest FDI in Turkey comes from European countries, amounting to $6.5 billion (64.6% of the total Turkey's FDI) in 2018. Similarly, FDI in Turkey from Asian countries, American countries, Oceania countries, and African countries amounted to $1.7 billion, $484 million, $42 million, and $24 million, respectively, during the same period (CBRT, 2023).

Figure 12. Foreign Direct Investment in Turkey by Other Countries, 2009-2022



Source: Central Bank of the Republic of Turkey (2023)

The fluctuations in investments between Turkey and Germany, like other facets of their investment relationship, can be attributed to various factors, including Turkey's political conditions, currency dynamics, and the evolving nature of the bilateral relationship with Germany. In early-2014, there has been a noticeable decline in the volume of investments. However, recent trends suggest a resurgence in investment activity[47]. Notably, most foreign direct investments directed towards Turkey find their place in the services sector. In contrast, Turkish capital tends to be channeled into the industry and services sectors. This sectoral distribution reflects the two countries' distinct investment preferences and strategies. Germany's investments in Turkey exhibit fluctuations over time, but perhaps more pronounced are the fluctuations in Turkey's investments in Germany. These variations underscore the dynamic nature of the economic ties between the two nations, shaped by many economic, political, and market forces.

FDI plays a pivotal role in fostering innovation. They facilitate the exchange of technology and knowledge between countries, thereby driving economic integration (Kuştepeli et al., 2013). Notably, German FDI has had a significant impact on the innovation landscape in Turkey. Research conducted by Ergül et al. (2016) highlights that between 2010 and 2014, Germany's FDI contributions played a crucial role in expediting the transition from patent applications to the actual issuance of patents. This effect was more pronounced compared to other foreign-based investments. As the Turkish economy has already reaped the benefits of

[47] FDI in Turkey from Germany has significantly increased and reached $697 million in 2022 (CBRT, 2023).

productivity gains resulting from structural changes, it actively seeks new avenues for productivity growth through research and development (R&D) and innovation. The inflow of knowledge and technology via FDI, mainly from Germany, has emerged as a valuable catalyst in this pursuit of innovation-driven growth.

Analyzing the composition of overall FDI from Germany into Turkey in 2010, it becomes evident that the top three sectors that attracted foreign capital were electricity, gas and water supply and distribution, financial intermediation, and manufacturing. The dominance of the electricity, gas, and water supply sectors was particularly noteworthy, which accounted for nearly 56.5% of the total FDI inflows that year. However, in 2012, there was a shift in the investment landscape, with the manufacturing sector taking the lead and accounting for 43% of the FDI inflows (CBRT, 2023).

German companies have historically shown a strong inclination towards investing in Turkey, primarily focusing on the manufacturing and service sectors, as evidenced by their activities between 2005 and 2015. However, there is now a notable pivot towards sustainability investments, particularly in the renewable energy sector[48]. This shift signifies a growing emphasis on environmentally responsible and sustainable investment practices, reflecting the evolving priorities in the economic relationship between Turkey and Germany.

4.5.2 The Dynamics of Turkish-German Trade: Sectoral Diversification

Since the 1960s, Germany has played a pivotal role in Turkish foreign trade. In 2018, the German-Turkish commodity trade volume was $38.89 billion. Of the total commodity trade volume, $21.54 billion was German exports to Turkey. In contrast, Turkish exports to Germany amounted to $17.35 billion, resulting in a negative trade balance of $4.19 billion in 2018 (The UN Comtrade database, 2023). As a result of these trade volumes, in 2018, Turkey ranked as the 17th export destination and the 19th import source for Germany among 216 countries. In contrast, Germany was Turkey's top export destination and the second-largest import source among 205 countries, respectively. Turkey accounted for 1.4% of German imports and represented the destination for approximately 1.5% of German exports (WITS, 2023).

However, in 2021, German-Turkish trade flows significantly increased to $41.04 billion. Out of the total trade flows, Turkish exports to Germany accounted for $19.31 billion. In comparison, Turkish imports from Germany totaled $21.73 billion, resulting in a negative trade balance of $2.42 billion in 2021 (The UN Comtrade database, 2023). Consequently, in

[48] German companies' investment in the energy sector of Turkey accounted for 25 billion euros.

2021, Germany ranked as Turkey's top export destination and the third-largest import source among 224 export and 219 import partners, respectively. In contrast, Turkey ranked as Germany's 17th export destination and the 18th import source among 230 export and 226 import partners, respectively. Turkey’s export share accounted for 8.57% of its total exports to Germany, while Turkey’s import share contributed 8% of its total imports from Germany in 2021 (WITS, 2023).

When examining the sectoral diversification of bilateral trade between Turkey and Germany, it becomes apparent that the patterns of Turkey's exports to Germany and its imports from Germany closely mirror each other. The top three products that Turkey imports from Germany encompass automobiles (cars) with a total value exceeding $2 billion, vehicle parts valued at $1.49 billion, and gold amounting to $664 million. On the flip side, Turkey's primary exports to Germany comprise cars valued at over $1 billion, vehicle parts valued at $993 million, and engine parts valued at nearly $1 billion. This symmetry in sectoral diversification is a recurring theme in the recent bilateral trade dynamics between Turkey and Germany, highlighting the robust and balanced nature of their trade relationship.

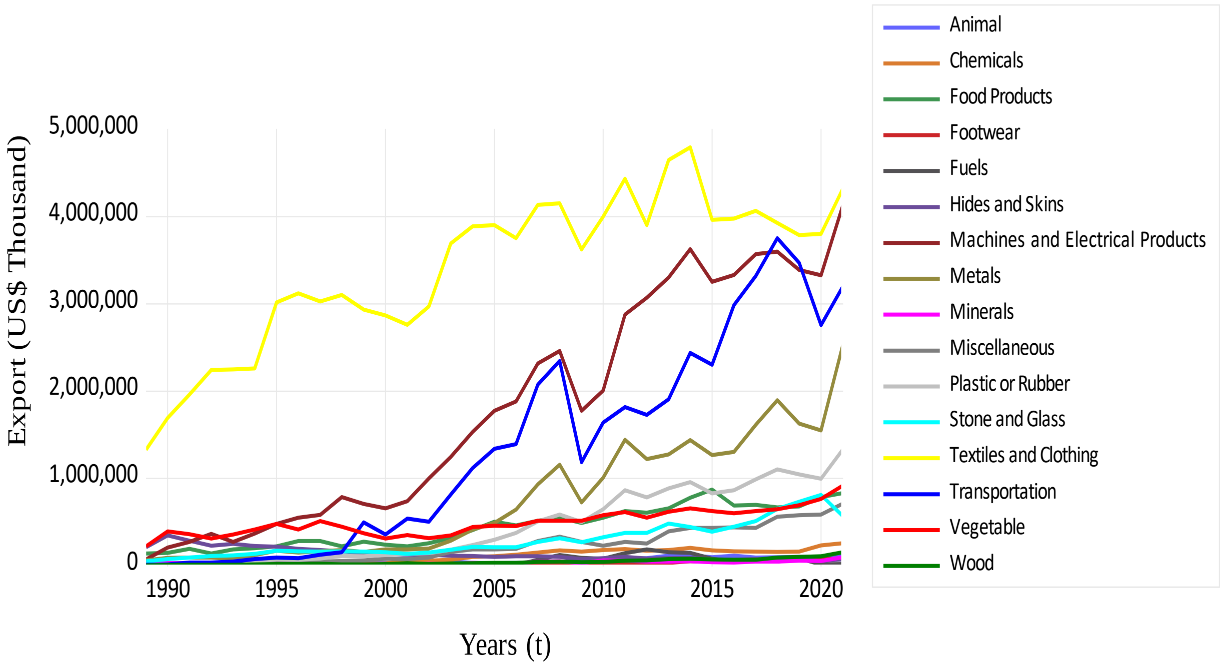
Specifically, the top 10 products that Turkey exported to Germany in 2022 included vehicles other than railway ($3.17 billion), machinery, nuclear reactors, and boilers ($2.93 billion), articles of apparel, knit or crocheted ($2.22 billion), electronic equipment ($1.31 billion), articles of apparel, not knit or crocheted ($1.21 billion), aluminium ($1.14 billion), articles of iron or steel ($1.13 billion), plastics ($756.10 million), rubbers ($687.07 million), and edible fruits, nuts, peel of citrus fruit, melons ($587.58 million). In contrast, Turkey’s top products imported from Germany in the same period included machinery, nuclear reactors, boilers ($5.52 billion), vehicles other than railway ($4.12 billion), plastics ($1.96 billion), electronic equipment ($1.85 billion), aircraft, spacecraft ($1.45 billion), iron and steel ($1.08 billion), pharmaceutical products ($958.35 million), medical apparatus ($845.17 million), organic chemicals ($619.03 million), and miscellaneous chemical products ($605.80 million) (WITS, 2023).

Over the past three decades, a discernible upward trajectory in sectoral exports from Turkey to Germany and sectoral imports from Germany is evident in Figures 13 and 14. This trend signifies a strengthening bilateral trade relationship between the two nations, reflecting their growing economic ties. Based on official statistics from WITS (2023), it is noteworthy that Turkish exports primarily consist of items with relatively low economic value. This characteristic is not reciprocated in the trade flow from Germany to Turkey. In simpler terms, Turkey tends to export lower-value products, while its imports from Germany exhibit greater diversity and often encompass high-value machinery and advanced technology.

A more detailed analysis of the sectoral composition of Turkey's imports from Germany highlights machinery, motor land vehicles, mechanical equipment, and various electrical appliances as the predominant import products that have consistently contributed significantly to Turkey's overall imports from Germany between 1989 and 2021. In contrast, when examining the sectoral composition of Turkish exports to Germany during the same period, it becomes evident that the Turkish economy has predominantly exported similar industrial products. However, textiles and clothing[49] have remained the leading export products, playing a significant role in Turkey's overall exports to Germany. This delineates the evolving trade dynamics and sectoral specialization within the economic relationship between Turkey and Germany.

Furthermore, about 70% of Turkey’s exports to Germany comprised industrial products in 2014-15, signaling noticeable changes in this sector. Compared to the 1980s, 1990s, and 2000s, the share of agricultural and textile goods significantly decreased in Turkey’s exports to Germany in 2014-15 (Inat, 2016). The same pattern is also noticeable in Figure 13 between 2015 and 2020.

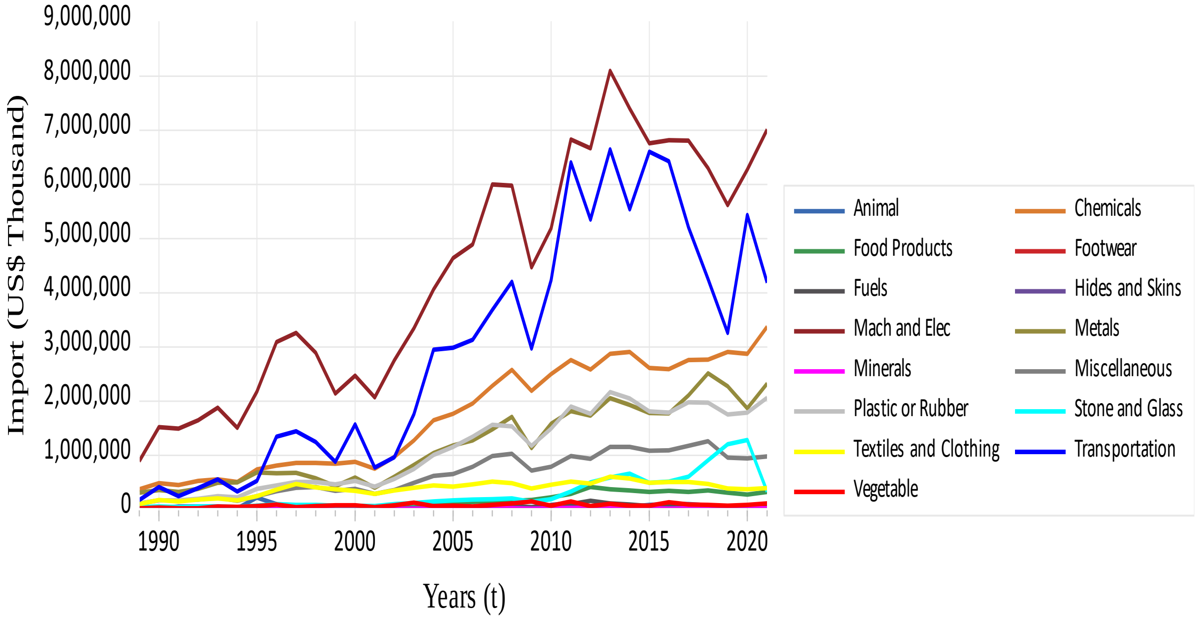
Figure 13. Trends in Sectoral Exports of Turkey to Germany, 1989-2021



Source: World Integrated Trade Solution (2023)

[49] Agricultural products

Figure 14. Trends in Sectoral Imports of Turkey from Germany, 1989-2021



Source: World Integrated Trade Solution (2023)

In terms of Turkey's trade worldwide, Turkey primarily exported consumer goods (which was 46.33% of its total exports) in 2020 to the global economy, while it imported mainly intermediate goods (which was 37.71 of its total imports) in 2020 from the global economy (refer to Table 3).

Table 3. Exports and Imports of Turkey in 2020 by Product Groups

Product categories	Exports		Imports		Weighted average (%)
	Export (million US dollars)	Export share (%)	Import (million US dollars)	Import share (%)	
Raw materials	12,317	7.26	22,406	10.21	4.10
Intermediate goods	41,424	24.42	82,772	37.71	1.95
Consumer goods	78,603	46.33	40,678	18.53	3.63
Capital goods	35,097	20.69	54,879	25.00	0.73

Source: WITS (2023) database

Similarly, Table 4 provides insights into the major products contributing significantly to Turkey's trade with Germany and the global economy.

Table 4. Top 5 Export and Import Products of Turkey

Exports			Imports		
HS-6-digit level	Product name	Export (US dollars)	HS-6-digit level	Product name	Import (US dollars)
271000	Petroleum oils, etc., (excl. crude); preparation	3,718,143.55	710812	Gold in unwrought forms non-monetary	25,179,297.61
870421	Diesel-powered trucks with a GVW not exceeding	3,558,574.56	271000	Petroleum oils, etc., (excl. crude); preparation	6,332,964.25
870390	Automobiles nes, including gas turbine-powered	3,549,754.81	720449	Ferrous waste and scrap, iron or steel, nes	6,061,417.36
711319	Art. of Jewellery and pts thereof of/o prec mtl	3,498,767.40	852520	Transmission apparatus, for radiotelegraph incorpo	3,123,380.70
710812	Gold in unwrought forms non-monetary	2,778,917.73	880240	Aircraft nes of an unladen weight exceeding 15	2,830,441.58

Source: WITS (2023) database

4.5.3 Trends in Export and Import Partner Shares

As shown in Figure 15, we can observe that Germany had a significant share in Turkey's export figures, accounting for 23.64% of overall exports in 1990. Turkey's imports from Germany represented 15.68% of its imports in 1990[50]. The average export share of Turkey's exports to Germany was 22.08%, 12.79%, and 9.60% in the 1990s, 2000s, and 2010s. Similarly, the average import share of Turkey's imports from Germany was 15.61%, 11.43%, and 9.73% in the 1990s, 2000s, and 2010s, respectively. Turkey's export share reached its historical lowest point at 8.57% in 2021, and its import share reached its lowest level at 8.01% in the same year.

The notable decline in both nations' export and import shares can be attributed to Turkey's strategic exploration of fresh international markets for its trade activities. Turkey has strategically diversified its import sources, notably turning to China and Russia for a substantial portion of its imports. This shift has led to a remarkable surge in imports from Turkey by these two countries. According to TurkStat (2023) statistical figures, Turkey's imports from January to December 2022 amounted to $363.71 billion, representing a significant increase of 34% compared to the previous year.

According to the UN Comtrade (2023) statistical figures, Germany remained the primary destination for Turkey's exports in 2022. However, when it comes to Turkey's imports, there was a notable shift in the rankings. Russia and China took the lead as Turkey's top import sources in 2022, pushing Germany down to the 3rd position. Germany, once again, outpaced Russia in exports to Turkey in 2022.

In more specific terms, Turkey's export share to Germany recorded 8.33% in 2022 of its total exports. In contrast, Turkey's import shares from Russia and China stood at 16.18% and 11.37% in 2022 of its total imports, respectively. Meanwhile, Turkey's import share from Germany further reduced to 6.61% in 2022 (refer to Table 5).

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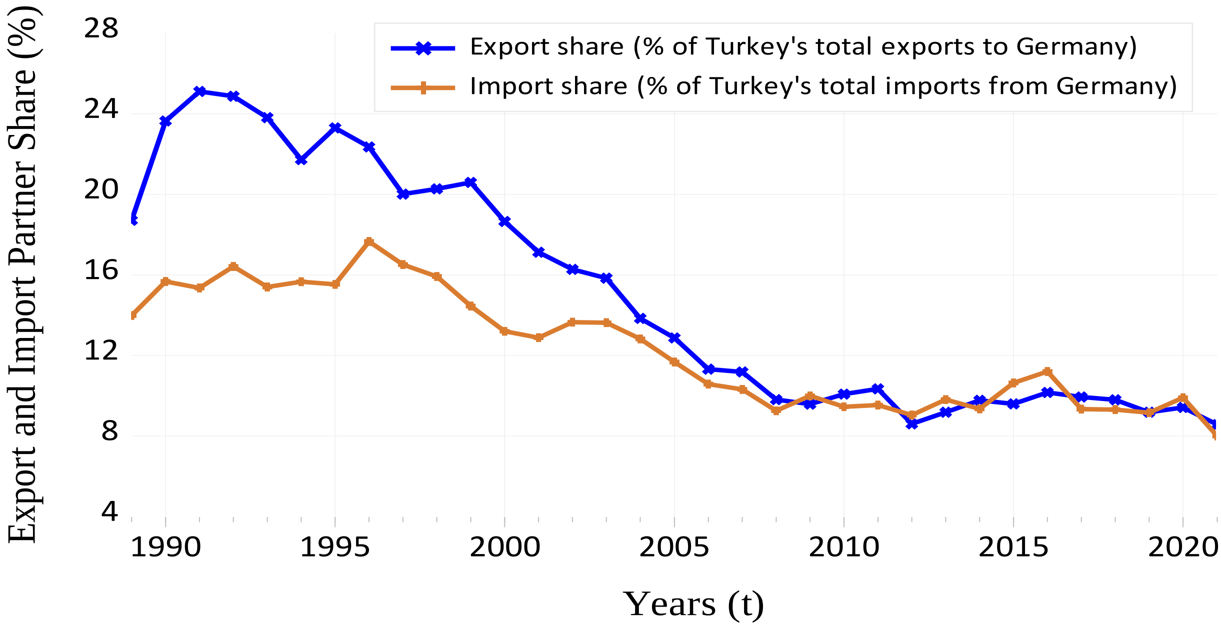
[50] Turkey's export share in its overall exports to Germany was 18.71% in 1989, while its import share in terms of its overall imports from Germany was 13.98% in the same year (WITS, 2023),

Figure 15. Export and Import Shares of Turkey's Trade with Germany, 1989-2021



Source: World Integrated Trade Solution (2023)

According to the UN Comtrade (2023) database, Germany, the U.S., Iraq, the UK, and Italy emerged as Turkey's top five export customers, collectively accounting for approximately 30.32% of Turkey's export sales in 2022. Regarding continental distribution of Turkish products, Europe was the primary destination for Turkish exports, receiving 55.1% of the total export value. Asian importers constituted the second-largest market, accounting for 25.1% of Turkey's exports. African countries constituted another significant market, absorbing 9.5% of Turkish exports, while North America received 7.8% of the exported goods. Moreover, smaller percentages of Turkish exports were directed to Latin America, excluding Mexico but including the Caribbean, making up 2% of the total value. Oceania, led by countries such as Australia, the Marshall Islands, and New Zealand, received a modest share of 0.6% of Turkey's exports.

Table 5. Turkey's Top 5 Export and Import Partners in 2022

Export Partners			Import Partners		
Exporter	Export (billion US dollars)	Export share (%)	Importer	Import (billion US dollars)	Import share (%)
Germany	21.1	8.33	Russia[51]	58.8	16.18
The USA	16.9	6.60	China	41.4	11.37

[51] According to the TurkStat (2023) figures, Turkey's imports in the period of January to December 2022 amounted to a value of $363.71 billion. This represented a significant increase of 34% compared to the previous year. Notably, imports from Russia experienced a noteworthy surge, doubling in value during the same period.

Iraq	13.8	5.41	Germany	24.0	6.61
The UK	13	5.12	Switzerland	15.3	4.21
Italy	12.4	4.88	The USA	15.2	4.18

Source: UN Comtrade (2023) database

4.5.4 Trends in Trade Balance: The Turkish-German Trade

As shown in Figure 16, the historical trade balance between Turkey and Germany consistently remained in deficit, following a similar downward trend over the past two decades. We can also observe some periods where the trade balance between the two countries remained favorable (surplus); however, the trade surplus amount was very low[52]. From 1980 to 2000, Turkey exported about $62.68 billion worth of commodities to Germany while importing $74.35 billion from Germany during the same period. The trade deficit during this period was recorded at -$11.67 billion.

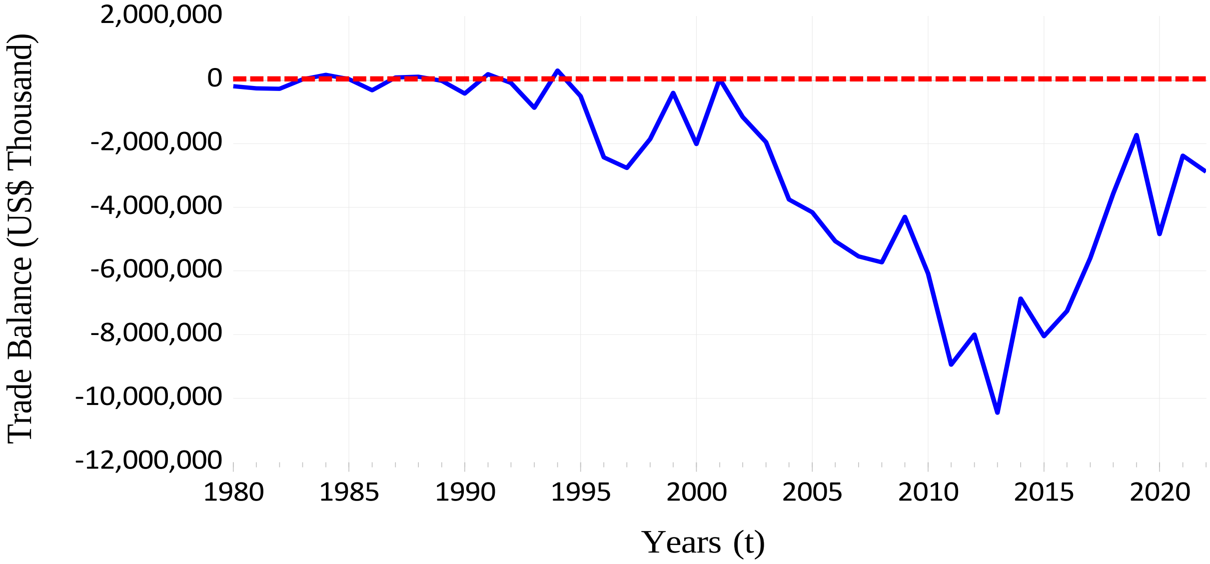
However, from 2002 to 2022, Turkey exported around $281.52 billion worth of items to Germany. Turkey imported $389.90 billion worth of items from Germany during the same period, leading to a trade deficit of about -$108.38 billion. Germany realized a $108.38 billion trade surplus with Turkey during this period. Turkey's exports to Germany increased from $5.87 billion to $21.14 billion between 2002 and 2022, with an average growth rate of about 12.47% per annum.

Conversely, Turkey's imports from Germany increased from $7.04 billion to $24.03 billion between 2002 and 2022, with an average growth rate of around 17.63% per annum. Unfortunately, the Turkish economy experienced a persistent trade account deficit that rose from -$1.17 billion to -$2.89 billion during 2002-2022, resulting in an average annual growth rate in deficit of -6.41 billion. The country's trade balance has been significantly influenced by various factors such as tariffs[53], trade growth rates, and the contribution of trade to the overall economy.

[52] The periods in which the trade balance was in a surplus position were 1983, 1984, 1985, 1987, 1988, 1991, 1994, and 2001.

[53] The Effectively Applied Tariff Weighted Average (customs duty) for Turkey is 2.85 percent, indicating the average tariff rate imposed on imported goods. The Most Favored Nation (MFN) Weighted Average tariff, representing the average tariff rate applied to all trading partners, is 4.81%.

Figure 16. Trends in the Trade Balance between Turkey and Germany, 1980-2022



Source: World Integrated Trade Solution (2023)

4.6 Advantages and Disadvantages of Turkey in International Trade

4.6.1 Advantages of Turkey in International Trade

(1) ***Strategic Location:*** Turkey's unique geographical location bridges Europe, Asia, and the Middle East, making it a natural crossroads for trade routes. This strategic position offers advantages in logistics, transportation, and access to various markets. According to the World Bank's Logistics Performance Index, Turkey ranked 47th out of 160 countries in 2018, indicating its relatively robust logistics infrastructure and efficiency.

(2) ***Diverse Economy:*** Turkey has a diverse economy with strengths in multiple sectors, such as manufacturing, agriculture, services, and tourism. This diversification gives Turkey a wide range of export products and a more resilient economy than countries relying heavily on a single sector. In 2020, Turkey's top export products included motor vehicles, machinery, textiles, iron, and steel (WITS, 2023). These sectors contribute significantly to the country's export earnings. Turkish automotive exports reached around $28 billion in 2020, showcasing the strength and competitiveness of the sector in international markets (The UN Comtrade database, 2023).

(3) ***Customs Union with the European Union (EU):*** Turkey's membership in the Customs Union with the EU grants it preferential access to the EU market for most goods, eliminating tariffs and trade barriers. This agreement has facilitated Turkey's integration into the European supply chains and boosted its exports to the EU. According to the Turkish Statistical Institute (TurkStat) (2023), The EU is Turkey's largest trading partner, accounting for a significant portion of its exports. In 2020, exports to the EU amounted to approximately $79 billion, representing around 47% of Turkey's total exports.

(4) Young and Skilled Workforce: Turkey benefits from a relatively young and dynamic workforce. The country has invested in improving education and skill development programs to enhance the productivity and competitiveness of its labor force. The Turkish workforce is known for its technical skills, with a focus on engineering, design, and information technology.

(5) Competitive Cost Structure: Turkey has maintained a competitive cost structure compared to some European countries, offering relatively lower labor and production costs. This advantage has attracted foreign direct investment and encouraged outsourcing activities, particularly in manufacturing sectors. Turkey's average monthly wage is lower than several European countries, making it an attractive destination for cost-effective manufacturing.

4.6.2 Disadvantages of Turkey in International Trade

(1) External Vulnerabilities: Turkey's economy is exposed to external shocks, including fluctuations in global commodity prices, exchange rate volatility, and geopolitical tensions. These factors can impact trade flows, investment decisions, and economic stability. Turkey experienced significant currency depreciation in recent years, which affected the purchasing power of importers and increased the cost of imported goods.

(2) Dependence on Imports: Turkey relies on imports for specific critical resources, such as energy and raw materials. High import dependency can make the economy vulnerable to global price fluctuations, supply disruptions, and currency risks. Turkey is a net energy importer, with imports accounting for a significant portion of its energy needs. In 2020, the energy import bill alone accounted for around 23% of Turkey's total imports (TurkStat, 2023).

(3) Trade Imbalance: Turkey has traditionally experienced a trade deficit, with imports exceeding exports. While tourism revenues and foreign direct investment can partially offset this trade imbalance, it puts pressure on the CA balance and can impact the overall economic stability. In 2020, Turkey's trade deficit amounted to around $50 billion; imports reached approximately $219 billion, while exports stood at about $169 billion (WITS, 2023).

(4) Limited Access to Some Markets: While Turkey benefits from preferential access to the EU market through the Customs Union, it faces challenges in accessing some markets due to trade barriers[54], tariffs[55], and non-tariff barriers[56] imposed by certain countries. Market access restrictions can limit Turkey's export potential in specific sectors. Turkey has ongoing trade disputes and non-tariff barriers with some countries, which can hinder market access and affect export performance.

(5) Infrastructure Challenges: Despite significant investments in infrastructure, Turkey faces challenges in certain areas, such as transportation networks, logistics efficiency, and digital infrastructure. Addressing these challenges is crucial for enhancing trade connectivity and competitiveness. While Turkey has made significant investments in infrastructure, further improvements are needed to enhance transportation and logistics networks, particularly in remote regions.

4.7 Unveiling Turkey’s Trade Deficit Champions

In 2022, Turkey faced an overall trade deficit of -$46.1 billion across all products, representing a decrease of -7.5% compared to the -$48.6 billion deficit recorded in 2021 (TurkStat, 2023). A negative trade balance, or deficit, occurs when the total value of a country's imports exceeds the value of its exports. It is unrealistic for any exporting nation to expect uniformly positive trade balances with all its importing partners. Similarly, an exporting country may not necessarily have a negative trade balance with every individual trading partner, as trade imbalances can vary between different countries. Turkey's most enormous trade deficits were observed with the following countries, indicating significant disparities in its trade relationships.

Turkey experienced the most significant negative trade balances with Switzerland, Russia, and Malaysia, with the deficits growing remarkably from 2021 to 2022. The trade deficits with Switzerland increased by 678.6%, Russia by 113.6%, and Malaysia by 43.6% (Macrotrends, 2023). These growing deficits highlight Turkey's competitive disadvantages when trading with these countries. However, they also present significant opportunities for Turkey to develop targeted strategies to enhance its overall position in international trade. By

[54] In 2016, Turkey obtained a Logistic Performance Index (LPI) score of 3.42, positioning it at rank 34. These figures, sourced from WITS (2023), indicate Turkey’s logistical performance and its relevant standing compared to other countries.

[55] As of 2020, Turkey had engaged in 29 tariff agreements. Additionally, the value of duty-free imports for Turkey amounted to 138,362,791.75 (thousand U.S. dollar) in the same year. The duty-free tariff line stood at 68.22% in 2020 (WITS, 2023).

[56] Regarding non-tariff measures (NTMs), Turkey reported having 2 NTMs in 2013. Furthermore, in the same year, the number of products (HS-6 digit) affected by these measures reached 203 (WITS, 2023).

addressing the specific challenges these trading partners pose, Turkey can work towards reducing its trade deficits and strengthening its trade position.

Table 6. Top 10 Turkey's Trade Deficit Partners in 2022

Serial number	Country name	Amount of deficit (billion US dollars)
1	Russia	49.5
2	China	38.1
3	Switzerland	14
4	India	9.1
5	South Korea	8
6	Japan	4
7	Brazil	3.83
8	Malaysia	3.81
9	Saudi Arabia	3.1
10	Germany	2.9

Source: TurkStat (2023)

4.8 Turkey's Top Trade Surplus Partners

When a country's total value of exported goods exceeds the value of its imported goods, it is said to have a positive trade balance or surplus. Turkey experienced the most significant positive trade balances with Romania, Lebanon, and the Netherlands, with the surpluses increasing from 2021 to 2022. The trade surpluses with Romania increased by 107.5%, Lebanon by 56.4%, and the Netherlands by 56.2%. These growing surpluses highlight Turkey's competitive advantages when trading with these countries. They also present significant opportunities for Turkey to develop targeted strategies to enhance its overall position in international trade further. By leveraging its strengths and focusing on specific country-specific approaches, Turkey can maximize the benefits of these trading partnerships and optimize its trade position. Turkey achieved the highest trade surpluses among the countries listed in Table 7.

Table 7. Top 10 Turkey's Trade Surplus Partners in 2022

Serial number	Country name	Amount of surplus (billion US dollars)
1	Iraq	12.3
2	The UK	7.1
3	Israel	4.6

4	Romania	3.6
5	The Netherlands	3.5
6	Spain	2.6
7	Lebanon	2.6
8	Morocco	2.1
9	Libya	2.1
10	Bulgaria	2

Source: TurkStat (2023)

4.9 Conclusion

Turkey's economic growth has been marked by periods of expansion and volatility, influenced by trade liberalization and policy instability. While beneficial, its trade relationship with Germany has been characterized by a persistent trade deficit. The dynamics of this relationship are influenced by factors both within and outside their borders, making it essential for both countries to adapt to changing global economic conditions and work towards a more balanced trade relationship.

Since the 1960s, Turkey and Germany's economic and trade bonds have remained steadfast, transcending political preferences. These enduring ties, rooted in history and culture, underscore the mutual economic destiny shared by the two nations. Importantly, this shared economic future serves as a testament to their historical and cultural affinities and a means to align their strategic objectives.

The potential for collaboration between Turkey and Germany extends far beyond conventional trade domains. The alignment of Germany's green investment initiatives with Turkey's sustainability potential paves the way for increased investment and cooperation in the foreseeable future. Furthermore, Turkey's vibrant technology entrepreneurship ecosystem, especially in recent years, stands as a catalyst for enhanced collaboration and integration between the two countries. These developments illustrate the mutual benefits of a strengthened partnership, offering opportunities for shared economic growth and long-term prosperity.

CHAPTER V

The Relationship between Economic Growth and Trade

5.1 Background

This chapter comprehensively explores the dynamics between economic growth and international trade. By examining the significance of the relationship between economic growth and trade, theoretical frameworks, empirical evidence, influencing factors, mechanisms and channels, sectoral dynamics, policy implications, and challenges, we enhance our understanding of how trade shapes economic growth outcomes. This knowledge empowers economic policymakers, researchers, and stakeholders to navigate the complexities and leverage the growth-trade relationship to foster sustainable and inclusive economic development.

5.2 Trade: A Catalyst for Economic Growth

Studying the economic relationship between economic growth and international trade is paramount for several reasons. First and foremost, trade is crucial in driving economic development and prosperity. It enables countries to harness their comparative advantages, exploit economies of scale, and access a broader range of goods and services. Countries can enhance their economic efficiency and productivity by engaging in international trade, increasing output, income, and employment opportunities.

Furthermore, international trade significantly impacts economic growth by facilitating the transfer of knowledge, technology, and innovation across borders. Through trade, countries can learn from each other, adopt best practices, and acquire advanced technologies, enhancing their productive capacity and competitiveness. Trade also promotes investment and capital flows through foreign direct investment and access to international financial markets, contributing to economic growth.

Moreover, international trade catalyzes economic diversification and structural transformation. It enables countries to shift from traditional, low-productivity sectors to more dynamic and technologically advanced industries. This process of structural transformation, driven by trade, can lead to sustained economic growth, increased productivity, and improved living standards.

Given the profound impact of trade on economic development, it is imperative to understand the relationship between economic growth and trade comprehensively. By studying this relationship, policymakers can design effective trade policies to foster economic growth and development, including trade liberalization, regional integration, and export promotion strategies. Additionally, businesses can make informed decisions regarding market entry, investment, and international expansion based on a deeper understanding of the implications of trade for economic growth.

5.3 Trade Theories Unveiled: A Comprehensive Overview

5.3.1 The Comparative Advantage Theory

This classical theory was developed by David Ricardo in 1817 and plays a fundamental role in understanding the link between economic growth and foreign trade. According to Ricardo (1817), comparative advantage is when a country can produce a particular good/service at a lower opportunity cost than other countries. According to this theory, countries should specialize in producing goods and services with a comparative advantage and trade with other countries to maximize overall economic welfare.

Countries can allocate their resources more efficiently through specialization based on comparative advantage. Specialization allows countries to focus on producing goods and services that they can produce most efficiently, utilizing their abundant factors of production or superior technology. This leads to increased productivity, economies of scale, and enhanced competitiveness in international markets.

Trade based on comparative advantage enables countries to access goods and services they cannot produce efficiently or cost-effectively domestically. By engaging in trade, countries can import goods that would be expensive to produce domestically and export goods that they can produce at a lower cost than other countries. This leads to a more efficient allocation of resources, higher levels of production, and increased economic growth.

The theory can be explained through an example. Let's consider two countries, Country A and Country B, and two goods, wheat and cloth. Each country has a certain amount of resources and productivity levels. Country A can produce either 10 units of wheat or 20 units of cloth in a given period, while Country B can produce either 5 or 10 units of wheat in the same period. Based on these production possibilities, we can determine the opportunity costs for each country:

Country A: 1 unit of wheat = 2 units of cloth 1 unit of cloth = 0.5 units of wheat

Country B: 1 unit of wheat = 1 unit of cloth 1 unit of cloth = 1 unit of wheat

Comparing the opportunity costs, we see that Country A has a lower opportunity cost for producing cloth, while Country B has a lower opportunity cost for producing wheat. This indicates that Country A has a comparative advantage in cloth production, and Country B has a comparative advantage in wheat production.

According to the theory, it is beneficial for both countries to specialize in producing the goods in which they have a comparative advantage. By specializing, they can allocate their resources more efficiently and achieve a higher total output. With its comparative advantage in cloth, Country A could allocate all its resources to cloth production, resulting in 20 units of cloth. Similarly, with its comparative advantage in wheat, Country B could allocate all its resources to wheat production, resulting in 5 units of wheat.

However, for each country to enjoy both goods, they engage in trade. Both countries can increase their consumption possibilities by exchanging a specific cloth ratio for wheat. For example, if they agree to trade at a ratio of 1 unit of cloth for 2 units of wheat, Country A can trade 10 units of cloth for 20 units of wheat, while Country B can trade 5 units of wheat for 2.5 units of cloth. Through this trade, both countries had more goods than they could produce. Country A now has 10 units of cloth and 20 units of wheat, while Country B has 2.5 units of cloth and 2.5 units of wheat. This demonstrates the gains from trade and the benefits of specializing under comparative advantage.

The comparative advantage theory has been influential in international trade and has provided a foundation for understanding the benefits of specialization and trade. However, it is essential to note that the theory makes certain assumptions, such as perfect competition, constant costs, and the absence of trade barriers, which may not always hold in the real world (Krugman et al., 2014).

5.3.2 The Neo-Classical Trade Theory

Neoclassical trade theory, specifically the Heckscher-Ohlin theory[57], focuses on the role of factor endowments in determining trade patterns. The theory suggests that countries will specialize in and export goods that make intensive use of their abundant factors of production while importing goods that require using their scarce factors. Developed by Eli Heckscher (1919) and Bertil Ohlin (1933), this theory provides insights into how trade can lead to resource allocation efficiency and contribute to economic growth. The Heckscher-Ohlin theory is based on several key assumptions:

[57] The H-O theory

1. ***Factors of production:*** The theory recognizes three primary factors of production: labor, capital, and natural resources. These factors are assumed immobile between countries but can be reallocated within a country.
2. ***Factor endowments:*** Each country is characterized by its factor endowments, which refer to the relative abundance or scarcity of factors of production. For example, a country with a large labor force but limited capital would be considered labor-abundant.
3. ***Production technologies:*** Countries have different technologies that determine the factor intensities required to produce various goods. Some goods may be more labor-intensive, while others may be more capital-intensive.
4. ***Trade costs:*** The theory assumes the absence of trade barriers and transportation costs. This assumption allows for the free movement of goods between countries based solely on comparative advantages arising from factor endowments.

Based on these assumptions, the Heckscher-Ohlin theory predicts the following patterns of trade:

1. ***Factor intensity:*** Countries will export goods that are intensive in their abundant factors and import goods that are intensive in their scarce factors. For example, a labor-abundant country would export goods requiring abundant labor and import goods that require abundant capital.
2. ***Comparative advantage:*** The theory suggests that comparative advantage arises from differences in factor endowments. Therefore, trade occurs between countries with differing factor endowments, allowing each country to specialize in producing goods that align with their abundant factors.
3. ***Factor price equalization:*** Over time, trade based on factor endowments will equalize factor prices between countries. In other words, abundant factors will become relatively scarcer and more expensive, while scarce factors will become relatively more abundant and cheaper.

An example illustrating the Heckscher-Ohlin theory is the trade relationship between the U.S. and Mexico. The U.S. is considered capital-abundant, as it has a relatively high capital-to-labor ratio compared to Mexico. On the other hand, Mexico is considered labor-abundant due to its large labor force. According to the theory, the United States would specialize in and export goods that require abundant capital, such as high-tech machinery or advanced technology products. Mexico, being labor-abundant, would specialize in and export goods that require abundant labor, such as textiles or labor-intensive manufacturing goods. Thus, the theory predicts that the United States would import labor-intensive goods from Mexico while Mexico would import capital-intensive goods from the United States.

It is important to note that while the Heckscher-Ohlin theory provides valuable insights into trade patterns based on factor endowments, it is a simplified model that does not capture all real-world complexities, such as trade barriers, technological differences, or product differentiation. Nevertheless, it remains a foundational theory in international trade and has contributed significantly to our understanding of how factor endowments shape trade relationships (Krugman et al., 2014).

5.3.3 The New Trade Theory (NTT)

The new trade theory, developed by Paul Krugman in the 1970s, builds upon Ricardo's comparative advantage argument. It addresses the question of what determines comparative advantage, which was not fully explained in Ricardo's model. Krugman's (1979) work highlights that each country has a comparative advantage in producing certain goods or services more efficiently than others. This theory introduces the concepts of economies of scale and product differentiation, providing valuable insights into globalization and trade dynamics. These concepts offer a deeper understanding of how firms and countries gain a competitive edge in the global marketplace.

According to Krugman (1979, 2014), the NTT introduces economies of scale and product differentiation as crucial factors in the analysis of international trade. This theory suggests that countries can gain a competitive advantage by specializing in producing specific goods and achieving economies of scale, leading to increased productivity, innovation, and variety in consumption. The NTT highlights the role of non-price factors and strategic behavior in shaping trade patterns. The detailed explanation of the NTT includes the following vital aspects/assumptions:

(1) ***Economies of Scale:*** The NTT emphasizes the importance of economies of scale[58] in international trade. This situation occurs when the average cost of production decreases as output increases. In traditional trade theory, countries are assumed to have constant returns to scale, meaning that the cost per unit remains unchanged regardless of the production level. However, the NTT recognizes that some industries can benefit from economies of scale, leading to lower average costs and increased competitiveness.

[58] Economies of scale refer to the cost advantages that arise from producing a larger volume of output. In new trade theories, economies of scale play a crucial role in driving international trade and economic growth. By producing on a larger scale, firms can achieve lower average costs, which can make them more competitive in international markets. This can lead to increased trade volumes and economic growth.

(2) ***Product Differentiation:*** The theory also considers the role of product differentiation[59]. Products can differ in quality, features, design, or branding, creating a differentiation that allows firms to charge higher prices and capture market share. Product differentiation can be done by making investments in research and development, marketing, and branding. This differentiation gives firms a competitive advantage and allows them to engage in international trade.

(3) ***Increasing Returns to Scale:*** The NTT argues that industries characterized by increasing returns to scale (rather than constant returns to scale) can lead to a limited number of firms operating in the global market. As firms increase their production, they experience lower average costs and can capture a larger market share, creating barriers to entry for potential competitors. This can result in the concentration of production in a few countries or firms, known as monopolistic competition.

(4) ***Strategic Trade Policy:*** The theory suggests that governments can play a role in promoting industries with increasing returns to scale. Governments can help domestic firms overcome the initial barriers to entry and achieve economies of scale by implementing strategic trade policies, such as subsidies or protectionist measures. The primary objective of such policies is to boost the competitive edge of domestic industries in the global market, ultimately contributing to their growth and success.

The NTT can be illustrated with an example. Consider the automobile industry, where economies of scale and product differentiation play a significant role. Large-scale production allows firms to spread fixed costs over more units, leading to lower average costs. This enables automobile manufacturers to offer competitive prices and gain market share. Product differentiation through branding, design, and features also allows firms to target specific consumer segments and charge premium prices.

For instance, Germany has specialized in producing high-quality luxury cars, such as Mercedes-Benz, BMW, and Audi. The country's automotive industry benefits from economies of scale and invests heavily in research and development to maintain product differentiation. This specialization has allowed Germany to capture a significant global luxury car market share.

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[59] Imperfect competition refers to a market structure where firms have some degree of market power. New trade theories argue that imperfect competition can lead to trade even in the absence of differences in production costs (comparative advantage). In such situations, firms can engage in strategic behavior, such as product differentiation and marketing, to gain a competitive edge in international markets. This can lead to increased trade and economic growth.

While the NTT provides valuable insights into the role of economies of scale and product differentiation, it is essential to note that it is just one perspective in international trade. Other theories, such as comparative advantage-based theories, also contribute to our understanding of trade patterns. The NTT complements these theories by emphasizing the role of non-price factors and strategic behavior.

5.3.4 The Endogenous Growth Theory

Endogenous growth theory, pioneered by economists like Paul Romer (1986) and Robert Lucas (1988), shifts the focus from exogenous factors to internal factors within an economy, such as knowledge, technology, and human capital, as drivers of long-term economic growth. This theory suggests that trade is crucial in facilitating the diffusion of ideas, technological advancements, and knowledge spillovers across countries (Romer, 1994). By engaging in international trade, countries can import new technologies and ideas, leading to increased productivity, innovation, and sustained economic growth (Lucas, 1988; Romer, 1990). The detailed explanation of the Endogenous Growth Theory includes the following vital aspects/assumptions:

(1) Knowledge and Technological Progress: Endogenous growth theory argues that knowledge and technological progress are not exogenous or fixed factors but are created and accumulated within the economy. R&D investments, innovation, and dissemination of new knowledge drive economic growth. These factors are endogenous because policy choices, human capital development, and market forces influence them.

(2) Human Capital: The theory emphasizes the importance of human capital, which refers to the knowledge, skills, and education of a country's workforce. Investments in education and training contribute to human capital accumulation, leading to higher productivity levels and economic growth. Skilled workers are more adept at adopting and adapting new technologies, which enhances a country's ability to innovate and compete in the global market.

(3) Knowledge Spillovers: Trade is crucial in transmitting knowledge and technological advancements across countries. When countries engage in trade, they can import goods and services that embody new technologies and ideas. This exposure to foreign technologies can lead to knowledge spillovers, where imported technologies are adopted and adapted domestically, contributing to productivity gains and innovation. Knowledge spillovers can occur through various channels, such as FDI, international collaborations, or imitation of foreign products.

(4) ***Productivity and Economic Growth:*** Through the diffusion of knowledge and technological advancements, trade can contribute to productivity growth, a crucial driver of long-term economic growth. By importing more advanced technologies and ideas, countries can improve their production processes, increase efficiency, and expand their output possibilities. Higher productivity levels lead to higher incomes, improved living standards, and sustained economic growth.

An example that illustrates the endogenous growth theory is the case of South Korea. In the late 20th century, South Korea experienced rapid economic growth, known as the "Miracle on the Han River." This growth was driven by the country's focus on education and investment in human capital and its engagement in international trade. South Korea imported advanced technologies and ideas through trade, particularly in the electronics and automobile sectors. These imported technologies were adopted and adapted domestically, leading to the emergence of successful Korean companies like Samsung and Hyundai. The diffusion of knowledge and technology from trade contributed to productivity gains, innovation, and sustained economic growth in South Korea.

It is important to note that while the endogenous growth theory provides valuable insights into the role of knowledge, technology, and human capital, it is one of many theories explaining economic growth. Other theories, such as the Solow-Swan model, contribute to our understanding of growth dynamics. The endogenous growth theory complements these theories by emphasizing growth's internal factors and endogenous nature (Barro and Sala-i-Martin, 2003).

5.3.5 The Institutional Theory

The institutional theory emphasizes institutions' significant role in shaping trade patterns and economic growth. Institutions refer to the formal and informal rules, norms, and organizations that govern economic and social interactions within a society (North, 1990). Strong and well-functioning institutions, such as secure property rights, effective governance structures, and the rule of law, provide a conducive environment for trade, investment, and entrepreneurship, fostering economic growth. Conversely, weak or corrupt institutions can hinder trade and impede economic development (Hall and Jones, 1999). The detailed explanation of the institutional theory includes the following key aspects:

(1) ***Institutions and Economic Behavior:*** Institutional theorists argue that institutions influence economic behavior by providing the rules and incentives that shape individual and collective actions. Institutions establish property rights, enforce contracts, ensure

the rule of law, and set the regulatory framework for economic activities. These formal and informal rules guide decision-making, create predictability, and influence the behavior of economic agents, including firms and individuals (Rodrik, 2000).

(2) ***Property Rights:*** Secure property rights are crucial for economic development and trade. Institutions that protect and enforce property rights assure individuals and firms that their assets will be respected and can be used as collateral for investment and trade. Strong property rights encourage long-term investment, innovation, and risk-taking, essential for economic growth.

(3) ***Rule of Law:*** The rule of law ensures that laws and regulations are applied consistently and impartially, providing a predictable and stable business environment. Well-functioning legal systems protect contractual rights, resolve disputes, and provide a mechanism for enforcing rights and obligations. The rule of law reduces transaction costs, encourages trade, and fosters economic development.

(4) ***Governance Structures:*** Effective governance structures, including transparent and accountable institutions, are critical for economic growth. Institutions free from corruption and political interference promote efficiency, trust, and fairness in economic transactions. Transparent and accountable governance systems attract domestic and foreign investment, encourage entrepreneurship, and create an environment conducive to economic growth.

(5) ***Informal Institutions:*** Alongside formal institutions, informal institutions, such as social norms, customs, and cultural practices, also shape economic behavior. These informal rules influence trust, cooperation, and social interactions, impacting trade relationships and economic outcomes. Informal institutions can reinforce or challenge formal institutions, and their alignment is essential for promoting economic growth.

An example of the institutional theory is the contrasting cases of North and South Korea. Following the division of Korea, North Korea adopted a socialist system with weak institutions characterized by centralized planning, state ownership, and limited property rights. These weak institutions hindered trade and investment, leading to economic stagnation and limited economic growth. In contrast, South Korea implemented market-oriented reforms, established secure property rights, and developed strong institutions, including the rule of law and transparent governance structures. These institutions provided a favorable environment for trade, investment, and entrepreneurship. As a result, South Korea experienced significant economic growth, transforming itself into a major player in global trade and achieving high levels of prosperity.

It is important to note that while the institutional theory provides valuable insights into the role of institutions in shaping trade and economic growth, it is one of many theories explaining these phenomena. Other theories, such as neoclassical trade or endogenous growth theories, also contribute to our understanding. The institutional theory complements these theories by emphasizing the importance of institutional factors (Acemoglu et al., 2001).

5.4 The Empirical Evidence

Various schools of thought hold diverse perspectives regarding the impact of trade on a country's economic growth. The empirical evidence suggests a positive association between trade and EG, although the magnitude and nature of this relationship may vary across countries and periods. Were (2015) concluded that trade positively and significantly impacts economic growth. A one percent rise in the average trade-to-GDP ratio increases the average GDP per capita growth by about one-half (0.47) percentage point. Similarly, Afonso (2001) stated that during the neoclassical period, it was believed that international trade positively affected economic growth. Schmitt et al. (2019) reported that the hypothesized positive relationship between trade and EG is grounded in the idea that trade fosters production and overall economic development.

Key findings from the empirical literature indicate that increased trade openness is generally associated with higher levels of economic growth. Al Hemzawi and Umotoni (2021) pointed out that foreign trade generates resources that finance industrialization to produce more goods, create jobs, and thus contribute to economic growth. Countries that engage in more international trade tend to experience greater productivity gains, technological progress, and efficiency improvements. Trade allows countries to access larger markets, exploit economies of scale, and benefit from specialization, leading to increased output and economic growth (Damayanthi and Sandamali, 2016).

The empirical research on the connection between trade and EG is not without controversies and debates. Some empirical studies have identified a more pronounced link between trade and EG in developing countries, indicating that trade can significantly impact these economies regarding poverty reduction and overall development. For instance, analyzing the relationship between trade and economic development reveals that trade and growth are positive in developing countries and negative in developed countries (Gries and Redlin, 2020). Other empirical studies highlight the role of complementary factors, such as human capital, institutions, and infrastructure, in mediating the association between trade & growth. These factors can enhance a country's ability to harness trade benefits and translate trade openness into economic growth.

Moreover, the empirical literature reflects variations in empirical findings across different contexts. Factors such as country size, level of development, industry structure, and trade policies can influence the correlation between trade and growth. Arora and Vamvakidis (2004) emphasized that economic conditions in trading partner countries matter for growth. In particular, a country's economic growth is positively influenced by the growth of its trading partners. Some empirical studies found a stronger relationship in smaller economies or countries with higher industrialization levels, while others observed a significant relationship in both developed and developing nations. These variations posit that the impact of trade on economic growth is contingent upon specific country characteristics and contexts (Arora and Vamvakidis, 2004).

There are also distributional consequences of increasing trade. While on aggregate, economies gain enormously from increasing trade; as competition increases and many good jobs are created in export sectors, workers' wages in import-competing industries may suffer, or some workers may lose their jobs (The World Bank, 2018). The empirical literature suggests that trade openness can be a significant driver of economic growth, but the relationship is complex and contingent upon various factors (Manteli, 2015). Policymakers need to consider the specific context of their country and the potential distributional consequences of trade policies when designing strategies to promote economic growth through trade (The World Bank, 2018).

A synthesis of empirical verdicts reveals a positive association between trade and EG. Countries that engage in international trade tend to experience higher economic growth levels driven by productivity gains, technology transfer, specialization, and access to larger markets. However, the strength of the relationship may vary, and some studies find variations based on country characteristics and contextual factors.

Conflicting results in the empirical literature can be attributed to several factors. Differences in estimation methodology, model specifications, and data sources can contribute to variations in empirical findings (Rodriguez and Rodrik, 2000). Additionally, country characteristics, industry structure, and policy environment variations can shape the correlation between trade and EG (Gries and Redlin, 2020). Complementary factors such as human capital, infrastructure, and institutional quality also mediate the influence of trade on EG (Hallaert, 2006).

While the empirical evidence supports a positive connection between trade and EG, this relationship's specific dynamics and implications depend on various contextual factors. Future research should continue to explore these factors and deepen our understanding of how trade influences economic growth.

5.5 Factors Affecting the Relationship between Economic Growth and Trade

Several factors can influence the association between international trade and EG. These factors can shape the magnitude and nature of the relationship and the overall impact of trade on EG. Following are some key factors that affect the relationship between trade and EG:

(1) ***Institutional Framework:*** The quality and effectiveness of a country's institutions, including its legal and regulatory framework, property rights protection, contract enforcement, and governance, can significantly influence the relationship between economic growth and trade. Well-functioning institutions create a favorable environment for trade, promote competition, attract investments, and facilitate economic growth.

(2) ***Macroeconomic Stability:*** Macroeconomic stability, including macroeconomic factors such as inflation rates, fiscal discipline, and exchange rate stability, can impact the relationship between economic growth and trade. A stable macroeconomic environment provides a solid foundation for trade and investment, encourages business confidence, and promotes sustainable economic growth.

(3) ***Trade Policy:*** The design and implementation of trade policies are pivotal in shaping the relationship between economic growth and international trade. Policies related to trade openness, tariffs, quotas, subsidies, and trade facilitation measures can impact the competitiveness of domestic industries, exporters' market access, and the trade sector's overall performance. Well-designed and effectively implemented trade policies can foster economic growth, while protectionist measures or poorly formulated policies may hinder growth.

(4) ***Infrastructure:*** The quality and adequacy of physical infrastructure, including transportation networks, ports, energy systems, and telecommunications, can affect the capacity of a country to engage in international trade. Efficient infrastructure facilitates the movement of goods, reduces trade costs, and enhances competitiveness, positively influencing economic growth and trade.

(5) ***Human Capital:*** A country's workforce's skills, education, and knowledge are crucial for leveraging the benefits of international trade for economic growth. A well-educated

and skilled workforce can adapt to changing market conditions, adopt new technologies, and participate in higher value-added activities. Investing in human capital development through education and training programs is vital for countries to maximize trade benefits.

(6) Technological Innovation: Technological progress and innovation significantly shape economic growth and foreign trade links. Countries actively engaging in *R&D*, adopting advanced technologies, and promoting innovation are more likely to experience productivity gains, enhance competitiveness, and drive economic growth through trade.

(7) Global Economic Conditions: Global economic conditions, such as global demand, commodity prices, and financial market stability, can impact the correlation between economic growth and foreign trade. Changes in global economic conditions, including recessions, financial crises, or shifts in global trade patterns, can affect a country's export performance, market access, and overall economic growth.

(8) Geography and Natural Resources: Geographical location, access to natural resources, and landlockedness can influence a country's trade potential and economic growth. Landlocked countries may face higher transportation costs and limited access to international markets, which can challenge trade-driven economic growth. On the other hand, countries with abundant natural resources may benefit from trade in those resources, although careful management is required to avoid overreliance or resource curse effects.

(9) Market Size: The size of a country's domestic market can impact its ability to engage in international trade and drive economic growth. Larger domestic markets can provide economies of scale, attract foreign direct investment, and foster the development of competitive industries that can participate in global trade.

It is important to note that these factors interact and influence each other, creating a complex web of dynamics that affect the correlation between economic growth and foreign trade. Understanding these factors and their interplay is crucial for economic policymakers to design effective strategies and policies that leverage trade benefits for sustainable economic growth.

5.6 Mechanisms and Channels

5.6.1 Direct Channels

Trade directly impacts economic growth through various channels. These direct channels highlight the immediate effects of trade on factors such as employment, productivity, and income levels.

Trade plays a crucial role in expanding markets and creating opportunities for businesses to sell their goods and services abroad. Increased export opportunities lead to higher production levels, which, in turn, stimulate employment growth. As firms engage in international trade, they often expand their operations and hire more workers to meet the demand for their products or services. This increased employment contributes to economic growth by generating income and improving living standards.

Productivity gains are another direct mechanism through which trade influences economic growth. Trade exposes firms to competition from foreign producers, encouraging them to improve efficiency and adopt innovative technologies to remain competitive. This competition process leads to productivity growth as firms strive to enhance their production processes, reduce costs, and improve the quality of their commodities. Increased productivity, facilitated by trade, drives economic growth by increasing output levels and improving overall efficiency.

Furthermore, trade has the potential to affect income levels in a country. Countries can earn revenue from exporting goods and services by engaging in international trade. This revenue can be invested in infrastructure, education, and other sectors, leading to higher income levels and improved economic growth. Additionally, trade can contribute to increased purchasing power and a wider variety of consumer goods and services, further stimulating economic growth.

5.6.2 Indirect Channels

Trade also indirectly influences economic growth by transferring knowledge, technology, and innovation.

One important mechanism is technology transfer. Countries can access foreign technologies, know-how, and best practices through trade. Exposure to foreign markets encourages firms to adopt and adapt new technologies and production methods, leading to technological progress and increased productivity. Technology transfer through trade facilitates innovation and contributes to long-term economic growth.

Trade also promotes knowledge spillovers. When countries engage in trade, knowledge and ideas can flow across borders. These knowledge spillovers can occur through various channels, such as collaborations, joint ventures, and the mobility of skilled workers. The exchange of knowledge and ideas between countries enhances learning opportunities and can lead to innovation and technological advancements. Accumulating knowledge and innovation, driven by trade, fuels economic growth.

5.7 Sectoral Analysis

A sectoral analysis provides insights into the industries or sectors that most benefit from trade and contribute to economic growth.

Specific industries are particularly well-suited for international trade due to their comparative advantages or high productivity levels. For example, industries that rely on natural resources, such as mining or agriculture, often have a comparative advantage and can significantly benefit from trade. Trade allows these sectors to access international markets, increase their export earnings, and contribute to economic growth.

Manufacturing industries also benefit from trade, as they can take advantage of economies of scale and specialization. Trade enables manufacturing firms to access larger markets, expand production, and achieve cost efficiencies. Countries can diversify their industrial base by exporting manufactured goods, creating employment opportunities, and driving economic growth.

In addition to natural resources and manufacturing, services sectors, such as tourism, finance, and business, contribute to economic growth through trade. These sectors benefit from the movement of people, cross-border investments, and the exchange of services. Trade in services can lead to job creation, income generation, and increased competitiveness in the global marketplace.

By conducting a sectoral analysis, policymakers and researchers can identify the most responsive sectors to trade and design targeted policies to promote their growth and contribution to economic development.

5.8 Policy Implications

5.8.1 Policy Considerations

Understanding the relationship between trade and EG holds significant policy implications. Governments can design and implement trade policies to promote economic growth and maximize trade benefits. Some key policy considerations include:

(1) ***Trade Liberalization:*** Governments can pursue policies that reduce barriers to international trade, such as tariffs, quotas, and non-tariff barriers. Trade liberalization promotes economic growth by expanding market access, stimulating competition, and fostering productivity gains. However, careful attention should be given to protecting vulnerable industries and ensuring a level playing field for domestic producers.

(2) ***Regional Integration:*** Governments can actively participate in regional integration initiatives, such as free trade agreements and customs unions. These agreements promote trade flows among participating countries, increasing economic growth and regional cooperation. Regional integration can create larger markets, attract investment, and enhance competitiveness by facilitating the movement of goods, services, and capital.

(3) ***Export Promotion Strategies:*** Governments can implement policies that encourage and support domestic firms in entering and expanding into international markets. This can involve providing financial incentives, export credit facilities, market intelligence, and assistance with trade facilitation. Export promotion strategies help firms access global markets, diversify their customer base, and increase export earnings, contributing to economic growth.

(4) ***Investment in Infrastructure and Human Capital:*** Governments can prioritize investments in infrastructure development, such as transportation networks, logistics systems, and communication technologies. These investments improve connectivity and reduce trade costs, making it easier for firms to engage in international trade. Additionally, governments can invest in education and skill development programs to enhance the human capital of their workforce, enabling firms to be more competitive in international markets.

(5) ***Innovation and R&D:*** Policies that foster innovation, *R&D*, and technology adoption can enhance the productivity and competitiveness of domestic firms. Governments can incentivize firms to invest in *R&D*, support collaboration between academia and industry, and protect intellectual property rights. Innovation-led growth can create new industries, generate high-quality jobs, and sustain economic growth.

5.8.2 Challenges and Considerations

While trade-driven economic growth offers numerous benefits, there are also challenges and considerations that policymakers should address:

(1) ***Income Inequality:*** Trade can lead to income disparities, as specific industries and regions benefit more than others. Governments need to design policies that ensure the gains from trade are equitably distributed. This may involve implementing social safety nets, investing in education and skill development for vulnerable groups, and promoting inclusive growth.
(2) ***Sustainability:*** Policies should consider the environmental and social impacts of trade. Sustainable trade practices involve promoting environmentally friendly production processes, addressing climate change concerns, and protecting natural resources. Trade agreements can incorporate provisions to uphold labor standards, human rights, and environmental protection.
(3) ***Protectionism:*** Protectionist measures, e.g., tariffs, subsidies, and trade barriers, can hinder economic growth and distort international trade. Governments should be cautious about adopting protectionist policies that may lead to retaliation and reduced global market access. Maintaining an open and rules-based trading system is crucial for sustained economic growth.
(4) ***Global Cooperation:*** Given the interconnected nature of trade, international cooperation is essential. Governments should actively engage in multilateral trade negotiations and uphold international trade rules. Collaborative efforts can address challenges such as market access barriers, trade disputes, and the harmonization of regulatory frameworks, promoting a stable and predictable trade environment.
(5) ***Monitoring and Evaluation:*** Policymakers need to continuously monitor the influence of trade policies on economic progress and regularly evaluate their effectiveness. This includes analyzing trade data, assessing the outcomes of policy interventions, and making necessary adjustments to optimize policy outcomes.

In conclusion, policymakers should consider the policy implications derived from the connection between economic growth and trade. Trade policies that promote liberalization, regional integration, export promotion, infrastructure development, and innovation can foster economic growth. However, challenges such as income inequality, sustainability, protectionism, and the need for global cooperation should also be addressed to maximize the benefits of trade-driven economic growth.

CHAPTER VI

Economic Modeling and Estimation Methodology

6.1 Introduction

The discussion regarding the impact of exchange rate uncertainty on foreign trade has gained a subject of extensive theoretical and empirical studies since the breakdown of the Bretton-Woods agreement in the 1970s. The conventional argument suggests that unexpected fluctuations in exchange rates introduce a significant element of uncertainty and risk, leading risk-averse traders/agents to reduce their export/import activities and shift production/output towards domestic markets. Numerous empirical studies, including Akhtar and Hilton (1984), Cushman (1983, 1988), Kenen and Rodrik (1986), Koray and Lastrapes (1989), Pozo (1992), Chowdury (1993), Caporale and Doroodian (1994), and Arize (1995, 1997), have provided empirical evidence indicating that exchange rate volatility hurts foreign trade. According to their empirical findings, increased volatility leads to decreased trade volumes as firms become cautious due to the uncertainty and potential losses associated with fluctuating exchange rates.

However, an opposing group of economists argues that firms view trade as an option, and the value of this option may increase with volatility. This perspective suggests that increased exchange rate volatility can allow firms to benefit from price fluctuations and engage in arbitrage activities. The studies conducted by De Grauwe and Bellefroid (1987), Franke (1991), Sercu and Vanhulle (1991), Assery and Pell (1991), and Dellas and Zilberfarb (1993) have supported this opposing view, highlighting the positive relationship between exchange rate volatility and foreign trade. On the other hand, some studies, such as those by Gotur (1985), Bailey et al. (1986), and McKenzie (1999), have found the influence of ER uncertainty on trade to be statistically insignificant. These studies suggest that factors like market size, trade policies, and macroeconomic stability may wield a more dominant influence on trade flows than exchange rate volatility.

In studying the influence of ER uncertainty on trade, researchers have utilized different empirical specifications to capture the relationship between these variables. Initially, conventional techniques were commonly employed, but they often produced mixed conclusions (Daly, 1996; Arize et al., 2003). These studies focused on analyzing how fluctuations in exchange rates influence trade flows and examined the influence of ER uncertainty on exports (Doğanlar, 2002; Öksüzler, 2003).

Early empirical models relied on cointegration procedures proposed by Engle and Granger (1987) and Johansen (1988) to identify the long-term relationship between ER uncertainty and trade volumes, dealing with issues of stationarity and non-stationarity (Doğanlar, 2002; Bahmani-Oskooee & Hegerty, 2007; Panda & Mohanty, 2015). When the variables showed mixed orders of integration, more advanced and complex estimation methods were employed. One popular approach is the ARDL cointegration approach, which allows researchers to analyze short-term and long-term dynamics between ER uncertainty and trade. This approach has been widely used in various empirical studies, including those by Bahmani-Oskooee & Satawatananon (2012), Bahmani-Oskooee et al. (2013, 2014, 2016, 2017), Baek (2014), Soleymani & Chua (2014), and Dogo and Aras (2021).

In recent years, modified versions of the ARDL cointegration approach[60] have also been adopted by researchers in their empirical studies (Šimáková, 2018; Bahmani-Oskooee & Kanitpong, 2019; Bahmani-Oskooee & Arize, 2020; Baek & Nam, 2021, Lee et al., 2022). These models incorporate error correction procedures[61] to capture the adjustment mechanism between the variables in the long-term (Bahmani-Oskooee & Nouira, 2019; Bahmani-Oskooee & Saha, 2020; Bahmani-Oskooee & Karamelikli, 2021). These modified ARDL (or NARDL) techniques offer additional insights into the connection between ER uncertainty and trade.

6.2 Econometric Specifications

6.2.1 Model 1: Modeling Bilateral Export and Import Flows

In testing the association between ER uncertainty and trade, we utilize export and import models to estimate the influence of ER uncertainty on real trade volumes between Turkey and Germany. Each demand model incorporates essential variables, including real income (as a scale variable), the RER (as a relative price term), and RER uncertainty (as a relative price volatility term). To ensure the relevance and alignment with recent empirical studies, we closely follow the methodologies employed in several recent empirical studies, including those by Bahmani-Oskooee and Aftab (2018), Bahmani-Oskooee and Kanitpong (2019), Bahmani-Oskooee et al. (2019), Bahmani-Oskooee et al. (2020), Bahmani-Oskooee and Saha (2020), Bahmani-Oskooee and Karamelikli (2021), Chien et al. (2020), Iqbal et al. (2021), Lee et al. (2022), and Khalid et al. (2023). Since one of the primary objectives of this study is to estimate the bilateral commodity trade model, we adopt the following econometric specifications at the disaggregated level between Turkey and Germany:

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

[60] The NARDL methodology

[61] The error correction modeling (ECM)

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

In Equations (1) and (2), $XV_{i,t}$ ($MV_{i,t}$) represents the real value of industry *i* exported to (imported from) Germany by Turkey at time *t*, Y_t^{GR}(Y_t^{TR}) represents the real income of Germany (Turkey), REX_t represents the RER between the TL and EUR, and VOL_t^{TRGR} represents the real lira-euro exchange rate volatility[62]. Additionally, DM_t stands for the dummy indicator used to capture the impact of trade liberalization reforms on commodity trade volumes between Turkey and Germany. In specific terms, DM_t takes the value of 0 (1) for the period 1980-1983 (1984-2022))[63]. Our theoretical expectations regarding the anticipated coefficients suggest $\alpha_1 > 0$ ($\beta_1 > 0$), indicating that trade liberalization reforms in Turkey could have a positive effect on real commodity flows (Civcir & Yücel, 2020). Furthermore, we expect $\alpha_2 > 0$ ($\beta_2 > 0$) to demonstrate that Turkey's exports (imports) increase as the real income of Germany (Turkey) rises.

In our study, REX_t, in real terms, is defined as the number of TL per EUR. However, since direct data on the nominal lira-euro rate is not accessible, we employed a cross-exchange rate approach using the U.S. dollar as a reference currency. For this purpose, we have used the cross-exchange rate formula as follows:

$$NEX = \left(\frac{Turkish\ Lira}{USD} * \frac{USD}{Euro}\right) \quad (3)$$

In this expression, NEX represents the nominal lira-euro rate, showing the Turkish lira per euro (i.e., # TL/1 EUR). After calculating the nominal exchange rate, we can calculate the real exchange rate (REX) as follows:

$$REX = \left(\frac{CPI^{GR} \times NEX}{CPI^{TR}}\right) \quad (4)$$

In Equation (4), REX represents the real lira-euro rate, NEX represents the nominal lira-euro rate, CPI^{GR} represents Germany's price level, and CPI^{TR} represents Turkey's price level. Based upon this construction, increased RER signifies an appreciation of the Turkish lira and vice versa. Theoretically, we expect $\alpha_3 > 0$ ($\beta_3 < 0$), if an increase in REX_t (indicating a TL depreciation) causes export (import) prices to fall (rise), which causes Turkey's exports (imports) to (from) Germany to rise (fall). Lastly, VOL_t^{TRGR} measures the real lira-euro uncertainty, which could potentially negatively or positively impact real trade flows. Hence,

[62] It should be noted that the data has been constructed from the perspective of Turkey.

[63] In our study, we incorporated several country-specific dummy variables to account for the potential effects of some specific events, including the 2000/01 two-tier crisis, the 2008/09 global financial crisis, the 2016 coup attempt, the 2018 Branson effect, and the *COVID*-19 pandemic in 2019/20. However, our analysis revealed that these dummy variables did not exhibit statistical significance.

we theoretically expect α_4 (β_4) $\lesseqgtr 0$. It is worth noting that before 1999, the euro/dollar exchange rate was calculated as 1.956 Deutsche Mark equals 1 euro. This conversion factor was applied to maintain consistency in the exchange rate calculations.

In our research, the real lira-euro uncertainty (VOL_t^{TRGR}) is measured utilizing the GARCH (1,1) model developed by Bollerslev (1986). Although there are numerous methods for measuring volatility[64], the GARCH approach has been widely utilized in various empirical studies, including Arize et al. (2008), Bahmani-Oskooee & Aftab (2018), Bahmani-Oskooee & Kanitpong (2019), Bahmani-Oskooee & Arize (2020), Bahmani-Oskooee et al. (2021), Bahmani-Oskooee & Karamelikli (2021), Bahmani-Oskooee et al. (2020, 2023), Lee et al. (2022), and Khalid et al. (2023). We assume that REX, our variable of interest, is a random variable and follows an AR (1) process. This implies that the current value of REX is influenced by its previous value, capturing the autocorrelation and temporal dynamics of the ER over time. Symbolically,

$$REX_t = \alpha_0 + \alpha_1 REX_{t-1} + \varepsilon_t \tag{5}$$

In Equation (5), ε_t represents a white noise error term with the properties $E(\varepsilon_t) = 0$ and $\delta^2(\varepsilon_t) = h_t^2$. To predict the variance of REX_t, we can estimate the conditional variance of ε_t as follows:

$$h_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \varepsilon_{t-2}^2 + \cdots + \beta_q \varepsilon_{t-q}^2 + \omega_1 h_{t-1}^2 + \omega_2 h_{t-2}^2 + \cdots + \omega_p h_{t-p}^2 \tag{6}$$

In this study, we utilize the GARCH (*p, q*) model, as depicted in Equation (6), to forecast the conditional variance. Following the detection of an ARCH (autoregressive conditional heteroscedasticity) effect, simultaneous estimation of Equations (5) and (6) was conducted. The determination of the order of the GARCH model in Equation (6) was based on the significance of the parameters β's and ω's. In our study, a GARCH (1,1) model was deemed appropriate. The results obtained from the GARCH (1,1) approach can be found below, along with the corresponding *p*-values indicated in parentheses[65]:

$$REX_t = 0.7871(0.0125) + 0.7544\ (0.0000)\ REX_{t-1} + \varepsilon_t \tag{7}$$

$$\hat{h}_t^2 = 0.0181\ (0.0189) - 0.1754\ (0.0596)\hat{\varepsilon}_{t-1}^2 + 1.1610\ (0.0000)\ \hat{h}_{t-1}^2 \tag{8}$$

6.2.2 Model 2: Modeling the Third-Country Exchange Rate Risk

Recent empirical research has placed significant emphasis on the role of the third-economy effect as a crucial determinant that can exert a significant influence on commodity trade

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[64] The standard deviation method

[65] Refer to Table 34 in Appendix B for further details.

between Turkey and Germany (Bahmani-Oskooee & Xu, 2012; Bahmani-Oskooee et al., 2013, 2016, 2017; Bahmani-Oskooee & Bolhassani, 2014; Bahmani-Oskooee & Aftab, 2018; Abbasi & Iqbal, 2020; Usman et al., 2021; Khalid et al., 2023). The third-economy effect implies that risk-averse traders might redirect their trade flows to a third-economy due to increased exchange rate uncertainty between the bilateral counterparts (Cushman, 1986).

Previous empirical works exploring the influence of the third-economy effect on trade flows have consistently shown that third-economy volatility significantly influences trade flows (Choudhry et al., 2014; Bahmani-Oskooee et al., 2017; Soleymani et al., 2017). Notably, Bahmani-Oskooee and Aftab (2018) found more robust and significant empirical estimates when they incorporated the third-economy risk into their analysis of the relationship between ER uncertainty and trade flows.

This empirical research contributes to the existing empirical literature by examining the influence of lira-euro ER uncertainty on Turkish-German commodity trade while considering the influence of third-country risk (the U.S. dollar). In doing so, we closely follow the research conducted by Cushman (1986), Bahmani-Oskooee et al. (2016, 2017), Usman et al. (2021), and Khalid et al. (2023), which have taken into account the risks associated with third-economy volatility. To capture the third-economy effect, we construct the following export and import demand models:

$$lnXV_{i,t} = \alpha_0 + \alpha_1 DM_t + \alpha_2 lnY_t^{GR} + \alpha_3 lnREX_t + \alpha_4 lnVOL_t^{TRUS} + \varepsilon_t \quad (9)$$

$$lnMV_{i,t} = \beta_0 + \beta_1 DM_t + \beta_2 lnY_t^{TR} + \beta_3 lnREX_t + \beta_4 lnVOL_t^{TRUS} + v_t \quad (10)$$

In Equations (9) and (10), the variable VOL_t^{TRUS} represents the real lira-dollar volatility. This measure positively or negatively influences Turkish-German commodity trade flows, reflecting the potential risks traders face and the extent of substitution between products across borders. Thus, our theoretical expectation is α_4 $(\beta_4) \lesseqgtr 0$[66], indicating that uncertainty in the TL-dollar rate may influence Turkish-German trade flows, but its specific effect could be in either direction. This consideration is essential in understanding the potential role of third-economy ER uncertainty in shaping bilateral trade dynamics between the two countries.

In this study, we adopt a methodology similar to that used by Bahmani-Oskooee and Aftab (2017, 2018) and Khalid et al. (2023) to derive third-economy volatility. We employ the GARCH (1, 1) specification to estimate the conditional variance of the third-economy ER, which captures its time-varying volatility.

[66] The other explained and explanatory variables in Equations (9) and (10) have already been previously defined, therefore, there is no need to redefine them.

$$REX_t = \alpha_0 + \alpha_1 REX_{t-1} + \varepsilon_t \tag{11}$$

In Equation (11), the error term ε_t is assumed to be white noise with the properties $E(\varepsilon_t) = 0$ and $\delta^2(\varepsilon_t) = h_t^2$. To predict the variance of REX_t, we can estimate the conditional variance of ε_t, denoted as h_t^2, using the specifications mentioned below:

$$h_t^2 = \beta_0 + \beta_1 \varepsilon_{t-1}^2 + \beta_2 \varepsilon_{t-2}^2 + \beta_3 \varepsilon_{t-3}^2 + \cdots + \beta_q \varepsilon_{t-q}^2 + \omega_1 h_{t-1}^2 + \omega_2 h_{t-2}^2 + \omega_3 h_{t-3}^2 + \cdots + \omega_p h_{t-p}^2 \tag{12}$$

In this study, we employed the GARCH (*p, q*) model, as described in Equation (12), to forecast the conditional variance. After detecting an ARCH effect, simultaneous estimation of Equations (11) and (12) was performed. The order of the GARCH model in Equation (12) was determined based on the significance of the parameters β*'s* and ω'*s*. As is commonly observed, a GARCH (1,1) specification was found to be appropriate for our study. The outcome of the GARCH (1,1) method is presented as follows[67]:

$$\underset{}{REX_t} = \underset{(0.0150)}{0.6646} + \underset{(0.0000)}{0.7595}\, REX_{t-1} + \varepsilon_t \tag{13}$$

$$\hat{h}_t^2 = \underset{(0.0189)}{0.016015} + \underset{(0.0442)}{0.103758}\, \hat{\varepsilon}_{t-1}^2 + \underset{(0.0000)}{1.036535}\, \hat{h}_{t-1}^2 \tag{14}$$

6.2.3 Model 3: Determination of the Equilibrium Real Exchange Rate Model

Depending on the objective, focus, conceptual framework, empirical methodology, and assumptions, different measures are suggested by researchers to measure the ERER. There are several methods in the literature for measuring the long-run ERER. These measurement methods may be model-independent or model-dependent. All measurement approaches provide different figures for the equilibrium ER, depending on the sample period, econometric methodology, and underlying assumptions about the macroeconomic fundamentals.

There are two main challenges in estimating RER misalignment because ERER is an unobservable and dynamic variable that changes over time as macroeconomic factors change (Alper & Civcir, 2012). The common thread in the empirical literature examining RER misalignments is the estimation of deviations (dispersions) from the ERER using a long-term macroeconomic equilibrium specification (Aguirre & Calderón, 2005; Elbadawi et al., 2012). Hinkle and Montiel (1999) proposed that achieving macroeconomic equilibrium in an economy depends on the sustainability of exogenous and policy variables. In addition, understanding the fundamental macroeconomic variables that impact the ER of a country is of paramount

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[67] Refer to Table 35 in Appendix B for further details.

importance. Policymakers need to comprehend these factors, particularly those affecting the long-term ERER, as previous research conducted by Elbadawi and Helleiner (1998) and Aguirre and Calderón (2005) have argued that maintaining a RER close to its equilibrium level is crucial for sustained economic growth, stability, and external competitiveness.

Numerous studies, such as Baffes et al. (1999), Aguirre and Calderón (2005), Elbadawi et al. (2012), Akram and Rath (2017), Conrad and Jagessar (2018), Mamun et al. (2020), Abbasi and Iqbal (2021), Ali and Aqil (2022), and Iqbal et al. (2023), have also emphasized the significance of modeling the macroeconomic fundamentals to understand Turkey's ERER. To this end, we employ the following single-equation econometric specification:

$$lnRER_t = \beta_0 + \beta_1 lnY_t + \beta_2 lnG_t + \beta_3 lnNFA_t + \beta_4 CRP_t + \beta_5 TOT_t + \beta_6 lnFER_t + \beta_7 lnLP_t + \varepsilon_t \tag{15}$$

In Equation (15), RER is the real exchange rate, Y is real GDP[68] (constant 2009 million TL), *G*[69] is total government consumption expenditure (billion U.S. dollars), *NFA*[70] is net foreign assets (thousand TL), *CRP* is the private sector domestic credit as a percentage of GDP, *TOT* is the terms of trade index (2010=100), *FER* is foreign exchange reserves (million USD), *LP* is labor productivity (U.S. dollars), β_0 is the constant term, β_1- β_7 are the long-run coefficients, the subscript *t* denotes the sample period, and *ε* is the stochastic disturbance term. This equation uses the natural log values of the RER, real GDP, government expenditures, net foreign assets, foreign exchange reserves, and labor productivity. Whereas *CRP* and *TOT* indicate their share in nominal GDP.

Taking 2015=100 as the base year, the RER is measured from the NER, expressed in U.S. dollars per unit of the Turkish lira, and the CPI of Turkey and the United States. Symbolically,

$$RER_t = NER_t * \left(\frac{CPI_t^{TUR}}{CPI_t^{USA}}\right) \tag{16}$$

In Equation (16), RER_t is the real exchange rate, NER_t is the nominal bilateral exchange (USD/1TL), CPI_t^{TUR} is the consumer price index of Turkey, and CPI_t^{USA} is the consumer price index of the United States. According to this expression, when the real exchange rate increases, it signifies an appreciation of the TL relative to the U.S. dollar.

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[68] Output levels exhibit very obvious seasonality in Turkey; therefore, we use seasonally adjusted real GDP.

[69] Government spending includes total government consumption, investment and transfer payments.

[70] We use the net foreign assets of the Central Bank of Turkey (CBRT), which is the difference between foreign assets and liabilities to nonresidents.

To move from a theoretical model to empirical implementation, it is necessary to determine the theoretical relationship between the RER and its associated economic fundamentals. The empirical literature shows that government consumption expenditure affects the ERER in two ways. As Ibrahim (2016) noted, government consumption expenditure depends on the tradable vs. non-tradable commodities composition. The exchange rate will either appreciate (with a positive sign) or depreciate (with a negative sign) if the increased government consumption expenditures are biased towards non-tradable or tradable, respectively (Dağdeviren et al., 2012). Acosta et al. (2009) have argued that when real GDP rises, the RER appreciates; hence, we expect the real GDP coefficient to be positive. The variable foreign exchange reserves are expected to have a positive sign, suggesting that an increase in foreign exchange reserves entails an appreciation of the TL (Habib et al., 2017).

Conrad and Jagessar (2018) found that if the return on foreign assets exceeds the GDP growth rate, a larger net foreign assets position should be associated with a more immense appreciation of the RER in the long-run[71]. Abbasi and Iqbal (2021) and Iqbal et al. (2022) argued that excessive lending to the private sector would boost internal demand for imported commodities, leading to trade and current account deficits. As a result, demand for foreign currency increases, and the domestic currency depreciates; hence, we expect a negative sign for the private sector credit variable. According to the a priori expectation, a higher *TOT* leads to a stronger appreciation of the RER (Elbadawi et al., 2012). The impact of *TOT* depends on how strong the negative S.E is relative to the positive I.E. There is a depreciation of the RER if the I.E dominates the S.E; otherwise, the coefficient is negative, implying an appreciation of the RER (Conrad and Jagessar, 2018). Finally, labour productivity growth leads to a real appreciation of the TL. Hence, $\beta_1,\ \beta_3,\ \beta_4,\ \beta_6,\ \beta_7 > 0$; $\beta_2,\ \beta_5 \lesseqgtr 0$.

6.2.4 Model 4: Determination of the Real Exchange Rate Misalignment

In our research, we derive the real exchange rate misalignment (*RERMIS*) by calculating the difference between the natural logarithm of the observed RER and the natural logarithm of the estimated ERER. This approach is supported by Aguirre and Calderón (2005), Elbadawi et al. (2012), and Conrad and Jagessar (2018), which emphasizes the use of permanent components of fundamental macroeconomic factors to compute the ERER. To obtain the ERER, we multiply the long-run coefficients derived from Equation (34) by the permanent or sustainable values of the fundamental factors. The permanent values of time series data can be determined

[71] The expected sign of net foreign assets is not predicted or unclear (Alper & Civcir, 2012).

using two standard methods in the empirical literature. The first method is the Beveridge-Nelson (1981) decomposition approach, and the second method is the Hodrick-Prescott (H-P) Filter (1997) technique. These methodologies enable us to estimate the ERER and understand the degree of real exchange rate misalignment, which has important implications for assessing a country's economic stability and competitiveness.

In this research, we adopt the Hodrick-Prescott (H-P) filtering technique to estimate the permanent components of fundamental macroeconomic factors. This approach has been previously utilized by Alberola (2003)[72] and Edwards (1989). As emphasized by Elbadawi et al. (2012) and Mamun et al. (2020), these permanent components are considered sustainable levels, aligning with the concept of equilibrium in the context of the ER analysis. The H-P filtering method is a widely employed detrending or data-smoothing procedure in empirical macroeconomic analysis. It has been extensively used to identify the permanent component of various time series in previous studies, including Berument & Pasaogullari (2003), Akram & Rath (2017), Conrad & Jagessar (2018), Mamun et al. (2020), Abbasi (2021), Abbasi & Iqbal (2021), and Iqbal et al. (2023).

The actual economic time series (Y_t) is decomposed into a trend component (T_t) and a cyclical component (C_t)[73]. Symbolically,

$$Y_t = T_t + C_t \tag{17}$$

It is necessary to eliminate the short-term fluctuations associated with the business cycle to arrive at the sustainable values of the fundamentals. Therefore, the cyclical component (C_t) can be obtained by subtracting the trend (T_t) series from the actual series (Y_t) as follows:

$$C_t = Y_t - T_t \tag{18}$$

The H-P filter technique is a two-sided linear filtering technique that computes the smoothed series 'T_t' of a given time series 'Y_t'. This filter aims to find the trend component that represents the underlying long-term movements in the data. This is achieved by minimizing the variance of the original time series 'Y_t' around the smoothed series 'T_t' while also imposing a penalty to control the smoothness of the trend. The penalty term constrains the second difference of 'T_t' making it a smoother representation of the data.

[72] To estimate the long-run/permanent component of the RER series, we have chosen the smoothing parameter (λ) value as 1600.

[73] The trend components may not be stationary (may contain a stochastic or deterministic trend), but the cyclical component is stationary.

In essence, the H-P filter seeks to separate the short-term fluctuations, considered as noise or transitory movements, from the long-term trend, representing the permanent or sustainable component of the time series. By minimizing the loss function through this filtering process, the H-P method effectively identifies the underlying trend, providing a clearer perspective on the permanent behavior of the data and enabling a more in-depth analysis of macroeconomic factors such as those related to the ERER in our analysis. This detrending method isolates the trend component by minimizing the following loss function:

$$min_{T_t}[\sum_{t=1}^{T}(Y_t - T_t)^2 + \lambda \sum_{t=2}^{T-1}\{(T_{t+1} - T_t) - (T_t - T_{t-1})\}^2] \tag{19}$$

In Equation (19), the smoothing parameter (λ) is a critical component that plays a central role in achieving the trend component smoothing *(T_t)*. This parameter must tak positive values (i.e., $\lambda > 0$). Its significance is ensuring an effective and accurate extraction of the underlying trend from the original time series data. The smoothing parameter (λ) value determines the volatility level in the trend component. As the value of λ increases, the trend becomes smoother, and the fluctuations in the trend are reduced. Conversely, as λ approaches infinity, the trend series (T_t) gradually approaches a linear trend, with minimal deviations from a straight line.

Once we estimate the ERER, we can efficiently compute the real exchange rate misalignment as follows:

$$RERMIS_t = lnRER_t - ln\widehat{ERER}_t \tag{20}$$

In Equation (20), $ln\widehat{ERER}_t$ represents the predicted or estimated ERER, $lnRER_t$ represents the actual/observed RER, and $RERMIS_t$ represents the degree of currency misalignment. The TL is overvalued (undervalued) if the values of the exchange rate misalignment are positive (negative).

6.2.5 H-P Filter vs. Hamilton Filter: The Comparative Analysis

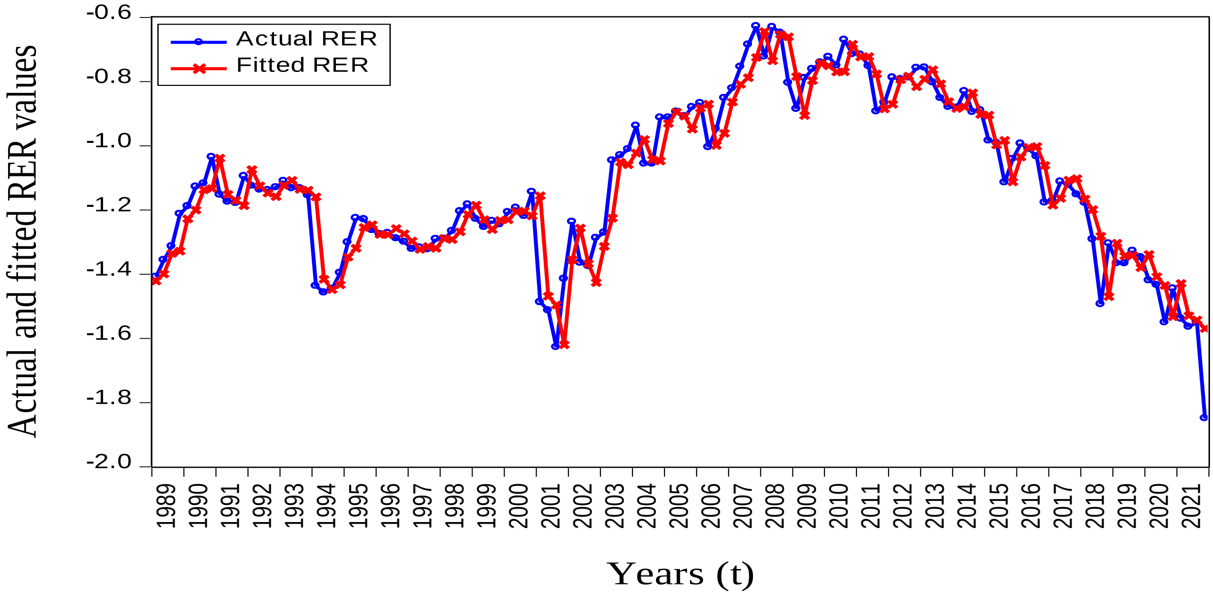
Several researchers have criticized using the H-P filter procedure to estimate deviations from the long-term equilibrium value. Hamilton (2018) claims that the H-P filter procedure produces spurious dynamics. Moreover, this technique generates filtered values with properties that differ between the sample's middle and ends. Finally, the conventional implementation of H-P filtering contradicts its statistical foundations. Consequently, Hamilton argues that the H-P filtering technique is inappropriate for calculating the *RERMIS* and decomposing other economic time series. In calculating deviations from equilibrium values, Hamilton suggested using linear projections. The regression filter suggested by Hamilton can address the drawbacks found in the H-P filter, such as end-of-sample bias, spurious cycles, and ad hoc assumptions for parameter smoothing. Therefore, the current study considers two commonly used detrending approaches for extracting cyclical fluctuations: deterministic and stochastic. In this study, we investigate whether the Hamiltonian regression filter changes the cyclical components of the H-P filter-derived RER.

The graphical illustration of the H-P filter depicts that the trend line is a cyclical curve, consistent with stochastic short-term oscillations. This non-linear trend will likely persist over extended periods and indicates major structural, technological, and economic shocks. Moreover, the shape of the trend line relies on λ. Suppose λ is too small, the tendency of the trend line to be linear. Also, selecting the appropriate value of λ is more arbitrary than the theoretical justification. In addition, this method presumes that deviations from the equilibrium position are temporary and can be quickly reversed. In particular, the H-P filter method assumes that a prolonged decline below an equilibrium exchange rate cannot occur; however, a prolonged decline is considered a decline in the ERER. In Figure 17, the Hamilton trend line represents the dynamics of the RER series and best fits the data. However, this outcome is consistent with the trend line of the H-P filter displayed in Figure 19.

Hamilton suggested focusing on a regression filter to address the drawbacks of the H-P filter mentioned earlier. Figures 17 and 18 show that using the trend and cyclical components of the Hamilton regression filter results in higher cyclical volatility than the H-P filter. This outcome is because the two-year Hamilton filter emphasizes frequencies larger than the typical frequencies of a business cycle and smooths the oscillations in about two years; however, it does not capture all the business cycle phases classified by Jordà et al. (2020).

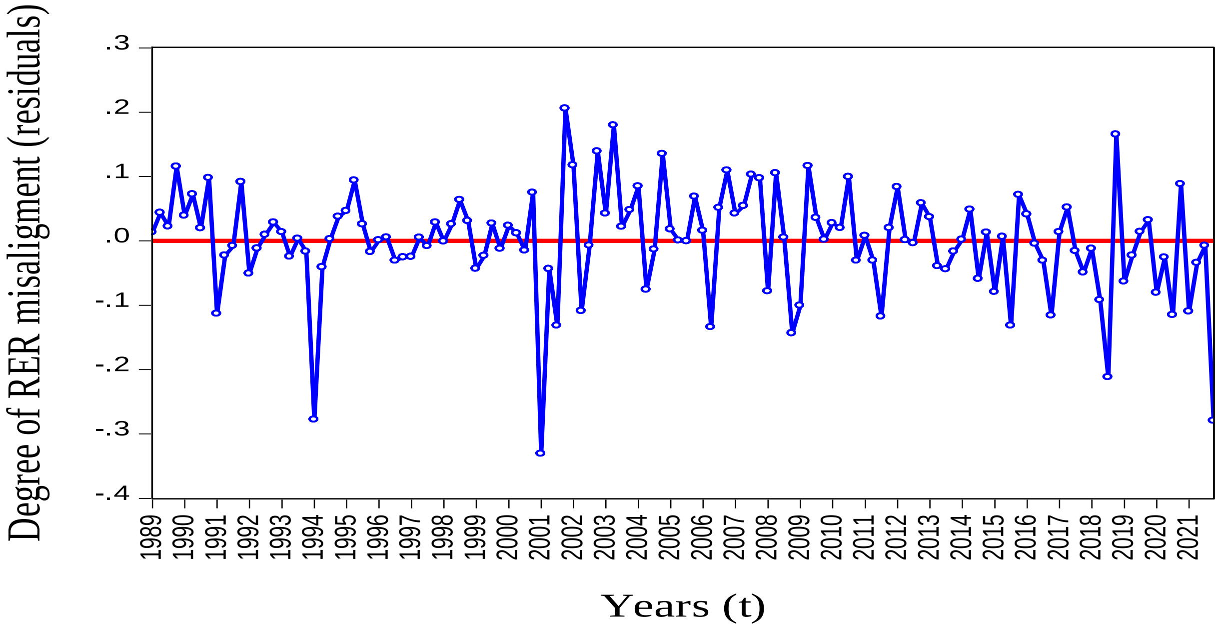
In particular, the two-year cycles of the Hamiltonian regression filter last longer than the cycles of the H-P filter because the trend-reduced series of the two-year regression filter has higher volatility. However, the RER phases are mainly determined by medium-term cycles. Since λ affects the volatility trend of the H-P process, it is challenging to predict the cycle and the trend separately. Hence, the comparative analysis of the two detrending strategies shows that the Hamilton filter performs more effectively than the H-P procedure and has a sound theoretical basis. As a result, Hodrick (2020) examines whether the Hamilton approach is superior to the H-P approach in removing the cyclical counterpart of simulated time series calibrated to mimic real U.S. GDP. Hodrick concludes that the H-P filter is more effective at isolating the cyclical component than the Hamilton filter for the growth-cyclical time series. In this research, we utilize the H-P procedure to estimate currency misalignment associated with the Turkish lira's appreciation and depreciation.

Figure 17. Hamilton Filter (Actual RER and Fitted RER) over the Period 1989Q1-2021Q4



Source: Data processed by the author using EViews 12 (2023)

Figure 18. RER Misalignment Calculated Using the Hamilton-based Filter, 1989Q1-2021Q4



Source: Data processed by the author using EViews 12 (2023)

6.2.6 Model 5: Estimation of the Effect of Misalignment on Growth

To investigate the influence of currency misalignment on Turkey's economic growth, we adopt an approach similar to previous empirical studies conducted by various researchers, including Razin and Collins (1997), Aguirre and Calderón (2005), Elbadawi et al. (2012), Couharde and Sallenave (2013), Habib et al. (2017), Conrad and Jagessar (2018), Abbasi (2021), Abbasi and

Iqbal (2021), and Iqbal et al. (2023). Accordingly, we specify the economic growth equation as follows:

$$Y_{g_t} = \alpha_0 + \alpha_1 D94_t + \alpha_2 RERMIS_t + \alpha_3 SAV_t + \alpha_4 TOT_t + \alpha_5 CRP_t + \alpha_6 lnFER_t + \alpha_7 INF_t + \alpha_8 lnGED_t + \varepsilon_t \quad (21)$$

In Equation (21), Y_g is the real GDP growth rate (2009=100), $RERMIS$ is the RER misalignment, SAV is the gross saving rate, *TOT* is the terms of trade, *CRP*[74] is the credit to the private sector (million U.S. dollar), *FER* is the foreign exchange reserves, *INF* is the rate of inflation, *GED* is the gross external debt (million U.S. dollar), α_0 is the intercept, α_2-α_8 represent the long-run coefficients to be determined, and ε is the error term. In this equation, the log values of *FER* and *GED* are considered, while Y_g, *SAV*, *TOT*, *CRP*, and *INF* indicate their shares of GDP. In addition, we incorporate a dummy variable (*D94*) to capture the impact of the 1994 crisis on economic growth. This dummy variable takes the value one in the defined quarter (*1994Q3= 1*) and zero otherwise. The coefficient for exchange rate misalignment is expected to be negative based on the Washington Consensus (Williamson, 1990). Theoretically, the expected signs of the growth determinants are: $\alpha_1,\ \alpha_2\ ,\ \alpha_7 < 0, \alpha_3,\ \alpha_4,\ \alpha_5,\ \alpha_6 > 0,\ \alpha_8 \lesseqgtr 0$.

6.3 Empirical Methodology

This empirical study explores the symmetric and asymmetric influences of bilateral RER uncertainty and third-country risk on commodity trade volumes between Germany and Turkey. Additionally, the research investigates the symmetric and asymmetric effects of RER misalignment on Turkey's EG. To achieve these objectives, we utilize the symmetric/linear ARDL method developed by Pesaran et al. (2001) and the asymmetric/nonlinear ARDL methodology developed by Shin et al. (2014). These estimation techniques suit stationary *I(0)* and nonstationary *I(1)* variables.

Based on the existing empirical research, it is suggested that the RER volatility and RER misalignment variables exhibit stationarity at the level or *I(0)*. However, other time series variables considered in this study, such as real exports, real imports, real income, real foreign income, and relative prices, are considered nonstationary at the level or *I(1)*.

[74] It is used as an indicator (a proxy variable) of financial development.

6.3.1 The ARDL Methodology

Before introducing the ARDL model, economists commonly relied on the vector autoregressive model (VAR) and the vector error correction model (VECM) to analyze the relationships among various macroeconomic variables. These econometric models assumed that all economic variables possessed the same order of integration, i.e., they were either stationary *I(0)* or nonstationary *I(1)*.

However, economic variables often display different integration properties in practice, some being stationary *I(0)* and others being nonstationary *I(1)*. This discrepancy in integration properties created challenges when applying VAR and VECM, as these models required uniform integration orders for all variables. To address this limitation and accommodate mixed integration orders, the ARDL model was developed. Unlike VAR and VECM, the ARDL model can handle situations where some variables are stationary while others are nonstationary, making it a valuable econometric tool in economic analysis.

The advantage of the ARDL model becomes particularly evident when dealing with real-world empirical macroeconomic data that may exhibit different integration properties, including stationary *I(0)* and nonstationary variables *I(1)*. By accommodating these diverse integration orders, the ARDL models give researchers a more accurate representation of the econometric relationships. Another significant benefit of using the ARDL model is its ability to address the issue of autocorrelated errors that can arise in the finite distributed lag model (Hill et al., 2008). Autocorrelated errors can lead to biased and inconsistent parameter estimates, compromising the reliability of the model's results. By adopting the ARDL framework, researchers can effectively tackle this problem and obtain more reliable and robust empirical estimates (Pesaran et al., 2001).

In the ARDL model, determining the optimal lag length is critical. This can be achieved by applying the minimum (AIC) and Schwartz Information Criterion (SIC). These help researchers identify the most appropriate lag length that minimizes the risk of overfitting and ensures the model's generalizability.

In recent years, the ARDL models gained renewed interest in empirical studies as a method for examining cointegrating relationships between *I(0)* and *I(1)* variables (Pesaran and Shin, 1998; Pesaran et al., 2001). The general representation of the ARDL model (p,q) can be structured as below:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \cdots + \beta_p Y_{t-p} + \delta_1 X_t + \delta_2 X_{t-1} + \delta_3 X_{t-2} + \cdots + \delta_q X_{t-q} + \varepsilon_t \qquad (22)$$

In compact form, the general ARDL (*p,q*) model represented in Equation (22) can be rewritten as follows:

$$Y_t = \beta_0 + \sum_{i=1}^{p} \beta_i Y_{t-i} + \sum_{i=0}^{q} \delta_i X_{t-i} + \varepsilon_t \tag{23}$$

The ARDL bounds test model can be expressed as below:

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{p} \lambda_i \Delta Y_{t-i} + \sum_{i=0}^{q} \delta_i \Delta X_{t-i} + \varphi_1 Y_{t-1} + \varphi_2 X_{t-1} + \nu_t \tag{24}$$

In conducting the ARDL bounds test, the econometric model is estimated using the ordinary least squares (OLS) method. The estimated coefficients obtained from the OLS regression are then utilized to examine a long-term connection between the investigated variables. To achieve this, we calculate the F-statistic based on the Wald test and evaluate the joint significance of the lagged variables. The critical values associated with the F-statistic are contingent on the sample size and the number of variables considered in the analysis. These critical values play a crucial role in determining the presence or absence of cointegration. If the calculated F-statistic surpasses the upper critical bound, it suggests a long-term relationship, indicating cointegration between the explanatory variables. On the contrary, if the calculated F-statistic falls below the lower critical value, it indicates no cointegration[75] among the variables.

The ARDL bounds test model tests for the long-term connection (cointegration) between variables, while the error correction representation focuses on the short-term dynamics and the adjustment process toward the long-run equilibrium. It captures the speed of adjustment of variables towards their long-term equilibrium relationship. In a cointegrated system, deviations from the long-term equilibrium (residuals) tend to be corrected in subsequent periods. The error correction term captures this adjustment, typically included in the model. The error correction term, often denoted as ECT_{t-1} captures the disequilibrium or deviations from the long-term equilibrium in the previous period and is included as an additional explanatory variable in the specification. The *ECT* coefficient indicates the speed of adjustment, with a negative coefficient suggesting that deviations from equilibrium are corrected over time.

If we replace the long-run component (i.e., $\varphi_1 Y_{t-1} + \varphi_2 X_{t-1}$) with lagged residuals (Z_{t-1}) in the ARDL (*p,q*) model, the long-term ARDL specification reverts to the error correction model (*ECM*) as shown in Equation (25):

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[75] The null hypothesis can be written as: H_0: $\lambda_1 = \lambda_2 = 0$, indicating the non-existence of a stable long-term association among explanatory variables. On the other hand, the alternative hypothesis can be written as: H_1: $\lambda_1 \neq \lambda_2 \neq 0$, indicating the existence of a long-term association among explanatory variables.

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{p} \lambda_i \, \Delta Y_{t-i} + \sum_{i=0}^{q} \delta_i \, \Delta X_{t-i} + \varphi Z_{t-1} + \nu_t \quad (25)^{76}$$

In such cases, ARDL models may be viewed as a form of unrestricted *ECM* model because all the long-run relationship variables (i.e., the X_{it-1}) are specified and not restricted.

6.3.1.1 Model 1: Estimation of the Bilateral Export and Import Flows Models – The Symmetric Analysis. The traditional ARDL export and import specifications presented in Equations (1) and (2) are considered long-run specifications and unsuitable for estimating the short-term effects. To overcome this limitation, we must transform Equations (1) and (2) into an error-correction representation, which helps us examine the explanatory variables' short-term effects on commodity trade flows. To achieve this, we adopt the methodology proposed by Pesaran and Shin (1999) and Pesaran et al. (2001), which involves constructing error correction models, as depicted in Equations (26) and (27):

$$\Delta lnXV_{i,t} = \alpha_0 + \alpha_1 DM_t + \sum_{j=1}^{n_1} \alpha_{2i} \Delta lnXV_{t-j} + \sum_{j=0}^{n_2} \alpha_{3i} \Delta lnY_{t-j}^{GR} + \sum_{j=0}^{n_3} \alpha_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \alpha_{5i} \Delta lnVOL_{t-j}^{TRGR} + \theta_1 lnXV_{t-1} + \theta_2 lnY_{t-1}^{GR} + \theta_3 lnREX_{t-1} + \theta_4 lnVOL_{t-1}^{TRGR} + \varepsilon_t \quad (26)$$

$$\Delta lnMV_{i,t} = \beta_0 + \beta_1 DM_t + \sum_{j=1}^{n_1} \beta_{2i} \Delta lnMV_{t-j} + \sum_{j=0}^{n_2} \beta_{3i} \Delta lnY_{t-j}^{TR} + \sum_{j=0}^{n_3} \beta_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \beta_{5i} \Delta lnVOL_{t-j}^{TRGR} + \rho_1 lnMV_{t-1} + \rho_2 lnY_{t-1}^{TR} + \rho_3 lnREX_{t-1} + \rho_4 lnVOL_{t-1}^{TRGR} + \varepsilon_t{}' \quad (27)$$

The error-correction models described by Equations (26) and (27) are designed to capture both short-term and long-term effects of explanatory variables on export and import flows, respectively. The first-differenced variables represent the short-term effects, while the long-term effects are estimated through the normalized coefficient estimates, denoted as $\theta_2 - \theta_4$on $\theta_1$in Equation (26) and $\rho_2 - \rho_4$ on ρ_1 in Equation (27)). In our study, we utilize these linear ARDL models to assess the symmetric influence of bilateral ER uncertainty on trade volumes between the two countries.

The linear ARDL methodology offers several advantages over other alternative estimation methodologies, particularly in obtaining unbiased estimation results for small samples, as in our case. This method enables simultaneous estimation of short-term and long-term estimates by utilizing a single-equation model. Additionally, economic variables with mixed integration orders [*I(0)* and *I(1)*] can be considered, but none of the variables should have an order of integration *I(2).* Bahmani-Oskooee et al. (2020) demonstrate that the mixed integration properties of variables do not affect the empirical estimates of the ARDL approach, irrespective of whether the variables in question are *I(0)* or *I(1).*

[76] $ECT_{t-1} = U_{t-1} = Y_{t-1} - \alpha - \beta X_{t-1}$

After estimating the ARDL models presented in Equations (26) and (27) using the OLS method, we test the cointegrating association among the long-run variables by formulating the null hypotheses, such as $H_0: \theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ in Equation (26) and $H_0: \rho_1 = \rho_2 = \rho_3 = \rho_4 = 0$ in Equation (27) against their alternative hypotheses, such as $H_1: \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq 0$ in Equation (26) and $H_1: \rho_1 \neq \rho_2 \neq \rho_3 \neq \rho_4 \neq 0$ in Equation (27), using the Wald test. To confirm the co-integrating relationship among these explanatory variables, we replace the lagged-level variables in Equations (26) and (27) with the lagged values of the error correction terms (*ECTs*). We then re-estimate Equations (26) and (27) and test the statistical significance of the *ECT* (or *ECM*) using Equations (28) and (29). Suppose the ECT is statistically significant at a particular significance level, and the coefficient has a negative sign. This guarantees that the short-run coefficients are stable and that the variables adjust to long-term equilibrium. Thus, the short-run link can be derived from the error correction models, as specified in Equations (28) and (29), as follows:

$$\Delta lnXV_{i,t} = \alpha_0 + \alpha_1 DM_t + \sum_{j=1}^{n_1} \alpha_{2i} \Delta lnXV_{t-j} + \sum_{j=0}^{n_2} \alpha_{3i} \Delta lnY_{t-j}^{GR} + \sum_{j=0}^{n_3} \alpha_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \alpha_{5i} \Delta lnVOL_{t-j}^{TRGR} + \psi ECT_{t-1} + \varepsilon_t \quad (28)$$

$$\Delta lnMV_{i,t} = \beta_0 + \beta_1 DM_t + \sum_{j=1}^{n_1} \beta_{2i} \Delta lnMV_{t-j} + \sum_{j=0}^{n_2} \beta_{3i} \Delta lnY_{t-j}^{TR} + \sum_{j=0}^{n_3} \beta_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \beta_{5i} \Delta lnVOL_{t-j}^{TRGR} + \psi ECT_{t-1} + \varepsilon_t' \quad (29)$$

We can perform *OLS* estimation to analyze these error correction models, where the optimal lag length[77] in these models is selected based on the lowest *AIC* and *SIC* values.

6.3.1.2 Model 2: Estimation of the Third-Country Volatility Risk – The Symmetric Analysis. One of the primary objectives of this empirical research is to analyze the symmetric influence of third-country uncertainty on bilateral commodity trade flows between Turkey and Germany; certain modifications are made to the export and import demand functions, as presented in Equations (9) and (10). As previously mentioned, conventional ARDL models specified in Equations (9) and (10) are unsuitable for assessing the short-term effects of the variables under consideration. To address this concern, we transform Equations (9) and (10) into error-correction models to estimate the short-term influences of examined variables on trade volumes. In line with this methodology, we follow the studies of Pesaran and Shin (1999) and Pesaran et al. (2001) and employ the error-correction models described in Equations (30) and (31), which are presented below:

[77] In these *ECM* frameworks, $n_1, \ldots, n_4$ represents the number of lags.

$$\Delta lnXV_{i,t} = \alpha_0 + \alpha_1 DM_t + \sum_{j=1}^{n_1} \alpha_{2i} \Delta lnXV_{t-j} + \sum_{j=0}^{n_2} \alpha_{3i} \Delta lnY_{t-j}^{GR} + \sum_{j=0}^{n_3} \alpha_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \alpha_{5i} \Delta lnVOL_{t-j}^{TRUS} + \theta_1 lnXV_{t-1} + \theta_2 lnY_{t-1}^{GR} + \theta_3 lnREX_{t-1} + \theta_4 lnVOL_{t-1}^{TRUS} + \varepsilon_t \quad (30)$$

$$\Delta lnMV_{i,t} = \beta_0 + \beta_1 DM_t + \sum_{j=1}^{n_1} \beta_{2i} \Delta lnMV_{t-j} + \sum_{j=0}^{n_2} \beta_{3i} \Delta lnY_{t-j}^{TR} + \sum_{j=0}^{n_3} \beta_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \beta_{5i} \Delta lnVOL_{t-j}^{TRUS} + \rho_1 lnMV_{t-1} + \rho_2 lnY_{t-1}^{TR} + \rho_3 lnREX_{t-1} + \rho_4 lnVOL_{t-1}^{TRUS} + \varepsilon_t' \quad (31)$$

These *ECM* representations can capture the short-term influences of explanatory variables on trade volumes through the first-differenced variables. Meanwhile, the long-term influences of explanatory variables are estimated through the normalized coefficients, denoted as $\theta_2 - \theta_4$on $\theta_1$in Equation (30) and $\rho_2 - \rho_4$ on ρ_1 in Equation (31). For example, in Equation (30), the short-term influence of lira-dollar exchange rate volatility on real export flows is represented by the coefficient of α_{5i}. Similarly, in Equation (31), the short-run effect on real import flows is captured by the coefficient β_{5i}. The econometric specifications outlined in Equations (30) and (31) are called symmetric/linear ARDL models.

The ARDL methodology offers several notable advantages compared to alternative estimation approaches[78] like the Engle-Granger (1987) methodology and the Johansen-Jeselius (1990) methodology. One significant advantage of the ARDL approach is its ability to provide unbiased estimations even with small sample sizes. Moreover, it allows for the simultaneous estimation of short-term and long-term coefficients within a single-equation, making it a convenient and efficient modeling technique. Another strength of the ARDL methodology is its flexibility in handling mixed orders of integration, specifically considering variables with different integration levels (*I(0)* and *I(1)*). Nevertheless, the validity of the long-run estimates must be supported by cointegration. Cointegration ensures a stable long-term relationship between the variables, which is essential for interpreting and drawing meaningful conclusions from the estimated coefficients. This highlights the significance of testing for cointegration before conducting an ARDL analysis.

Pesaran et al. (2001) introduced the ARDL bounds test, the *F*-test, to examine cointegration among explanatory variables. This statistical test determines critical values for the *F*-test, utilizing findings from both Pesaran et al. (2001) and Narayan (2005) for large and small sample sizes, respectively, at significance levels of 1%, 5%, and 10%. The test incorporates multiple exogenous variables (*k*) and establishes upper and lower critical bounds. To interpret the results, if the computed *F*-statistic exceeds the critical upper bound, the null

[78] It is a bound test procedure that is easy to follow and implement.

hypothesis (which implies no cointegration) is rejected, suggesting the presence of cointegration among the variables and vice versa.

Pesaran et al. (2001) outlined that when the Wald or *F*-statistic falls within the critical bounds, it leads to an inconclusive outcome. To reach definitive conclusions, it is essential to determine the integration order of the given variables. Specifically, if all the variables are non-stationary *I(1),* but their first differences are stationary, the decision can be taken based on the upper critical bound. On the other hand, if the variables are *I(0)*, indicating they are stationary, then the decision can be made based on the lower critical bound.

After estimating the ARDL models [(30) and (31)] using the *OLS* technique, we test the cointegrating relationship among the variables, such as $H_0: \theta_1 = \theta_2 = \theta_3 = \theta_4 = 0$ in Equation (30) and $H_0: \rho_1 = \rho_2 = \rho_3 = \rho_4 = 0$ in Equation (31) against their alternative hypotheses, such as $H_1: \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq 0$ in Equation (30) and $H_1: \rho_1 \neq \rho_2 \neq \rho_3 \neq \rho_4 \neq 0$ in Equation (31). These hypotheses have been tested using the Wald test. To validate the presence of cointegration among variables, we replace the lagged-level variables in Equations (30) and (31) with the lagged values of the error correction terms. We then re-estimate Equations (30) and (31) and test the statistical significance of the *ECT* using Equations (32) and (33). Suppose the *ECT* is statistically significant at a particular significance level, and the coefficient has a negative sign. In that case, this guarantees that the short-term estimates are stable and that the variables adjust to equilibrium in the long-term. Thus, the short-term association can be derived from the error correction models, as specified in Equations (32) and (33), as follows:

$$\Delta lnXV_{i,t} = \alpha_0 + \alpha_1 DM_t + \sum_{j=1}^{n_1} \alpha_{2i} \Delta lnXV_{t-j} + \sum_{j=0}^{n_2} \alpha_{3i} \Delta lnY_{t-j}^{GR} + \sum_{j=0}^{n_3} \alpha_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \alpha_{5i} \Delta lnVOL_{t-j}^{TRUS} + \psi ECT_{t-1} + \varepsilon_t \quad (32)$$

$$\Delta lnMV_{i,t} = \beta_0 + \beta_1 DM_t + \sum_{j=1}^{n_1} \beta_{2i} \Delta lnMV_{t-j} + \sum_{j=0}^{n_2} \beta_{3i} \Delta lnY_{t-j}^{TR} + \sum_{j=0}^{n_3} \beta_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \beta_{5i} \Delta lnVOL_{t-j}^{TRUS} + \psi ECT_{t-1} + \varepsilon_t' \quad (33)$$

We can perform *OLS* estimation to analyze these error correction models, where the optimal lag length[79] in these models is selected based on the lowest *AIC* and *SIC* values.

6.3.1.3 Model 3: Estimation of the ERER Model. One of the primary purposes of this empirical research is to explore the symmetric impact of currency misalignment on Turkey's economic growth. However, we can only achieve this target once we estimate Turkey's equilibrium real exchange rate. Considering the cointegration approach, we utilize the ARDL

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[79] In these *ECM* models, $n_1, \dots, n_4$ represents the number of lags.

methodology to estimate the ERER. This cointegration approach has several advantages over alternative estimation methods: it is desirable to obtain unbiased results in small samples; to obtain short and long-run coefficients simultaneously, we need to estimate a single equation; and we can consider variables with mixed orders of integration, but none of the variables should have *I(2)* orders (Pesaran et al., 2001; Sami & Kreishan, 2012; Akram & Rath, 2017; Conrad & Jagessar, 2018; Iqbal et al., 2022).

Since the traditional ARDL model shown in Equation (15) is known to be a long-term equilibrium specification, it can't be employed to evaluate the short-term dynamics of macroeconomic fundamentals on the real exchange rate. Therefore, a standard approach is to convert Equation (15) into an *ECM* representation to estimate the short-term dynamics of fundamental factors on the real exchange rate. For this reason, we follow Pesaran et al. (2001) and construct the *ECM* specification outlined in Equation (34) as follows:

$$\Delta lnRER_t = \beta_0 + \sum_{j=1}^{n_1} \beta_1 \, lnRER_{t-j} + \sum_{j=0}^{n_2} \beta_2 lnY_{t-j} + \sum_{j=0}^{n_3} \beta_3 lnG_{t-j} + \sum_{j=0}^{n_4} \beta_4 lnNFA_{t-j} + \sum_{j=0}^{n_5} \beta_5 CRP_{t-j} + \sum_{j=0}^{n_6} \beta_6 TOT_{t-j} + \sum_{j=0}^{n_7} \beta_7 lnFER_{t-j} + \sum_{j=0}^{n_8} \beta_8 lnLP_{t-j} + \gamma_1 lnRER_{t-1} + \gamma_2 lnY_{t-1} + \gamma_3 lnG_{t-1} + \gamma_4 lnNFA_{t-1} + \gamma_5 CRP_{t-1} + \gamma_6 TOT_{t-1} + \gamma_7 lnFER_{t-1} + \gamma_8 lnLP_{t-1} + \mu_t \quad (34)$$

In Equation (34), the symbol Δ denotes the difference operator, β_0 denotes the constant term, μ denotes the stochastic disturbance term, and n_1-n_8 denotes the appropriate lag length considered utilizing the *AIC* and *SIC* criteria. In this linear ARDL framework, the short-term coefficients ($\beta_1 - \beta_8$) are derived through the first-differenced variables, while the normalized coefficient estimates are used to determine the long-run effects ($\gamma_2 - \gamma_8$ on γ_1).

The ARDL *F*-bounds test is employed to establish cointegration between macroeconomic fundamentals, which is crucial for ensuring the validity of long-term estimates. Narayan (2005) and Pesaran et al. (2001) have calculated critical *F*-test values for small and large samples, respectively. When the estimated *F*-statistic surpasses the critical upper bound, the null hypothesis (i.e., no cointegration) is rejected[80], and vice versa. However, if the calculated *F*-statistic falls within the range of critical bounds, the decision regarding cointegration remains indeterminate. Building on the previously mentioned explanation, the *ECM* can be expressed in Equation (35) as follows:

[80] $H_0: \gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = \gamma_6 = \gamma_7 = \gamma_8 = 0$ (No cointegration)

$H_1: \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq \gamma_6 \neq \gamma_7 \neq \gamma_8 \neq 0$ (Cointegration)

$$\Delta lnRER_t = \beta_0 + \sum_{j=1}^{n_1} \beta_1 \, lnRER_{t-j} + \sum_{j=0}^{n_2} \beta_2 lnY_{t-j} + \sum_{j=0}^{n_3} \beta_3 lnG_{t-j} + \sum_{j=0}^{n_4} \beta_4 lnNFA_{t-j} + \sum_{j=0}^{n_5} \beta_5 CRP_{t-j} + \sum_{j=0}^{n_6} \beta_6 TOT_{t-j} + \sum_{j=0}^{n_7} \beta_7 lnFER_{t-j} + \sum_{j=0}^{n_8} \beta_8 lnLP_{t-j} + \psi ECT_{t-1} + \mu_t \quad (35)$$

6.3.1.4 Model 4: Measurement of the RER Misalignment. After estimating Equation (34), the currency misalignment (*RERMIS*) can be computed as follows:

$$RERMIS_t = lnRER_t - ln\widehat{ERER}_t \quad (36)$$[81]

The TL is overvalued (undervalued) if the real exchange rate misalignment values are positive (negative).

6.3.1.5 Model 5: Estimation of the Economic Growth Model – Symmetric Analysis. The primary focus of this empirical investigation is to analyze the symmetric influence of RER misalignment on Turkey's economic growth. However, it is essential to note that the ARDL model presented by Equation (21) is primarily a long-term model and may not be suitable for evaluating the short-term effects of macroeconomic variables on economic growth. For this purpose, we convert the long-run ARDL model into an ECM format to estimate the short-term dynamics of macroeconomic variables on economic growth. Following Pesaran et al. (2001), we construct the ECM as mentioned below:

$$\Delta Y_{g_t} = \alpha_0 + \alpha_1 D94_t + \sum_{j=1}^{m_1} \alpha_2 \, \Delta Y_{g_{t-j}} + \sum_{j=0}^{m_2} \alpha_3 \Delta RERMIS_{t-j} + \sum_{j=0}^{m_3} \alpha_4 \Delta SAV_{t-j} + \sum_{j=0}^{m_4} \alpha_5 \Delta TOT_{t-j} + \sum_{j=0}^{m_5} \alpha_6 \Delta CRP_{t-j} + \sum_{j=0}^{m_6} \alpha_7 \Delta lnFER_{t-j} + \sum_{j=0}^{m_7} \alpha_8 \Delta INF_{t-j} + \sum_{j=0}^{m_8} \alpha_9 \Delta lnGED_{t-j} + \omega_1 Y_{g_{t-1}} + \omega_2 RERMIS_{t-1} + \omega_3 SAV_{t-1} + \omega_4 TOT_{t-1} + \omega_5 CRP_{t-1} + \omega_6 lnFER_{t-1} + \omega_7 INF_{t-1} + \omega_8 lnGED_{t-1} + e_t \quad (37)$$

In Equation (37), the symbol Δ denotes the difference operator, α_0 denotes the constant term, e denotes the stochastic disturbance term, and m_1-m_8 denotes the suitable lags considered utilizing the *AIC* and *SIC* criteria. Within the linear ARDL model, the short-run effects ($\alpha_2 - \alpha_9$) are determined by estimating the first-differenced variables, whereas the normalized coefficients are utilized to assess the long-run effects ($\omega_2 - \omega_8$ on ω_1).

The ARDL *F*-bounds test serves as a method to determine cointegration among growth determinants. Narayan (2005) and Pesaran et al. (2001) have computed critical *F*-test values for small and large sample sizes, respectively. These critical bounds cover a range of values based on a specified significance level and the number of exogenous variables denoted as *k*. If

[81] Equation (20) reflects the same idea.

the estimated F-statistic surpasses the critical upper bound, the null hypothesis (i.e., no cointegration) is rejected[82], and vice versa. The ECM model for the growth equation can be specified as follows:

$$\Delta Y_{g_t} = \alpha_0 + \alpha_1 D94_t + \sum_{j=1}^{m_1} \alpha_2 \Delta Y_{g_{t-j}} + \sum_{j=0}^{m_2} \alpha_3 \Delta RERMIS_{t-j} + \sum_{j=0}^{m_3} \alpha_4 \Delta SAV_{t-j} + \sum_{j=0}^{m_4} \alpha_5 \Delta TOT_{t-j} + \sum_{j=0}^{m_5} \alpha_6 \Delta CRP_{t-j} + \sum_{j=0}^{m_6} \alpha_7 \Delta lnFER_{t-j} + \sum_{j=0}^{m_7} \alpha_8 \Delta INF_{t-j} + \sum_{j=0}^{m_8} \alpha_9 \Delta lnGED_{t-j} + \psi ECT_{t-1} + e_t \quad (38)$$

6.4 Symmetric vs. Asymmetric Analysis: Recent Methodological Advances

Bahmani-Oskooee and Fariditavana (2016) have highlighted a possible limitation in previous empirical research, where they noted that the potential asymmetric effects of ER uncertainty on real trade volumes have not been adequately addressed. Previous empirical studies commonly assumed that fluctuations in ERs have a symmetric influence on trade flows, implying that an increase or decrease in ER uncertainty would have an equal and opposite impact on trade flows. In other words, these studies treat the influences of ER uncertainty as symmetric and of equal magnitude. In symmetric analysis, exporters and importers face similar uncertainties due to exchange rate uncertainties. If a country's currency depreciates, its exports become relatively cheaper, potentially boosting trade flows. Conversely, if a country's currency appreciates, its exports become relatively more expensive, which may reduce trade flows. However, the strict symmetry assumption may not exist (Bahmani-Oskooee & Aftab, 2018).

Bahmani-Oskooee and Aftab (2017) argued that traders' expectations change significantly when currency volatility increases compared to when it decreases, resulting in an asymmetric response. For example, increased ER uncertainty may lead to higher uncertainty and risk aversion among traders, causing them to reduce their export activities more than they would increase in response to decreased volatility. This could be due to concerns about the potential adverse effects of exchange rate uncertainties on their profitability, production costs, or market access. In addition, if exporters face high risk due to exchange rate volatility, they may reduce their export activities, leading to a deterioration in the trade balance.

Recent advances in econometric methodologies have highlighted the significance of incorporating asymmetric effects when studying the association between ER uncertainty and real trade volumes. Notably, recent research by Bussiere (2013) and Bahmani-Oskooee and

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[82] $H_0: \omega_1 = \omega_2 = \omega_3 = \omega_4 = \omega_5 = \omega_6 = \omega_7 = \omega_8 = 0$ (No cointegration)

$H_1: \omega_1 \neq \omega_2 \neq \omega_3 \neq \omega_4 \neq \omega_5 \neq \omega_6 \neq \omega_7 \neq \omega_8 \neq 0$ (Cointegration exists)

Aftab (2017, 2018) has emphasized that export and import prices may react asymmetrically to fluctuations in exchange rates. This indicates that the impact of ER uncertainty on import and export prices may not be uniform in magnitude and direction.

Given the potential asymmetry in the responses of export and import prices to exchange rate variations, it is reasonable to anticipate that trade flows will also exhibit an asymmetric reaction to volatility in exchange rates. Consequently, exporters and importers might adopt distinct approaches to exchange rate volatility. As exporters generally receive foreign currency payments, they could be more vulnerable to ER movements. Therefore, increased ER uncertainty might have a more pronounced adverse effect on exporters than importers.

To understand the association between ER uncertainty and trade volumes, researchers have turned to nonlinear models that can account for asymmetric effects and incorporate traders' expectations and price dynamics. These sophisticated econometric methodologies provide a more nuanced approach to studying the subject, acknowledging the possible variations in the size and direction of effects. By utilizing these advanced techniques, researchers can better explain and predict how trade flows respond to changes in ER uncertainty (Bahmani-Oskooee & Fariditavana, 2016).

Despite the numerous advantages of the symmetric ARDL model, the fundamental problem with the symmetric ARDL model is that it assumes a symmetric approach to cointegration. It assumes that the response of variables is always symmetric, capturing the similar or symmetric effects of both increased and decreased exchange rate uncertainty on real trade volumes (Rose, 2000; Brooks, 2008). Notably, Bahmani-Oskooee and Aftab (2017, 2018) have raised concerns regarding this assumption and argued that exchange rate uncertainty may impact trade volumes asymmetrically.

Therefore, this empirical study aims to contribute to the recent literature on international trade by examining the asymmetric influences of bilateral volatility and third-economy uncertainty on commodity trade flows between Germany and Turkey. This study also investigates the asymmetric effects of currency misalignment on Turkey’s growth progress. To this end, we employ the NARDL methodology by Shin et al. (2014) to examine the asymmetric effects of lira-euro and lira-dollar volatility on the Turkish-German commodity trade volumes to achieve these objectives.

6.4.1 The NARDL Methodology

The linear ARDL model assumes that the underlying co-integrating or long-run relationship among economic variables may be represented as a linear combination of the underlying nonstationary variables, which may be excessively restrictive. The long-run or co-integrating relationship among economic variables may exhibit asymmetry or nonlinearity. In general, the non-linear or asymmetric function can be written as follows:

$$y = f(x_t'^{+} + x_t'^{-}) \tag{39}$$

The NARDL methodology allows for nonlinearities in both the long-term connection and the error correction mechanism, providing a more comprehensive and flexible framework for analyzing time series data. It combines the advantages of capturing long-term asymmetries and incorporating short-term dynamics. The NARDL model is advantageous when investigating asymmetric effects of variables such as ER uncertainty on trade volumes, where the response to positive shocks (increases) may differ from negative shocks (decreases). Obeng (2017) stated that the NARDL method is a plausible and appropriate method to explore the influence of ER uncertainty on trade volume and exchange rate misalignment on economic growth. The NARDL method provides efficiency and flexibility to analyze the relationship between variables. According to Arize et al. (2017), the different responses of variables have increased the chances of modeling the asymmetry to improve further the understanding of the long-term relationship between macroeconomic variables.

The NARDL methodology provides a unified econometric approach that accommodates asymmetries and nonlinearity in the long-term association between variables. By incorporating nonlinear terms and allowing for asymmetry in the econometric specification, the NARDL model enables researchers to capture more subtle and realistic patterns in economic data. It provides a powerful tool for analyzing the behavior of economic variables and understanding the dynamics of their relationships over time.

Consider the following asymmetric long-run regression describes the empirical model:

$$y_t = \beta^{+} x_t^{+} + \beta^{-} x_t^{-} + u_t \tag{40}$$

In Equation (40), β^{+} and β^{-} are the associated long-run parameters to be empirically estimated using the NARDL method. The x_t is a $k * 1$ vector of regressors decomposed as:

$$x_t = x_0 + x_t^{+} + x_t^{-} \tag{41}$$

In Equation (41), x^{+} and x^{-} are partial sum processes of positive and negative variations in the independent variable (x_t). In compact form, the independent variable (x_t) is decomposed into its positive and negative partial sum components and can be expressed as follows:

$$x_t^{+} = \sum_{j=1}^{t} \Delta x_j^{+} = \sum_{j=1}^{t} max(\Delta x_j, 0) \tag{42}$$

$$x_t^{-} = \sum_{j=1}^{t} \Delta x_j^{-} = \sum_{j=1}^{t} min\,(\Delta x_j, 0) \tag{43}$$

Equation (40) can be framed in an ARDL setting along the lines of Pesaran and Shin (1999) and Pesaran et al. (2001) as specified in Equation (44) as follows:

$$\Delta y_t = \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{j-1}^{p-1} \varphi_j \Delta y_{t-j} + \sum_{j=0}^{q} \left(\pi_j^+ \Delta x_{t-j}^+ + \pi_j^- \Delta x_{t-j}^-\right) + e_t \quad (44)$$

In Equation (40), $\beta^+ = -\frac{\theta^+}{\rho}$ and $\beta^- = -\frac{\theta^-}{\rho}$ are the aforementioned long-run impacts of increase and decrease in x_t on y_t. In Equation (44), $\sum_{j=0}^{q} \pi_j^+$ measures the short-run influences of an increase in x_t on y_t while $\sum_{j=0}^{q} \pi_j^-$ measures the short-run influences of a decrease in x_t on y_t.[83]

The general form of the NARDL (*p,q*) model can be represented as follows:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta Y_{t-i} + \sum_{i=0}^{q} \alpha_{2i} \Delta X_{t-i}^+ + \sum_{i=0}^{q} \alpha_{3i} \Delta X_{t-i}^- + \rho Y_{t-1} + \varphi^+ X_{t-1}^+ + \varphi^- X_{t-1}^- + \mu_t \quad (45)$$

In Equation (45), ΔY_t represents the change in the dependent variable (i.e., trade volume) at time *t* and ΔX_t represents the change in the independent variable (i.e., exchange rate volatility) at time *t*. The coefficients α_i and φ_i represent the short-run and long-run influences of the lagged changes in the variables, respectively. The terms φ^+ and φ^- capture the asymmetric effects of positive and negative shocks in the ER uncertainty. The asymmetric functions ($\Delta X_{t-i}^+ > 0$) and ($\Delta X_{t-i}^- < 0$) take a value of 1 if ΔX_{t-i} is positive or negative, respectively, and 0 otherwise. We calculate the NARDL long-run level asymmetric coefficients by dividing the negative of the coefficient of X_t^+(i.e., φ^+) by the coefficient of Y_{t-1} (i.e., ρ). Consequently, the long-term asymmetric effects of X_t^+ on Y_{t-1} is calculated as follows:

$$L_{M1+} = -\left(\frac{\varphi^+}{\rho}\right). \quad (46)$$

Similarly, we calculate the NARDL long-run levels asymmetric coefficients by dividing the negative of the coefficient of X_t^-(i.e., φ^-) by the coefficient of Y_{t-1} (i.e., ρ). Symbolically, the long-term asymmetric effects of X_t^- on Y_{t-1} is calculated as follows:

$$L_{M1-} = -\left(\frac{\varphi^-}{\rho}\right). \quad (47)$$

If a long-run asymmetric relationship exists (after applying the F-bounds test), we test if the difference in the asymmetric coefficients is statistically significant[84].

$$H_0: -\left(\frac{\varphi^+}{\rho}\right) = -\left(\frac{\varphi^-}{\rho}\right) = \left(\frac{\varphi^+}{\rho}\right) = \left(\frac{\varphi^-}{\rho}\right)$$

$$H_1: -\left(\frac{\varphi^+}{\rho}\right) \neq -\left(\frac{\varphi^-}{\rho}\right) = \left(\frac{\varphi^+}{\rho}\right) \neq \left(\frac{\varphi^-}{\rho}\right). \quad (48)$$

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[83] Short-run asymmetric effects of X^+on *Y* is represented by $\sum_{i=0}^{q} \alpha_{2i}^+$ and X^-on *Y* is represented by $\sum_{i=0}^{q} \alpha_{3i}^-$.

[84]

Using the Wald test, if we reject the null hypothesis (H_0), it means we have long-run asymmetry. In other words, when X increases, the magnitude of the change in Y differs from when X decreases. Similarly, if the null hypothesis $\left(\sum_{i=0}^{q} \alpha_{2i}^{+} = \sum_{i=0}^{q} \alpha_{3i}^{-}\right)$ for the short-run asymmetric is rejected, we conclude that the impact of X on Y is asymmetric. The Wald test can be applied to test for the equality of the sum of positive and negative lags of each regressor in the NARDL model. Moreover, the Wald test of additive short-run asymmetry (i.e., adding up the positive and negative coefficients) was used by Shin et al. (2014), Bahmani-Oskooee and Harvey (2017), and Akçay (2019).

6.4.1.1 Model 1: Estimation of the Bilateral Export and Import Flows Models – The Asymmetric Analysis. The traditional ARDL model assumes a linear relationship between the variables and a symmetric adjustment mechanism. However, variables may exhibit nonlinear patterns in many economic contexts and respond differently to positive and negative shocks. NARDL models address these issues by incorporating nonlinear functional forms and allowing for different adjustment speeds for positive and negative changes. Component decomposition, often used in NARDL models, helps analyze the individual/separate contributions of different variables and their interactions. It provides valuable insights into the extent and depth of the associations among specific economic variables. Shin et al. (2014), Choudhry and Hassan (2015), Bahmani-Oskooee and Aftab (2017), Arize et al. (2017), and Bahmani-Oskooee and Arize (2019) have highlighted the importance of incorporating nonlinearities and asymmetries in modeling macroeconomic variables. Their contributions emphasize that macroeconomic relationships are not uniform across different states or periods and that capturing the nonlinearities is crucial for a comprehensive understanding of the underlying dynamics.

When examining the influence of bilateral ER uncertainty on trade volumes, it is imperative to consider the potential presence of asymmetric effects, which traditional linear ARDL models might fail to capture adequately. To address this critical issue, Shin et al. (2014) introduced modifications to the conventional ARDL specifications described in Equations (26) and (27), enabling the assessment of potential asymmetric influences of real bilateral ER uncertainty on trade volumes. This research investigates the asymmetric influences of real lira-euro rate uncertainty on commodity trade volumes between Turkey and Germany.

To accomplish this, we employ the partial sum concepts that Shin et al. (2014) developed to decompose the increase and decrease in lira-euro volatilities. This decomposition allows us to evaluate short-term and long-term estimates reflecting the asymmetric influences of lira-euro rate uncertainty on trade volumes. The adoption of the partial sum decomposition approach has been widely used in numerous empirical studies to explore the individual effects of positive and negative components of real exchange rate volatility on trade volumes (Bahmani-Oskooee & Aftab, 2017, 2018; Šimáková, 2018; Bahmani-Oskooee & Kanitpong, 2019; Bahmani-Oskooee and Arize, 2020; Baek and Nam, 2021; Bahmani-Oskooee and Saha, 2021; Chien et al., 2020; Abbasi, 2021; Bahmani-Oskooee & Karamelikli, 2021; Iqbal et al., 2021; Usman et al., 2021; Lee et al., 2022). Through this comprehensive approach, our study aims to contribute valuable insights into the potential asymmetric influences of uncertainty on commodity trade flows between Germany and Turkey. Simply,

$$POS_t^{TRGR} = \sum_{j=1}^{t} \max(\Delta lnVOL_j^{TRGR}, 0)$$
$$NEG_t^{TRGR} = \sum_{j=1}^{t} \min(\Delta ln\, VOL_j^{TRGR}, 0) \qquad (49)$$

In Equation (49), POS_t^{TRGR} (NEG_t^{TRGR}) represents the partial sum of positive (negative) fluctuations in $\Delta lnVOL_j^{TRGR}$, signifying an increase (decrease) in lira-euro volatility. Returning to Equations (26) and (27), we replace $lnVOL_j^{TRGR}$ with POS_t^{TRGR} and NEG_t^{TRGR}. Consequently, the new *ECM* specifications can be constructed as follows:

$$lnXV_{i,t} = \chi_0 + \chi_1 DM_t + \sum_{j=1}^{n_1} \chi_{2i} \Delta lnXV_{t-j} + \sum_{j=0}^{n_2} \chi_{3i} \Delta lnY_{t-j}^{GR} + \sum_{j=0}^{n_3} \chi_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \chi_{5i} \Delta lnPOS_{t-j}^{TRGR} + \sum_{j=0}^{n_5} \chi_{6i} \Delta lnNEG_{t-j}^{TRGR} + \vartheta_1\, lnXV_{t-1} + \vartheta_2 lnY_{t-1}^{GR} + \vartheta_3 lnREX_{t-1} + \vartheta_4 lnPOS_{t-1}^{TRGR} + \vartheta_5 lnNEG_{t-1}^{TRGR} + \varepsilon_t \qquad (50)$$

$$\Delta lnMV_{i,t} = \delta_0 + \delta_1 DM_t + \sum_{j=1}^{n_1} \delta_{2i} \Delta lnMV_{t-j} + \sum_{j=0}^{n_2} \delta_{3i} \Delta lnY_{t-j}^{TR} + \sum_{j=0}^{n_3} \delta_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \delta_{5i} \Delta lnPOS_{t-j}^{TRGR} + \sum_{j=0}^{n_5} \delta_{6i} \Delta lnNEG_{t-j}^{TRGR} + \sigma_1 lnMV_{t-1} + \sigma_2 lnY_{t-1}^{TR} + \sigma_3 lnREX_{t-1} + \sigma_4 lnPOS_{t-1}^{TRGR} + \sigma_5 lnNEG_{t-1}^{TRGR} + \varepsilon_t{}' \qquad (51)$$

The models presented in Equations (50) and (51) are termed nonlinear ARDL (NARDL) models because the introduction of partial sum variables induces nonlinearity into the adjustment process. Both linear ARDL and NARDL models are estimated using the OLS method, and the same cointegration *F*-test developed by Pesaran et al. (2001) is applied[85]. The cointegration test examines all lagged-level variables in Equations (50) and (51). The null hypotheses $H_0: \vartheta_1 = \vartheta_2 = \vartheta_3 = \vartheta_4 = \vartheta_5 = 0$ and $H_0: \sigma_1 = \sigma_2 = \sigma_3 = \sigma_4 = \sigma_5 = 0$ in Equations (50) and (51), respectively, are rejected if the estimated F-statistic value exceeds the critical upper bound *I(1)*, indicating the presence of cointegration and vice versa. However, if

[85] Shin et al. (2014) posited that by utilizing nonlinear ARDL models, the partial sum variables, which exhibit dependence on each other, should be treated as a single variable to maintain high and conservative critical *F*-test values when transitioning from a linear to a nonlinear ARDL model.

the calculated F-statistic falls between the *I(0)* and *I(1)* bounds, the error-correction specification (ECM_{t-1}) is employed to re-estimate Equations (26), (27), (50), or (51). Cointegration is confirmed if the estimated coefficient of ECM_{t-1} is statistically significant with a negative sign at a given significance level (Bahmani-Oskooee et al., 2014).

After confirming the presence of cointegration among the variables, the study proceeds to estimate the short-term and long-term asymmetric impacts of bilateral real ER uncertainty on export and import volumes using NARDL models specified in Equations (50) and (51). Several asymmetry hypotheses[86] are tested through this analysis. Firstly, short-term adjustment asymmetry is detected if the positive (*POS*) partial sum variable considers distinct lags compared to the negative (*NEG*) partial sum variable. Additionally, short-run asymmetric effects are tested by comparing the sign and magnitude of the coefficient estimates linked to *NEG & POS* at lag *j*. Furthermore, the short-term cumulative asymmetric effect is examined by evaluating whether the sum of estimates linked to *POS* differs from that of estimates linked to *NEG*. This is expressed as $\sum \hat{\chi}_{5i} \neq \sum \hat{\chi}_{6i}$ in Equation (50) and $\sum \hat{\delta}_{5i} \neq \sum \hat{\delta}_{6i}$ in Equation (51). Finally, long-term asymmetric effects are observed when the long-run coefficient linked to *NEG* and *POS* statistically differs. The hypothesis of long-run asymmetry for Equation (50) is tested using the Wald test, which is expressed as $\left({}^{\hat{\vartheta}_4}\!/_{-\hat{\vartheta}_1} \neq {}^{\hat{\vartheta}_5}\!/_{-\hat{\vartheta}_1}\right)$. Similarly, the long-term asymmetric hypothesis for Equation (51) can be evaluated employing the Wald test, represented as $\left({}^{\hat{\sigma}_4}\!/_{-\hat{\sigma}_1} \neq {}^{\hat{\sigma}_5}\!/_{-\hat{\sigma}_1}\right)$[87].

The error correction models can also capture the long-term association among the examined explanatory variables, where we replace the bilateral real *ER* uncertainty components/variables with the partial sum components (i.e., *POS* and *NEG* counterparts). Hence, the error correction models can be specified as follows:

$$lnXV_{i,t} = \chi_0 + \chi_1 DM_t + \sum_{j=1}^{n_1} \chi_{2i} \Delta lnXV_{t-j} + \sum_{j=0}^{n_2} \chi_{3i} \Delta lnY_{t-j}^{GR} + \sum_{j=0}^{n_3} \chi_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \chi_{5i} \Delta lnPOS_{t-j}^{TRGR} + \sum_{j=0}^{n_5} \chi_{6i} \Delta lnNEG_{t-j}^{TRGR} + \psi ECT_{t-1} + \varepsilon_t \quad (52)$$

$$\Delta lnMV_{i,t} = \delta_0 + \delta_1 DM_t + \sum_{j=1}^{n_1} \delta_{2i} \Delta lnMV_{t-j} + \sum_{j=0}^{n_2} \delta_{3i} \Delta lnY_{t-j}^{TR} + \sum_{j=0}^{n_3} \delta_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \delta_{5i} \Delta lnPOS_{t-j}^{TRGR} + \sum_{j=0}^{n_5} \delta_{6i} \Delta lnNEG_{t-j}^{TRGR} + \psi ECT_{t-1} + \varepsilon_t' \quad (53)$$

[86] The short-term plus long-term Wald tests were applied to investigate and identify any potential asymmetry in the effects of volatility, providing valuable insights into the dynamics of the relationships under study (Bahmani-Oskooee & Aftab, 2017).
[87] For further details, refer to Bahmani-Oskooee and Saha (2020).

6.4.1.2 Estimation of the Third-Country Volatility Risk – The Asymmetric Analysis. In recent years, several scholars, such as Abbasi (2021) and Iqbal et al. (2023), have raised concerns about the conventional assumption that ER variability symmetrically influences trade volumes. According to these studies, the ER uncertainty exerts asymmetric effects on trade volumes. This study follows the approach adopted by Shin et al. (2014) to address this issue. We decompose an increase in RER volatility from a decrease in RER volatility to observe their separate effects on commodity trade volumes. To this end, the study constructs a measure labelled $\Delta lnVOL$, which encompasses positive and negative exchange rate uncertainties. Subsequently, the partial sums concept is applied to create positive components (*POS*) plus negative components (*NEG*) series. We can write the decomposed volatility components as follows:

$$POS_t = \sum_{j=1}^{t} \Delta lnVOL_j^+ = \sum_{j=1}^{t} \max(\Delta lnVOL_j, 0)$$
$$NEG_t = \sum_{j=1}^{t} \Delta lnVOL_j^- = \sum_{j=1}^{t} \min(\Delta lnVOL_j, 0) \quad (54)$$

Researchers have extensively utilized the partial sum methodology to decompose ER uncertainty, and recent studies by Usman et al. (2021), Iqbal et al. (2023), and Khalid et al. (2023) have successfully employed this method. With this methodology in mind, we proceed to apply the same approach to our research and can write the decomposed components of lira-dollar uncertainty represented as POS^{TRUS} and NEG^{TRUS}.

$$POS_t^{TRUS} = \sum_{j=1}^{t} \max(\Delta lnVOL_j^{TRUS}, 0)$$
$$NEG_t^{TRUS} = \sum_{j=1}^{t} \min(\Delta ln\, VOL_j^{TRUS}, 0) \quad (55)$$

After decomposing the volatility measure (VOL_t^{TRUS}) of the lira-dollar exchange rate, we continue by integrating these separate components into Equations (30) and (31), leading to the formulation of Equations (56) and (57):

$$\Delta lnXV_{i,t} = \chi_0 + \chi_1 DM_t + \sum_{j=1}^{n_1} \chi_{2i} \Delta lnXV_{t-j} + \sum_{j=0}^{n_2} \chi_{3i} \Delta lnY_{t-j}^{GR} + \sum_{j=0}^{n_3} \chi_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \chi_{5i} \Delta lnPOS_{t-j}^{TRUS} + \sum_{j=0}^{n_5} \chi_{6i} \Delta lnNEG_{t-j}^{TRUS} + \vartheta_1\, lnXV_{t-1} + \vartheta_2 lnY_{t-1}^{GR} + \vartheta_3 lnREX_{t-1} + \vartheta_4 lnPOS_{t-1}^{TRUS} + \vartheta_5 lnNEG_{t-1}^{TRUS} + \varepsilon_t \quad (56)$$

$$\Delta lnMV_{i,t} = \delta_0 + \delta_1 DM_t + \sum_{j=1}^{n_1} \delta_{2i} \Delta lnMV_{t-j} + \sum_{j=0}^{n_2} \delta_{3i} \Delta lnY_{t-j}^{TR} + \sum_{j=0}^{n_3} \delta_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \delta_{5i} \Delta lnPOS_{t-j}^{TRUS} + \sum_{j=0}^{n_5} \delta_{6i} \Delta lnNEG_{t-j}^{TRUS} + \sigma_1 lnMV_{t-1} + \sigma_2 lnY_{t-1}^{TR} + \sigma_3 lnREX_{t-1} + \sigma_4 lnPOS_{t-1}^{TRUS} + \sigma_5 lnNEG_{t-1}^{TRUS} + \varepsilon_t' \quad (57)$$

The specifications presented in Equations (56) and (57) are referred to as NARDL models.

This study aims to explore the potential asymmetry of third-economy uncertainty on real trade volumes. To achieve this, we employ the OLS technique to estimate Equations (56) and (57). Subsequently, we subject these equations to asymmetry tests to ascertain whether the impacts of increased lira-dollar volatility and decreased lira-dollar volatility are symmetric or exhibit asymmetry. To accomplish this task, we specifically employ short-run and long-run asymmetry tests.

In this context, asymmetry in short-run adjustment can be observed when the number of lags differs between *POS* and *NEG* effects. Additionally, short-term asymmetric influences are evidenced when the sign or magnitude of coefficients related to *NEG* and *POS* vary for each lag (*j*). The short-term impact asymmetry can be observed by assessing whether *POS* is distinct from *NEG,* denoted as $\sum \hat{\chi}_{5i} \neq \sum \hat{\chi}_{6i}$ in Equation (56) and $\sum \hat{\delta}_{5i} \neq \sum \hat{\delta}_{6i}$ in Equation (57). On the other hand, long-run asymmetric effects are confirmed when long-run coefficients linked to *NEG* and *POS* are varied. The long-term asymmetry for Equation (56) can be tested by applying the Wald test, i.e., $\left({\hat{\vartheta}_4}/{-\hat{\vartheta}_1} \neq {\hat{\vartheta}_5}/{-\hat{\vartheta}_1}\right)$. For Equation (57), we can write as $\left({\hat{\sigma}_4}/{-\hat{\sigma}_1} \neq {\hat{\sigma}_5}/{-\hat{\sigma}_1}\right)$.

The error correction models (*ECMs*) can also confirm the cointegrating relationship among the explanatory variables at hand, where we replace the real lira-dollar volatility variables with the partial sum components (i.e., *POS* and *NEG*). Hence, the error correction models can be represented below:

$$\Delta lnXV_{i,t} = \chi_0 + \chi_1 DM_t + \sum_{j=1}^{n_1} \chi_{2i} \Delta lnXV_{t-j} + \sum_{j=0}^{n_2} \chi_{3i} \Delta lnY_{t-j}^{GR} + \sum_{j=0}^{n_3} \chi_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \chi_{5i} \Delta lnPOS_{t-j}^{TRUS} + \sum_{j=0}^{n_5} \chi_{6i} \Delta lnNEG_{t-j}^{TRUS} + \psi ECT_{t-1} + \varepsilon_t \quad (58)$$

$$\Delta lnMV_{i,t} = \delta_0 + \delta_1 DM_t + \sum_{j=1}^{n_1} \delta_{2i} \Delta lnMV_{t-j} + \sum_{j=0}^{n_2} \delta_{3i} \Delta lnY_{t-j}^{TR} + \sum_{j=0}^{n_3} \delta_{4i} \Delta lnREX_{t-j} + \sum_{j=0}^{n_4} \delta_{5i} \Delta lnPOS_{t-j}^{TRUS} + \sum_{j=0}^{n_5} \delta_{6i} \Delta lnNEG_{t-j}^{TRUS} + \psi ECT_{t-1} + \varepsilon_t' \quad (59)$$

6.4.1.3 Model 5: Estimation of the Economic Growth Model – Asymmetric Analysis. According to Abbasi (2021), Abbasi and Iqbal (2021), and Iqbal et al. (2023), the symmetric approach has a severe limitation because it overlooks the hidden cointegration that may exist among the components of a time series. To address this issue, the present study adopts the cointegration approach introduced by Granger & Yoon (2002), which examines the hidden cointegrating association among the variables. Despite the absence of linear correlation within the overall *RER* misalignment series, this approach provides evidence of long-term cointegrating association between the overvalued and undervalued components. As a result, asymmetric or non-linear ARDL models are preferred over symmetric or linear ARDL models, as they allow for individual effects of the overvalued and undervalued components of the Turkish lira on economic growth.

Granger and Yoon (2002) and Hatemi-J (2012, 2014) have provided evidence that the non-linear adjustment mechanism can be transformed into a linear one without losing essential information. Both data series are assumed to exhibit hidden cointegration in cases where both positive and negative series are cointegrated. This form of non-linear cointegration can be effectively studied when the conventional linear cointegration methods fail to detect the underlying cointegrating association among the variables. To illustrate, let's consider two random walk series, namely Z_t & $Y_{t,}$:

$$Z_t = Z_{t-1} + \mu_t = Z_0 + \sum_{t=1}^{t} \mu_i \tag{60}$$

$$Y_t = Y_{t-1} + \daleth_t = Y_0 + \sum_{t=1}^{t} \daleth_i \tag{61}$$

In Equations (60) and (61), where $t = 1, 2, 3, \ldots, T,$ and Z_0 and Y_0 represent initial values while μ_i and $\daleth_i$ represent disturbance terms with zero-mean white noise. If the two series (Y_t & Z_t) are cointegrated by a single vector, they have a linear cointegrating relationship. Nevertheless, the possibility of hidden cointegration arises between the two series if they exhibit asymmetric movements. Granger and Yoon (2002) propose a definition for both overvalued and undervalued exchange rates as follows:

$$\mu_i^+ = \max\ (\mu_i, 0), \mu_i^- = \min\ (\mu_i, 0) \tag{62}$$

$$\daleth_i^+ = \max\ (\daleth_i, 0), \daleth_i^- = \min\ (\daleth_i, 0) \tag{63}$$

$$\mu_i = \mu_i^+ + \mu_i^- and\ \daleth_i = \daleth_i^+ + \daleth_i^- \tag{64}$$

Hence,

$$Z_t = Z_{t-1} + \mu_t = Z_0 + \sum_{t=1}^{t} \mu_i^+ \sum_{t=1}^{t} \mu_i^- \tag{65}$$

$$Y_t = Y_{t-1} + \daleth_t = Y_0 + \sum_{t=1}^{t} \daleth_i^+ \sum_{t=1}^{t} \daleth_i^- \tag{66}$$

To simplify the notations, we can write as follows:

$$Z_i^+ = \sum_{t=1}^{t} \mu_i^+\ and\ \ Z_i^- = \sum_{t=1}^{t} \mu_i^- \tag{67}$$

$$Y_i^+ = \sum_{t=1}^{t} \daleth_i^+\ and\ \ Y_i^- = \sum_{t=1}^{t} \daleth_i^- \tag{68}$$

Thus,

$$Z_t = Z_0 + Z_i^+ + Z_i^- \text{ and } Y_t = Y_0 + Y_i^+ + Y_i^- \tag{69}$$

Subsequently,

$$\Delta Z_t^+ = \mu_t^+, \Delta Z_t^- = \mu_t^-, \Delta Y_t^+ = \daleth_t^+, \Delta Y_t^- = \daleth_t^- \tag{70}$$

To investigate the presence of hidden cointegration between the series Z_t and Y_t, we perform the first difference calculation on each series, obtaining $\Delta Z_t = Z_t - Z_{t-1}$, which gives us the series of overvalued and undervalued movements denoted as $\Delta Z_t^+\ \Delta Z_t^-$. We then proceed to compute the cumulative sum of positive and negative changes separately, resulting in $Z_t^+ = \sum \Delta Z_t^+ \ and \ Z_t^- = \sum \Delta Z_t^-$. A similar process is applied to the series Y_t, yielding $Y_t^+ = \sum \Delta Y_t^+ \ and \ Y_t^- = \sum \Delta Y_t^-$.

If the components of the two series are cointegrated, we assume the existence of hidden cointegration between them. For ease of understanding, we replace Z_t with our variable of interest (*REERMIS*), and we denote Z_t^+ and Z_t^- as *OVER_{VAL}* (overvaluation) and *UNDER_{VAL}* (undervaluation), respectively. Consequently, we can separately assess the effects of RER undervaluation and overvaluation on economic growth. To achieve this, we substitute the variable *REERMIS* in Equation (15) with the variables $OVER_{VAL}$ and $UNDER_{VAL}$ in Equations (71) and (72) as follows:

$$OVER_{VAL_t} = \sum_{j=1}^{t} \Delta RERMIS_j^+ = \sum_{j=1}^{t} \max(\Delta RERMIS_j , 0) \tag{71}$$

$$UNDER_{VAL_t} = \sum_{j=1}^{t} \Delta RERMIS_j^- = \sum_{j=1}^{t} \min(\Delta RERMIS_j , 0) \tag{72}$$

Hence, the non-linear economic growth model, where the variable *RERMIS* is replaced with its decomposed components ($OVER_{VAL}$ and $UNDER_{VAL}$), can be formulated as follows:

$$Y_{g_t} = \delta_0 + \delta_1 SAV_t + \delta_2 TOT_t + \delta_3 CRP_t + \delta_4 lnFER_t + \delta_5 INF_t + \delta_6 lnGED_t + \delta_7 OVER_{VAL_t} + \delta_8 UNDER_{VAL_t} + \upsilon_t \tag{73}$$

In Equation (73), the variables $OVER_{VAL}$ and $UNDER_{VAL}$ correspond to the positive misalignment (overvaluation) and negative misalignment (undervaluation) of the domestic currency, respectively. The control variables in the growth equation remain unchanged and are as described in Equation (15). To assess the cointegrating relationship between these growth determinants, we employ the ARDL bounds test. We use the F-bounds test approach to model the NARDL framework to confirm cointegration. This allows us to assess short-term and long-term effects in the growth model presented in Equation (74). The structure of the NARDL representation for the growth model is as follows:

$$\Delta Y_{g_t} = \eta_0 + \sum_{j=1}^{p_1} \eta_1 Y_{g_{t-j}} + \sum_{j=0}^{p_2} \eta_2 SAV_{t-j} + \sum_{j=0}^{p_3} \eta_3 TOT_{t-j} + \sum_{j=0}^{p_4} \eta_4 CRP_{t-j} + \sum_{j=0}^{p_5} \eta_5 lnFER_{t-j} + \sum_{j=0}^{p_6} \eta_6 INF_{t-j} + \sum_{j=0}^{p_7} \eta_7 lnGED_{t-j} + \sum_{j=0}^{p_8} \eta_8 OVER_{VAL_{t-j}} + \sum_{j=0}^{p_9} \eta_9 UNDER_{VAL_{t-j}} + \varrho_1 Y_{g_{t-1}} + \varrho_2 SAV_{t-1} + \varrho_3 TOT_{t-1} + \varrho_4 CRP_{t-1} + \varrho_5 lnFER_{t-1} + \varrho_6 INF_{t-1} + \varrho_7 lnGED_{t-1} + \varrho_8 OVER_{VAL_{t-1}} + \varrho_9 UNDER_{VAL_{t-1}} + \Omega_t \tag{74}$$

We can examine several asymmetry hypotheses when estimating Equation (74) using the OLS technique. These hypotheses are: (1) Short-run adjustment asymmetry occurs when a different number of lags characterizes the variable *OVERVAL* compared to $UNDER_{VAL}$. (2) Short-term asymmetric influences are evident when the magnitude or sign of the coefficients linked to $OVER_{VAL}$ and $UNDER_{VAL}$ vary across various lag orders (j). (3) Short-term impact asymmetry can be identified by assessing whether $OVER_{VAL}$ is statistically different from $UNDER_{VAL}$ $\left(\sum_{j=0}^{p_8} \eta_8 \neq \sum_{j=0}^{p_9} \eta_9\right)$. (4) Long-run asymmetric effects are evident when the long-run estimates of $OVER_{VAL}$ and $UNDER_{VAL}$ are statistically different. Specifically, we test $\left(\widehat{\varrho_8}/_{-\widehat{\varrho_1}} \neq \widehat{\varrho_9}/_{-\widehat{\varrho_1}}\right)$.

Another approach to assessing cointegration among macroeconomic variables involves calculating the error correction term within the framework of an error correction model. This concept has been extensively explained in the preceding sections. The error correction model representation of Equation (74) can be expressed as follows:

$$\Delta Y_{g_t} = \eta_0 + \sum_{j=1}^{p_1} \eta_1 Y_{g_{t-j}} + \sum_{j=0}^{p_2} \eta_2 SAV_{t-j} + \sum_{j=0}^{p_3} \eta_3 TOT_{t-j} + \sum_{j=0}^{p_4} \eta_4 CRP_{t-j} + \sum_{j=0}^{p_5} \eta_5 lnFER_{t-j} + \sum_{j=0}^{p_6} \eta_6 INF_{t-j} + \sum_{j=0}^{p_7} \eta_7 lnGED_{t-j} + \sum_{j=0}^{p_8} \eta_8 OVER_{VAL_{t-j}} + \sum_{j=0}^{p_9} \eta_9 UNDER_{VAL_{t-j}} + \psi ECT_{t-1} + \Omega_t \tag{75}$$

In Equation (75), the symbol Δ represents the difference operator, η_0 represents the intercept, Ω_t represents the stochastic disturbance term, and p_1 to p_8 represent the appropriate lag lengths determined using the lowest AIC and SIC criteria. The symbols ϱ_1 to ϱ_9 represent the normalized long-run coefficients, while the symbols η_1 to η_9 (associated with the first-differenced variables) represent the short-run coefficients.

Cointegration between macroeconomic variables can be established using the ARDL F-bounds test, which equally applies to the NARDL model. Narayan (2005) and Pesaran et al. (2001) have calculated critical F-test values for small and large samples, respectively. These critical bounds are determined based on a given significance level and the number of k exogenous variables. If the computed F-statistic exceeds the upper critical value, we reject the null hypothesis of no cointegration[88]and vice versa.

[88] H_0: $\varrho_1 = \varrho_2 = \varrho_3 = \varrho_4 = \varrho_5 = \varrho_6 = \varrho_7 = \varrho_8 = \varrho_9 = 0$ (No cointegration)

H_1: $\varrho_1 \neq \varrho_2 \neq \varrho_3 \neq \varrho_4 \neq \varrho_5 \neq \varrho_6 \neq \varrho_7 \neq \varrho_8 \neq \varrho_9 \neq 0$ (Cointegration exists)

CHAPTER VII

Bilateral Exchange Rate Volatility and Trade Dynamics

7.1 Introduction

The present study examines the symmetric and asymmetric influences of bilateral exchange rate uncertainty on commodity trade flows between Germany[89] and Turkey. To capture the symmetric plus asymmetric influences of bilateral real lira-euro volatility on Turkish-German commodity trade volumes, the study samples 90 SITC-1[90] (three-digit level) Turkish export industries (or German import industries) and 114 Turkish import industries (or German export industries)[91]. The export industries collectively account for approximately 87 percent of Turkey's total exports to Germany (or German imports from Turkey). The import industries constitute approximately 95 percent of the overall imports of Turkey from Germany (or German exports to Turkey).

To achieve these objectives, the study employs the ARDL methodology developed by Pesaran et al. (2001) to estimate linear export and import demand models[92] presented in Equations (26) and (27). However, for the sake of comparative analysis, the study also employs the NARDL methodology originated by Shin et al. (2014) to estimate nonlinear export and import demand equations[93] presented in Equations (50) and (51). For these purposes, the study has utilized annual time series data covering the period 1980-2022[94].

7.2 Variables Descriptions and Data Sources

The detailed description of the variables under investigation can be described as follows:

$\boldsymbol{XV_i}$[95] (export volume) = This represents the real volume of exports from Turkey to Germany for commodity i. The nominal value of exports (measured in 1,000 U.S. dollars) for each Turkish exporting industry is obtained from the WITS (2023) database. Since there is no available data on commodity prices, we follow the approach used by Abbasi (2021), Usman et

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[89] We have chosen Germany as a bilateral trade partner of Turkey because Germany is Turkey’s top export destination, accounting for 8.32% of Turkey’s exports to Germany, totaling $21,144 million in 2022 (UN Comtrade (2023) database).
[90] This category refers to the highest level of aggregation in the SITC classification, representing the broadest categories of traded goods. These categories are relatively general and provide a high-level overview of trade flows.
[91] These sectors include both small and large industries.
[92] Model 1 (the symmetric analysis)
[93] Model 1 (the asymmetric analysis)
[94] We have chosen this sample period because data on the export unit value index and import unit value index for Turkey before 1980 are not available from all data sources.
[95] This is the dependent variable in the export demand model.

al. (2021), Lee et al. (2022), and Iqbal et al. (2023). We deflate nominal exports by the Turkish export unit value index (with a base year of 2015=100), using Equation (76):

$$Real\ export\ volume = \frac{Nominal\ exports}{Export\ unit\ value\ index} \tag{76}$$

The Turkish export unit value index data is obtained from the World Development Indicators (WDI) (2023).

$\boldsymbol{MV_i}$[96] (import volume) = It represents the real volume of imports for a specific commodity i from Germany to Turkey. The nominal import value (measured in 1,000 U.S. dollars) for each Turkish importing industry is obtained from the WITS (2023) database. Due to the absence of available data on commodity prices, we adopt the methodology employed by Abbasi (2021), Usman et al. (2021), Lee et al. (2022), and Iqbal et al. (2023). We adjust the nominal imports employing the Turkish import unit value index (with a base year of 2015=100), using Equation (77).

$$Real\ import\ volume = \frac{Nominal\ imports}{Import\ unit\ value\ index} \tag{77}$$

The Turkish import unit value index data is obtained from the WDI (2023).

$\boldsymbol{Y^{TR}}$(Turkey′real GDP) = It is a measure of the real income of Turkey, proxied by the real GDP of Turkey (measured in constant 2015 U.S. dollars). We have used Turkey's real GDP to eliminate the effect of inflation. The data on Turkey's real GDP has been selected from the WDI (2023).

$\boldsymbol{Y^{GR}}$(Germany′s real income) = It is a measure of Germany's real income or real GDP, proxied by Germany's real GDP (measured in constant 2015 U.S. dollars). We have used the real GDP of Germany to eliminate the effect of inflation. The data on the real GDP of Germany is sourced from the WDI (2023).

$\boldsymbol{REX}$ (real exchange rate) = This is the real exchange rate between the TL and the German euro. The bilateral real lira-euro rate is a significant explanatory factor utilized to assess the relative competitiveness of the Turkish lira against the German euro. However, as direct data for the nominal lira-euro rate is not accessible, we adopted a cross-exchange rate approach involving the U.S. dollar. The technique used for the cross-exchange rate is expressed as follows:

$$NEX = \left(\frac{Turkish\ Lira}{USD} * \frac{USD}{Euro}\right) \tag{78}$$

The real lira-euro exchange rate can be computed as follows:

[96] This is the dependent variable in the import demand model.

$$REX = \left(\frac{CPI^{GR} \times NEX}{CPI^{TR}}\right) \tag{79}$$

In Equation (79), the variable *NEX* denotes the nominal exchange rate, which represents the price of the Turkish lira in terms of the euro. Specifically, it indicates the number of Turkish liras required to purchase one euro. The term CPI^{GR} represents Germany's price level, calculated by the CPI index, while CPI^{TR} represents Turkey's price level, also calculated by the CPI index.

All nominal ER data are sourced from the International Financial Statistics (IFS) (2023). On the other hand, the nominal euro-dollar exchange rate data is retrieved from the Organization for Economic Co-operation and Development (OECD) (2023) database. Additionally, data on consumer price indices (CPIs) used in the calculation are compiled from the IFS (2023) database.

$\boldsymbol{VOL^{TRGR}}$(lira − euro volatility) = It represents the real lira-euro volatility measured through the GARCH (1,1) approach[97]. For more information on the methodology and application of this approach, see the studies by Bahmani-Oskooee and Aftab (2017, 2018).

7.3 Unit Root Properties of the Variables

It is essential to highlight that the ARDL methodology doesn't necessitate the preliminary testing of economic variables for stationarity. However, researchers often employ the Augmented Dickey-Fuller (*ADF*) test, initially introduced by Dickey and Fuller (1981), and the Phillips-Perron (*PP*) test, developed by Phillips and Perron (1988). These tests have been conducted to confirm whether any variable exhibits an order of integration of I*(2)*. Following the *ADF* and *PP* test results reported in Tables 8 and 9, it is established that the examined variables display a combination of integration orders of variables, specifically *I(0)* and *I(1),* and there is no variable exhibiting an *I(2)* order. Consequently, this outcome underscores the need to utilize the ARDL bounds test for the empirical analysis.

[97] Refer to sub-section 6.2.1 for its detail construction.

Table 8. ADF and PP Unit Root Test Results for Export Sectors

Variables *[ln (XV$_i$)]*	*ADF* Test				*PP* Test				
	Level		First Difference		Level		First Difference		Order of Integration
	I	*T & I*	*I*	*T & I*	*I*	*T & I*	*I*	*T & I*	
031	-0.44(0.89)	-1.95(0.61)	-6.64(0.00)*	-6.57(0.00)*	-0.45(0.89)	-2.02(0.57)	-6.64(0.00)*	-6.57(0.00)*	*I (1)*
032	-3.30(0.02)	-3.63(0.04)**	-7.73(0.00)*	-7.68(0.00)*	-3.35(0.19)	-3.59(0.04)**	-7.90(0.00)*	-7.73(0.00)*	*I (1)*
046	-1.96(0.30)	-2.10(0.53)	-7.49(0.00)*	-7.40(0.00)*	-1.87(0.34)	-2.01(0.58)	-7.57(0.00)*	-7.47(0.00)*	*I (1)*
047	-2.83(0.06)***	-3.52(0.05)***	-5.13(0.00)*	-5.30(0.00)*	-2.67(0.09)***	-3.27(0.09)***	-7.30(0.00)*	-7.25(0.00)*	*I (0)*
048	-1.29(0.62)	-2.48(0.34)	-4.95(0.00)*	-5.20(0.00)*	-1.29(0.62)	-1.55(0.80)	-3.64(0.01)*	-3.90(0.02)**	*I (1)*
051	-1.85(0.35)	-2.36(0.39)	-6.09(0.00)*	-5.96(0.00)*	-2.04(0.27)	-3.18(0.10)	-10.98(0.00)*	-10.56(0.00)*	*I (1)*
052	-1.25(0.64)	-2.36(0.40)	-6.05(0.00)*	-5.68(0.00)*	-1.20(0.67)	-0.50(0.33)	-6.69(0.00)*	-7.34(0.00)*	*I (1)*
053	-1.50(0.52)	-1.56(0.79)	-6.28(0.00)*	-6.40(0.00)*	-1.55(0.50)	-1.56(0.79)	-6.43(0.00)*	-9.18(0.00)*	*I (1)*
054	-2.15(0.23)	-2.41(0.37)	-8.46(0.00)*	-8.42(0.00)*	-1.85(0.35)	-2.91(0.17)	-9.75(0.00)*	-13.56(0.00)*	*I (1)*
055	-1.99(0.29)	-1.19(0.90)	-7.45(0.00)*	-8.10(0.00)*	-1.94(0.31)	-1.19(0.90)	-7.39(0.00)*	-8.14(0.00)*	*I (1)*
061	-2.78(0.07)***	-2.76(0.21)	-6.55(0.00)*	-6.63(0.00)*	-2.76(0.07)***	-2.76(0.21)	-7.21(0.00)*	-7.48(0.00)*	*I (1)*
062	-3.28(0.02)**	-2.87(0.18)	-6.63(0.00)*	-4.97(0.00)*	-0.98(0.75)	-1.94(0.61)	-6.97(0.00)*	-8.79(0.00)*	*I (1)*

073	-1.22(0.70)	-6.75(0.00)*	-6.74(0.00)*	-6.82(0.00)*	-1.10(0.71)	-7.83(0.00)*	-7.06(0.00)*	-7.09(0.00)*	*I (1)*
074	-4.37(0.00)*	-5.07(0.00)*	-7.46(0.00)*	-7.36(0.00)*	-4.41(0.00)*	-5.05(0.00)*	-18.88(0.00)*	-17.92(0.00)*	*I (0)*
075	-1.77(0.39)	-2.17(0.49)	-6.64(0.00)*	-6.67(0.00)*	-1.65(0.45)	-2.07(0.55)	-7.19(0.00)*	-11.10(0.00)*	*I (1)*
099	-0.15(0.09)***	-3.60(0.04)**	-7.00(0.00)*	-7.09(0.00)*	0.28(0.97)	-3.63(0.04)**	-7.04(0.00)*	-7.14(0.00)*	*I (0)*
112	-1.38(0.58)	-2.13(0.51)	-4.17(0.00)*	-4.25(0.00)*	-1.37(0.59)	-1.78(0.70)	-6.53(0.00)*	-6.54(0.00)*	*I (1)*
121	-0.31(0.91)	-1.07(0.92)	-6.04(0.00)*	-6.37(0.00)*	-1.49(0.53)	-2.25(0.45)	-10.30(0.00)*	-13.51(0.00)*	*I (1)*
221	-1.62(0.46)	-2.85(0.19)	-6.25(0.00)*	-6.18(0.00)*	-1.41(0.57)	-2.78(0.21)	-7.25(0.00)*	-7.06(0.00)*	*I (1)*
262	-5.36(0.00)*	-5.29(0.00)*	-10.06(0.00)*	-5.22(0.00)*	-5.44(0.00)*	-5.38(0.00)*	-11.26(0.00)*	-11.16(0.00)*	*I (0)*
263	-2.46(0.13)	-2.48(0.33)	-8.52(0.00)*	-8.65(0.00)*	-2.37(0.16)	-2.33(0.41)	-8.62(0.00)	-9.35(0.00)*	*I (1)*
266	-4.10(0.00)*	-4.65(0.00)*	-7.25(0.00)*	-7.02(0.00)*	-4.09(0.00)*	-4.66(0.00)*	-9.40(0.00)*	-11.03(0.00)*	*I (0)*
273	-1.51(0.52)	-2.47(0.34)	-9.19(0.00)*	-9.20(0.00)*	-1.35(0.60)	-2.35(0.40)	-9.64(0.00)*	-9.81(0.00)*	*I (1)*
276	-1.37(0.59)	-1.76(0.71)	-6.28(0.00)*	-6.24(0.00)*	-1.48(0.53)	-1.89(0.64)	-6.29(0.00)*	-6.24(0.00)*	*I (1)*
283	-4.04(0.00)*	-5.55(0.00)*	-11.13(0.00)*	-11.05(0.00)*	-3.91(0.00)*	-5.55(0.00)*	-18.82(0.00)*	-15.93(0.00)*	*I (0)*
291	-4.05(0.04)**	-3.11(0.02)*	-8.85(0.00)*	-8.74(0.00)*	-3.94(0.00)*	-4.03(0.02)**	-14.34(0.00)*	-16.46(0.00)*	*I (0)*

292	-1.49(0.53)	-4.09(0.01)**	-6.62(0.00)**	-6.06(0.03)*	-1.32(0.69)	-4.15(0.01)**	-17.35(0.00)*	-16.60(0.00)*	*I (0)*
421	-1.57(0.49)	-5.19(0.00)*	-6.45(0.00)*	-6.36(0.00)*	-1.36(0.59)	-4.99(0.00)*	-12.00(0.00)*	-11.84(0.00)*	*I (0)*
422	-1.59(0.48)	-4.40(0.01)*	-10.35(0.00)*	-10.22(0.00)*	-2.49(0.14)	-4.48(0.00)*	-13.03(0.00)*	-12.78(0.00)*	*I (0)*
512	-1.95(0.31)	-3.09(0.12)	-7.08(0.00)*	-7.10(0.00)*	-1.81(0.37)	-3.12(0.12)	-7.26(0.00)*	-7.73(0.00)*	*I (1)*
513	-0.79(0.81)	-3.73(0.03)**	-7.48(0.00)*	-7.50(0.00)*	-1.56(0.49)	-3.65(0.04)**	-7.03(0.00)*	-7.04(0.00)*	*I (0)*
514	-0.91(0.77)	-5.49(0.00)*	9.73(0.00)*	9.65(0.00)*	-1.59(0.48)	-5.49(0.00)*	-10.16(0.00)*	-10.05(0.00)*	*I (0)*
541	-5.13(0.00)*	-5.23(0.00)*	-7.28(0.00)*	-7.84(0.00)*	-3.60(0.01)*	-3.42(0.06)***	-7.22(0.00)*	-7.75(0.00)*	*I (0)*
551	-1.35(0.60)	-2.28(0.43)	-6.40(0.00)*	-6.38(0.00)*	-1.36(0.59)	-2.38(0.38)	-6.49(0.00)*	-6.85(0.00)*	*I (1)*
553	-1.13(0.69)	-3.24(0.09)***	-6.12(0.00)*	-6.03(0.01)*	-0.91(0.77)	-3.16(0.11)	-8.38(0.00)*	-8.11(0.00)*	*I (1)*
554	-5.36(0.00)*	-1.22(0.89)	-7.02(0.00)*	-7.58(0.00)*	-2.78(0.07)***	-3.04(0.14)	-10.16(0.00)*	-25.36(0.00)*	*I (1)*
581	-0.12(0.94)	-4.34(0.01)*	-6.80(0.00)*	-6.83(0.00)*	-1.52(0.52)	-4.48(0.01)*	-10.16(0.00)*	-10.02(0.00)*	*I (0)*
599	0.32(0.98)	-3.10(0.12)	-5.28(0.00)*	-5.29(0.00)*	-1.43(0.56)	-4.97(0.00)*	-15.73(0.00)*	-16.56(0.00)*	*I (1)*
612	-3.80(0.01)*	-3.98(0.02)**	-9.58(0.00)*	-9.91(0.00)*	-4.22(0.00)*	-3.98(0.02)*	-10.10(0.00)*	-10.21(0.00)*	*I (0)*

621	-3.38(0.02)*	-1.61(0.77)	-3.98(0.00)*	-4.86(0.00)*	-3.18(0.03)*	-1.62(0.77)	-3.94(0.00)*	-4.80(0.00)*	*I (1)*
629	-1.63(0.46)	-2.66(0.26)	-6.10(0.00)*	-5.05(0.00)*	-1.35(0.60)	-2.63(0.27)	-11.09(0.00)*	-25.63(0.00)*	*I (1)*
631	-3.57(0.01)*	-4.27(0.01)*	-6.85(0.00)*	-6.77(0.00)*	-2.30(0.18)	-2.82(0.02)	-7.10(0.00)*	-7.04(0.00)*	*I (0)*
632	-1.31(0.62)	-2.27(0.44)	-6.00(0.00)*	-5.99(0.00)*	-1.27(0.64)	-2.43(0.36)	-6.28(0.00)*	-6.51(0.00)*	*I (1)*
651	-2.40(0.15)	-3.35(0.07)***	-5.87(0.00)*	-5.81(0.00)*	-2.58(0.11)	-3.01(0.14)	-5.90(0.00)*	-5.78(0.00)*	*I (1)*
652	-2.61(0.10)	-2.12(0.52)	-5.89(0.00)*	-6.13(0.00)*	-2.60(0.10)	-2.13(0.51)	-5.87(0.00)*	-6.13(0.00)*	*I (1)*
653	-2.75(0.07)***	-2.42(0.36)	-5.96(0.00)*	-6.15(0.00)*	-3.87(0.01)*	-2.07(0.55)	-6.12(0.00)*	-9.69(0.00)*	*I (1)*
654	-6.15(0.00)*	-5.90(0.00)*	-8.67(0.00)*	-8.73(0.00)*	-5.82(0.00)*	-5.55(0.00)*	-11.04(0.00)*	-16.08(0.00)*	*I (0)*
656	-3.00(0.04)**	-1.48(0.82)	-6.03(0.00)*	-7.82(0.00)*	-3.05(0.04)**	-1.34(0.86)	-6.14(0.00)*	-7.84(0.00)*	*I (1)*
657	-0.79(0.81)	-2.28(0.43)	-6.76(0.00)*	-6.87(0.00)*	-1.60(0.47)	-2.55(0.30)	-7.12(0.00)*	-9.04(0.00)*	*I (1)*
661	-3.16(0.03)**	-5.39(0.00)*	-6.35(0.00)*	-6.21(0.00)*	-3.38(0.02)*	-2.89(0.08)***	-6.25(0.00)*	-6.15(0.00)*	*I (0)*
662	-1.43(0.56)	-5.99(0.00)*	-7.80(0.01)*	-6.69(0.00)*	-1.35(0.69)	-1.43(0.04)**	-5.46(0.00)*	-5.56(0.00)*	*I (0)*
663	-2.19(0.21)	-7.79(0.00)*	-5.45(0.03)**	-5.35(0.03)**	-1.84(0.36)	-3.81(0.03)**	-16.62(0.00)*	-19.48(0.00)*	*I (0)*
664	-2.58(0.11)	-3.44(0.06)***	-5.95(0.00)*	-6.06(0.00)*	-2.63(0.09)***	-2.35(0.04)**	-6.47(0.00)*	-6.87(0.00)*	*I (0)*
665	-2.25(0.19)	-2.02(0.57)	-5.68(0.00)*	-5.76(0.00)*	-1.89(0.32)	-1.77(0.70)	-5.65(0.00)*	-5.85(0.00)*	*I (1)*

666	-2.35(0.16)	-3.76(0.03)**	-6.86(0.00)*	-6.79(0.00)*	-2.27(0.19)	-3.69(0.03)**	-10.55(0.00)*	-13.14(0.00)*	*I (0)*
672	-1.04(0.73)	-5.70(0.00)*	-6.36(0.00)*	-6.22(0.00)*	-2.16(0.22)	-5.35(0.00)*	-13.96(0.00)*	-15.87(0.00)*	*I (0)*
673	-2.37(0.16)	-5.13(0.00)*	-6.04(0.00)*	-5.96(0.00)*	-2.08(0.25)	-5.13(0.00)*	-16.16(0.00)*	-15.77(0.00)*	*I (0)*
678	-5.43(0.00)*	-2.94(0.16)	-1.49(0.53)	-1.80(0.68)	-2.70(0.08)***	-2.51(0.32)	-8.32(0.00)*	-16.00(0.00)*	*I (1)*
684	-2.65(0.09)***	-2.38(0.39)	-6.38(0.00)*	-6.95(0.00)*	-2.65(0.09)***	-2.38(0.39)	-6.48(0.00)*	-6.92(0.00)*	*I (1)*
691	-1.26(0.64)	-4.17(0.01)*	-11.58(0.00)*	-11.44(0.00)*	-0.68(0.84)	-4.51(0.00)*	-11.84(0.00)*	-12.01(0.00)*	*I (0)*
695	-2.28(0.18)	-4.52(0.00)*	-5.19(0.00)*	-5.37(0.00)*	-2.24(0.19)	-4.46(0.00)*	-14.80(0.00)*	-36.42(0.00)*	*I (0)*
696	-3.33(0.02)**	-6.17(0.00)*	-10.73(0.00)*	-10.64(0.00)*	-3.15(0.03)**	-6.18(0.00)*	-19.71(0.00)*	-28.15(0.00)*	*I (0)*
697	-0.89(0.78)	-1.71(0.73)	-6.54(0.00)*	-6.47(0.00)*	-0.88(0.79)	-1.74(0.72)	-6.55(0.00)*	-6.47(0.00)*	*I (1)*
698	-1.88(0.34)	-2.47(0.34)	-9.85(0.00)*	-10.28(0.00)*	-2.76(0.07)***	-2.14(0.51)	-10.22(0.00)*	-12.36(0.00)*	*I (1)*
711	-2.01(0.28)	-1.89(0.64)	-7.98(0.00)*	-7.17(0.00)*	-1.56(0.49)	-2.44(0.35)	-12.86(0.00)*	-19.03(0.00)*	*I (1)*
715	-1.28(0.63)	-2.51(0.32)	-6.11(0.00)*	-5.96(0.00)*	-1.29(0.63)	-2.06(0.55)	-6.12(0.00)*	-6.16(0.00)*	*I (1)*

717	-2.28(0.18)	-3.30(0.08)***	-7.32(0.00)*	-7.28(0.00)*	-2.18(0.22)	-3.40(0.08)***	-7.32(0.00)**	-7.28(0.00)**	*I (0)*
718	-1.53(0.51)	-1.45(0.83)	-6.42(0.00)*	-6.56(0.00)*	-1.63(0.46)	-1.13(0.91)	-6.45(0.00)*	-12.96(0.00)*	*I (1)*
719	-1.69(0.43)	-2.22(0.47)	-4.97(0.00)*	-6.28(0.00)*	-2.33(0.17)	-3.30(0.08)***	-12.27(0.00)*	-30.93(0.00)*	*I (1)*
722	-2.76(0.07)***	-2.53(0.31)	-9.77(0.00)*	-11.20(0.00)*	-4.08(0.00)*	-2.53(0.31)	-9.03(0.00)*	-11.14(0.00)*	*I (1)*
723	-2.78(0.07)***	-5.36(0.09)*	-5.64(0.04)**	-7.34(0.00)*	-4.99(0.00)*	-4.02(0.02)**	-9.39(0.00)*	-10.41(0.00)*	*I (0)*
724	-1.53(0.51)	-0.38(0.99)	-5.01(0.00)*	-5.29(0.00)*	-1.52(0.52)	-0.03(0.99)	-5.02(0.00)*	-4.97(0.00)*	*I (1)*
725	-3.01(0.04)**	-3.07(0.13)	-9.64(0.00)*	-9.90(0.00)*	-3.29(0.02)**	-3.06(0.13)	-10.73(0.00)*	-12.75(0.00)*	*I (1)*
729	-2.93(0.05)***	-6.45(0.05)***	-4.04(0.00)*	-4.57(0.01)*	-2.24(0.20)	-6.53(0.00)*	-14.25(0.00)*	-14.31(0.00)*	*I (0)*
732	-1.66(0.45)	-1.52(0.81)	-9.89(0.00)*	-10.46(0.00)*	-3.60(0.0)*	-1.16(0.91)	-9.56(0.00)*	-13.53(0.00)*	*I (1)*
812	-9.79(0.00)*	-4.97(0.00)*	-4.09(0.00)*	-4.48(0.01)*	-11.16(0.00)*	-16.16(0.00)*	-4.09(0.00)*	-4.43(0.01)*	*I (0)*
821	-1.02(0.74)	-1.32(0.87)	-4.37(0.00)*	-4.43(0.01)*	-1.02(0.74)	-1.63(0.76)	-4.19(0.00)*	-4.93(0.00)*	*I (1)*
831	-3.36(0.02)**	-3.39(0.07)***	-6.72(0.00)*	-4.70(0.00)*	-3.55(0.00)*	-2.60(0.08)***	-6.74(0.00)*	-7.75(0.00)*	*I (0)*
841	-5.74(0.00)*	-3.44(0.06)***	-4.52(0.00)*	-6.00(0.00)*	-6.17(0.00)*	-3.70(0.03)**	-4.82(0.00)*	-6.27(0.00)*	*I (0)*

842	-1.58(0.48)	-1.50(0.81)	-5.82(0.00)*	-5.78(0.00)*	-1.61(0.47)	-1.51(0.81)	-5.80(0.00)*	-5.82(0.00)*	*I (1)*
851	-2.55(0.11)	-4.07(0.03)**	-6.27(0.00)*	-6.34(0.00)*	-3.10(0.03)**	-4.04(0.02)**	-7.40(0.00)*	-9.23(0.00)*	*I (0)*
861	-4.70(0.00)*	-5.73(0.02)**	-4.86(0.00)*	-6.00(0.00)*	-2.72(0.08)***	-5.02(0.00)*	-19.71(0.00)*	-30.21(0.00)*	*I (0)*
862	-3.86(0.01)*	-4.02(0.02)**	-9.11(0.00)*	-7.91(0.00)*	-3.72(0.01)*	-3.89(0.02)**	-10.76(0.00)*	-26.27(0.00)*	*I (0)*
891	-2.32(0.17)	-2.43(0.36)	-6.40(0.00)*	-6.20(0.00)*	-2.23(0.20)	-2.36(0.39)	-6.52(0.00)*	-6.33(0.00)*	*I (1)*
892	-1.96(0.30)	-4.77(0.00)*	-7.17(0.00)*	-7.08(0.00)*	-1.60(0.48)	-5.70(0.00)*	-13.50(0.00)*	-13.44(0.00)*	*I (0)*
893	-2.43(0.14)	-2.04(0.56)	-8.37(0.00)*	-8.49(0.00)*	-2.32(0.17)	-1.83(0.67)	-8.75(0.00)*	-12.27(0.00)*	*I (1)*
894	-2.27(0.19)	-4.37(0.01)*	-10.65(0.00)*	-10.48(0.00)*	-2.05(0.27)	-4.57(0.00)*	-12.38(0.00)*	-12.14(0.00)*	*I (0)*
895	-3.48(0.01)**	-4.24(0.01)*	-9.70(0.00)*	-9.63(0.00)*	-3.30(0.02)**	-4.15(0.01)**	-11.17(0.00)*	-11.71(0.00)*	*I (0)*
897	-2.12(0.24)	-2.84(0.19)	-8.84(0.00)*	-9.15(0.00)*	-2.07(0.26)	-2.68(0.25)	-9.24(0.00)*	-12.45(0.00)*	*I (1)*
899	-1.72(0.41)	-2.38(0.39)	-7.21(0.00)*	-4.91(0.00)*	-1.21(0.66)	-2.29(0.43)	-7.20(0.00)*	-7.16(0.00)*	*I (1)*
lnY^{GR}	-1.65(0.45)	-1.19(0.90)	-5.61(0.00)*	-5.88(0.00)*	-2.14(0.23)	-0.99(0.93)	-5.56(0.00)*	-7.52(0.00)*	*I (1)*
$lnREX$	-1.92(0.32)	-1.13(0.91)	-8.26(0.00)*	-8.18(0.00)*	-1.87(0.34)	-1.81(0.68)	-8.25(0.00)*	-8.18(0.00)*	*I (1)*
$lnVOL^{TRGR}$	-0.02(0.27)	-2.12(0.52)	-6.36(0.00)*	-6.29(0.00)*	-2.14(0.23)	-2.23(0.46)	-6.36(0.00)*	-6.29(0.00)*	*I (1)*
$lnPOS^{TRGR}$	-0.13(0.46)	-0.22(0.53)	-5.38(0.01)*	-5.35(0.00)*	-1.23(0.62)	-1.63(0.35)	-5.64(0.01)*	-5.36(0.00)*	*I (1)*

$lnNEG^{TRGR}$	-0.23(0.24)	-0.45(0.23)	-6.24(0.00)*	-6.11(0.01)*	-1.33(0.72)	-1.36(0.74)	-7.20(0.01)*	-7.23(0.00)*	*I (1)*

Notes: Numbers in parentheses are the one-sided *p*-values from MacKinnon (1996). '*', '**', and '***' indicate the rejection of the null hypothesis (H_0) for a unit root at the 1%, 5%, and 10% significance levels, respectively. *'I'* indicates an intercept-only model, and *'T & I'* indicates a model with both trends and intercept specifications for the unit root tests. *I(0)* & *I(1)* denote stationary and first-differenced series, respectively.

Source: Author’s calculations (2023)

Table 9. ADF and PP Unit Root Test Results for Import Sectors

Variables *[ln (MV_i)]*	*ADF* Test				*PP* Test				
	Level		First Difference		Level		First Difference		Order of Integration
	I	*T & I*	*I*	*T & I*	*I*	*T & I*	*I*	*T & I*	
001	-2.50(0.12)	-2.61(0.28)	-7.16(0.00)*	-7.07(0.00)*	-2.50(0.12)	-2.62(0.27)	-7.53(0.00)*	-7.43(0.00)*	*I (1)*
054	-3.39(0.02)**	-3.67(0.04)**	-6.90(0.00)*	-7.20(0.00)*	-3.36(0.02)**	-3.57(0.05)**	-13.29(0.00)*	-21.08(0.00)*	*I (0)*
061	-3.42(0.02)**	-4.54(0.00)*	-4.29(0.00)*	-4.53(0.01)*	-3.49(0.01)*	-4.52(0.00)*	-9.27(0.00)*	-8.61(0.00)*	*I (0)*
071	-4.30(0.00)*	-4.14(0.01)**	-8.79(0.00)*	-9.70(0.00)*	-4.30(0.00)*	-4.59(0.00)*	-8.77(0.00)*	-9.60(0.00)*	*I (0)*
072	-1.87(0.34)	-2.66(0.26)	-7.77(0.00)*	-7.77(0.00)*	-1.75(0.40)	-2.61(0.28)	-8.30(0.00)*	-8.34(0.00)*	*I (1)*
075	-4.07(0.00)*	-4.75(0.00)*	-6.97(0.00)*	-6.91(0.00)*	-4.05(0.00)*	-4.86(0.00)*	-14.61(0.00)*	-14.91(0.00)*	*I (0)*
081	-1.74(0.40)	-3.54(0.05)***	-7.13(0.00)*	-7.06(0.00)*	-1.43(0.56)	-3.49(0.05)**	-13.18(0.00)*	-15.41(0.00)*	*I (0)*
211	-3.05(0.04)**	-2.66(0.26)	-4.04(0.00)*	-4.40(0.00)*	-2.73(0.08)***	-2.39(0.38)	-5.43(0.00)*	-5.81(0.00)*	*I (1)*

231	-2.41(0.14)	-2.68(0.25)	-8.02(0.00)*	-8.11(0.00)*	-2.45(0.14)	-2.73(0.23)	-8.08(0.00)*	-8.36(0.00)*	*I (1)*
251	-2.04(0.27)	-3.50(0.05)***	-8.71(0.00)*	-8.66(0.00)*	-1.92(0.32)	-3.45(0.06)***	-10.15(0.00)*	-13.46(0.00)*	*I (0)*
262	-0.45(0.98)	-0.37(0.99)	-8.81(0.00)*	-4.80(0.00)*	-2.31(0.17)	-2.85(0.19)	-8.80(0.00)*	-9.25(0.00)*	*I (1)*
266	-1.94(0.31)	-1.39(0.85)	-8.37(0.00)*	-9.34(0.00)*	-1.85(0.35)	-0.83(0.95)	-8.54(0.00)*	-15.01(0.00)*	*I (1)*
275	-2.76(0.07)***	-2.84(0.19)	-8.27(0.00)*	-8.15(0.00)*	-2.70(0.08)***	-2.80(0.21)	-8.62(0.00)*	-8.50(0.00)*	*I (1)*
276	-1.16(0.68)	-2.71(0.24)	-5.32(0.00)*	-5.31(0.00)*	-1.16(0.68)	-2.31(0.42)	-5.35(0.00)*	-5.70(0.00)*	*I (1)*
282	-2.90(0.05)***	-2.16(0.50)	-10.93(0.00)*	-10.79(0.00)*	-2.77(0.07)***	-4.47(0.01)*	-11.81(0.00)*	-11.64(0.00)*	*I (0)*
283	-2.90(0.05)***	-2.16(0.50)	-10.93(0.00)*	-10.79(0.00)*	-2.77(0.07)***	-4.47(0.01)*	-11.81(0.00)*	-11.64(0.00)*	*I (0)*
284	-2.63(0.09)***	-4.18(0.01)*	-8.06(0.00)*	-8.03(0.00)*	-2.67(0.09)***	-4.18(0.01)*	-8.89(0.00)*	-8.85(0.00)*	*I (0)*
291	-2.25(0.19)	-4.12(0.01)**	-7.53(0.00)*	-7.43(0.00)*	-2.04(0.27)	-3.84(0.02)**	-17.39(0.00)*	-17.83(0.00)*	*I (0)*
292	-2.31(0.17)	-2.02(0.57)	-6.10(0.00)*	-5.44(0.00)*	-3.57(0.01)*	-1.76(0.70)	-6.14(0.00)*	-8.21(0.00)*	*I (1)*
321	-1.72(0.42)	-2.23(0.06)***	-9.19(0.00)*	-3.85(0.03)**	-6.41(0.00)*	-7.12(0.00)*	-14.03(0.00)*	-15.54(0.00)*	*I (0)*
332	-1.02(0.74)	-1.87(0.65)	-5.79(0.00)*	-5.77(0.00)*	-1.03(0.73)	-1.87(0.65)	-6.03(0.00)*	-8.23(0.00*	*I (1)*
411	-3.56(0.01)*	-3.75(0.03)**	-12.08(0.00)*	-12.26(0.00)*	-3.56(0.01)*	-3.75(0.03)**	-12.08(0.00)*	-12.26(0.00)*	*I (0)*

422	-2.60(0.10)	-2.72(0.23)	-7.05(0.00)*	-5.05(0.00)*	-2.72(0.08)***	-2.82(0.20)	-7.06(0.00)*	-7.02(0.00)*	*I (1)*
431	-1.84(0.36)	-2.33(0.41)	-6.86(0.00)*	-6.78(0.00)*	-1.81(0.37)	-2.35(0.40)	-6.89(0.00)*	-6.81(0.00)*	*I (1)*
512	-1.35(0.60)	-2.35(0.40)	-6.29(0.00)*	-6.23(0.00)*	-1.01(0.74)	-2.40(0.37)	-8.32(0.00)*	-12.31(0.00)*	*I (1)*
513	-0.68(0.84)	-3.74(0.03)*	-6.06(0.00)*	-6.07(0.00)*	-0.18(0.93)	-3.80(0.03)**	-6.78(0.00)*	-6.42(0.00)*	*I (0)*
514	-0.96(0.76)	-2.09(0.53)	-4.86(0.00)*	-4.80(0.00)*	-1.14(0.69)	-2.36(0.39)	-4.72(0.00)*	-4.69(0.00)*	*I (1)*
515	-2.41(0.15)	-2.52(0.32)	-7.12(0.00)*	-7.33(0.00)*	-2.41(0.15)	-2.52(0.32)	-7.14(0.00)*	-7.80(0.00)*	*I (1)*
521	-1.55(0.50)	-2.09(0.54)	-6.04(0.00)*	-6.04(0.00)*	-1.56(0.49)	-2.09(0.54)	-6.55(0.00)*	-8.17(0.00)*	*I (1)*
531	-1.69(0.43)	-1.46(0.83)	-5.68(0.00)*	-5.75(0.00)*	-1.46(0.53)	-2.01(0.35)	-7.25(0.01)*	-6.93(0.00)*	*I (1)*
532	-1.93(0.32)	-1.68(0.74)	-6.07(0.00)*	-6.11(0.00)*	-1.79(0.38)	-1.42(0.84)	-6.19(0.00)*	-8.22(0.00)*	*I (1)*
533	-5.60(0.00)*	-4.59(0.01)*	-2.73(0.08)****	-2.63(0.07)***	-1.54(0.50)	-1.55(0.80)	-5.53(0.00)*	-10.22(0.00)*	*I (1)*
541	-1.12(0.70)	-1.23(0.89)	-5.31(0.00)*	-5.42(0.00)*	-1.12(0.70)	-1.60(0.78)	-5.27(0.00)*	-10.38(0.00)*	*I (1)*
551	-1.46(0.54)	-1.63(0.77)	-3.87(0.01)*	-4.20(0.01)*	-1.50(0.53)	-1.81(0.68)	-5.82(0.00)*	-6.00(0.00)*	*I (1)*
554	-1.64(0.45)	-1.00(0.93)	-4.86(0.00)*	-5.08(0.00)*	-1.59(0.48)	-1.25(0.89)	-4.80(0.00)*	-5.21(0.00)*	*I (1)*
561	-3.89(0.00)*	-7.17(0.00)*	-8.43(0.00)*	-8.31(0.00)*	-4.01(0.00)*	-5.31(0.00)*	-21.29(0.00)*	-19.11(0.00)*	*I (0)*
571	-1.53(0.51)	-4.78(0.00)*	-7.32(0.00)*	-7.22(0.00)*	-2.96(0.05)*	-5.01(0.00)*	-11.21(0.00)*	-11.04(0.00)*	*I (0)*
581	-1.41(0.57)	-1.39(0.85)	-6.06(0.00)*	-6.16(0.00)*	-1.69(0.43)	-1.23(0.89)	-6.09(0.00)*	-7.46(0.00)*	*I (1)*

599	-4.62(0.00)*	-1.40(0.85)	-5.36(0.00)*	-9.59(0.00)*	-1.72(0.68)	-1.62(0.77)	-5.38(0.00)*	-11.60(0.00)*	*I (1)*
612	-1.89(0.33)	-1.54(0.80)	-7.89(0.00)*	-5.84(0.00)*	-1.76(0.40)	-1.14(0.91)	-8.12(0.00)*	-10.16(0.00)*	*I (1)*
621	-1.95(0.31)	-2.31(0.51)	-5.83(0.00)*	-6.00(0.00)*	-3.54(0.01)*	-1.97(0.00)*	-5.68(0.00)*	-7.20(0.00)*	*I (0)*
629	-2.51(0.12)	-0.96(0.94)	-4.71(0.00)*	-6.52(0.00)*	-2.90(0.05)**	-0.55(0.98)	-5.41(0.00)*	-10.32(0.00)*	*I (1)*
631	-1.82(0.36)	-1.43(0.84)	-6.27(0.00)*	-6.59(0.00)*	-1.81(0.37)	-1.43(0.84)	-6.27(0.00)*	-9.73(0.00)*	*I (1)*
632	-3.47(0.01)*	-3.04(0.13)	-7.72(0.00)*	-8.31(0.00)*	-4.26(0.00)*	-3.02(0.14)	-8.02(0.00)*	-9.67(0.00)*	*I (1)*
633	-1.67(0.44)	-6.35(0.20)	-8.05(0.00)*	-8.17(0.00)*	-1.28(0.63)	-1.62(0.77)	-8.21(0.00)*	-8.32(0.00*	*I (1)*
641	-2.55(0.11)	-1.77(0.70)	-3.86(0.01)*	-4.82(0.00)*	-1.66(0.45)	-0.88(0.94)	-4.30(0.00)*	-7.64(0.00)*	*I (1)*
642	-2.37(0.16)	-1.03(0.93)	-5.81(0.00)*	-6.78(0.00)*	-2.44(0.14)	-0.85(0.95)	-5.80(0.00)*	-8.54(0.00)*	*I (1)*
651	-1.70(0.42)	-1.36(0.86)	-6.85(0.00)*	-7.29(0.00)*	-1.74(0.41)	-1.38(0.85)	-6.83(0.00)*	-7.47(0.00)*	*I (1)*
652	-3.90(0.00)*	-2.59(0.29)	-6.36(0.00)*	-4.51(0.01)*	-4.31(0.00)*	-3.62(0.04)*	-6.57(0.00)*	-8.21(0.00)*	*I (0)*
653	-1.95(0.31)	-1.64(0.76)	-6.14(0.00)*	-6.44(0.00)*	-3.25(0.02)**	-3.86(0.66)	-6.15(0.00)*	-6.58(0.00)*	*I (1)*
654	-2.38(0.15)	-1.42(0.84)	-7.54(0.00)*	-9.59(0.00)*	-2.50(0.12)	-1.33(0.87)	-7.27(0.00)*	-9.18(0.00)*	*I (1)*
655	-1.63(0.46)	-1.28(0.88)	-4.90(0.00)*	-4.99(0.00)*	-1.73(0.41)	-1.21(0.90)	-4.74(0.00)*	-7.84(0.00)*	*I (1)*
656	-2.98(0.04)**	-2.62(0.27)	-9.22(0.00)*	-4.85(0.00)*	-3.04(0.04)**	-2.50(0.33)	-9.32(0.00)*	-12.90(0.00)*	*I (1)*
661	-2.06(0.26)	-4.41(0.01)*	-2.06(0.26)	-2.18(0.49)	-2.29(0.18)	-3.28(0.08)***	-13.60(0.00)*	-22.88(0.00)*	*I (0)*
662	-1.77(0.39)	-2.44(0.36)	-7.52(0.00)*	-7.52(0.00)*	-1.41(0.57)	-2.44(0.35)	-7.85(0.00)*	-8.76(0.00)*	*I (1)*

663	-2.02(0.28)	-2.27(0.44)	-7.08(0.00)*	-7.17(0.00)*	-1.39(0.58)	-2.29(0.43)	-7.36(0.00)*	-9.94(0.00)*	*I (1)*
664	-1.87(0.34)	-1.87(0.65)	-5.96(0.00)*	-6.00(0.00)*	-2.90(0.05)***	-1.50(0.81)	-6.04(0.00)*	-6.74(0.00)*	*I (1)*
665	-2.95(0.05)***	-1.94(0.62)	-6.12(0.00)*	-6.56(0.00)*	-3.75(0.01)*	-1.85(0.66)	-6.12(0.00)*	-6.87(0.00)*	*I (1)*
667	-2.37(0.16)	-2.31(0.42)	-6.47(0.00)*	-7.21(0.00)*	-2.21(0.21)	-2.20(0.48)	-9.17(0.00)*	-23.05(0.00)*	*I (1)*
671	-0.13(0.94)	-4.87(0.00)*	-6.04(0.00)*	-6.02(0.00)*	-1.84(0.36)	-4.66(0.00)*	-12.42(0.00)*	-19.57(0.00)*	*I (0)*
672	-1.59(0.48)	-3.62(0.04)**	-8.49(0.00)*	-8.48(0.00)*	-1.26(0.64)	-3.56(0.04)**	-10.21(0.00)*	-11.03(0.00)*	*I (0)*
673	-0.91(0.78)	-3.68(0.04)**	-7.09(0.00)*	-7.02(0.00)*	-0.53(0.87)	-3.68(0.04)**	-10.47(0.00)*	-8.83(0.00)*	*I (0)*
674	-1.37(0.59)	-2.28(0.44)	-5.50(0.00)*	-5.43(0.00)*	-1.56(0.49)	-2.28(0.44)	-5.52(0.00)*	-5.49(0.00)*	*I (1)*
676	-2.29(0.18)	-2.20(0.07)***	-6.08(0.00)*	-6.24(0.00)*	-3.41(0.02)**	-3.56(0.04)**	-15.53(0.00)*	-15.92(0.00)*	*I (1)*
677	-1.52(0.51)	-2.07(0.54)	-5.49(0.00)*	-5.43(0.00)*	-1.26(0.64)	-2.14(0.51)	-5.87(0.00)*	-6.45(0.00)*	*I (1)*
678	-2.34(0.17)	-3.41(0.06)*	-8.23(0.00)*	-8.33(0.00)*	-2.74(0.08)***	-3.26(0.09)****	-8.57(0.00)*	-9.16(0.00)*	*I (0)*
679	-2.32(0.17)	-3.04(0.13)	-8.34(0.00)*	-8.19(0.00)*	-2.27(0.19)	-3.07(0.13)	-9.53(0.00)*	-9.32(0.00)*	*I (1)*
681	-1.92(0.32)	-5.06(0.00)*	-4.97(0.00)*	-5.04(0.00)*	-1.78(0.39)	-2.62(0.08)***	-6.53(0.00)*	-7.34(0.00)*	*I (0)*
682	-1.83(0.36)	-3.03(0.14)	-5.18(0.00)*	-5.57(0.00)*	-1.47(0.54)	-3.08(0.13)	-8.67(0.00)*	-8.69(0.00)*	*I (1)*

683	-1.72(0.41)	-2.28(0.38)	-10.31(0.00)*	-10.28(0.00)*	-1.57(0.49)	-2.08(0.54)	-10.31(0.00)*	-10.13(0.00)*	*I (1)*
684	-5.16(0.00)*	-3.61(0.04)**	-4.17(0.00)*	-5.90(0.00)*	-2.98(0.04)**	-1.83(0.07)***	-6.26(0.00)*	-7.48(0.00)*	*I (0)*
685	-5.71(0.00)*	-5.69(0.00)*	-9.72(0.00)*	-9.62(0.00)*	-5.69(0.00)*	-5.66(0.00)*	-19.80(0.00)*	-17.22(0.00)*	*I (0)*
686	-2.94(0.05)**	-3.42(0.06)***	-9.94(0.00)*	-9.85(0.00)*	-3.06(0.04)**	-3.61(0.04)**	-9.94(0.00)*	-10.39(0.00)*	*I (0)*
687	-2.22(0.20)	-4.16(0.01)*	-6.16(0.00)*	-6.09(0.00)*	-2.22(0.20)	-4.18(0.01)*	-14.11(0.00)*	-13.84(0.00)*	*I (0)*
689	-2.55(0.11)	-2.61(0.30)	-8.51(0.00)*	-8.83(0.00)*	-2.43(0.14)	-2.43(0.36)	-8.74(0.00)*	-13.01(0.00)*	*I (1)*
691	-2.55(0.11)	-2.25(0.45)	-7.32(0.00)*	-7.19(0.00)*	-2.61(0.10)	-2.11(0.53)	-7.26(0.00)*	-7.98(0.00)*	*I (1)*
692	-1.94(0.32)	-1.58(0.78)	-8.53(0.00)*	-8.64(0.00)*	-1.68(0.43)	-1.79(0.69)	-8.61(0.00)*	-8.89(0.00)*	*I (1)*
693	-3.17(0.03)**	-4.39(0.00)*	-7.62(0.00)*	-7.56(0.00)*	-3.19(0.03)**	-4.32(0.01)*	-9.25(0.00)*	-9.14(0.00)*	*I (0)*
694	-1.83(0.36)	-1.83(0.67)	-6.21(0.00)*	-6.36(0.00)*	-2.84(0.06)***	-1.63(0.76)	-6.25(0.00)*	-9.14(0.00)*	*I (1)*
695	-5.41(0.00)*	-5.04(0.00)*	-6.49(0.00)*	-6.57(0.00)*	-3.00(0.04)**	-1.70(0.03)**	-7.01(0.00)	-15.79(0.00)*	*I (0)*
696	-2.28(0.18)	-1.79(0.69)	-8.75(0.00)*	-10.73(0.00)*	-2.72(0.08)***	-1.79(0.69)	-8.34(0.00)*	-12.42(0.00)*	*I (1)*
697	-1.81(0.37)	-1.73(0.72)	-6.64(0.00)*	-6.82(0.00)*	-1.97(0.30)	-1.50(0.81)	-6.65(0.00)*	-7.69(0.00)*	*I (1)*
698	-1.11(0.70)	-1.56(0.79)	-7.08(0.00)*	-7.54(0.00)*	-1.13(0.70)	-1.85(0.66)	-7.08(0.00)*	-8.66(0.00)*	*I (1)*

711	-1.18(0.67)	-2.93(0.16)	-6.23(0.00)*	-6.16(0.00)*	-1.09(0.72)	-2.93(0.16)	-6.62(0.00)*	-6.97(0.00)*	*I (1)*
712	-2.22(0.20)	-4.31(0.01)*	-7.80(0.00)*	-7.72(0.00)*	-2.18(0.22)	-4.01(0.02)**	-11.49(0.00)*	-11.92(0.00)*	*I (0)*
714	-2.92(0.06)***	-2.15(0.51)	5.31(0.00)*	-5.74(0.00)*	-3.32(0.02)**	-2.17(0.49)	-5.29(0.00)*	-5.72(0.00)*	*I (1)*
715	-2.92(0.05)*	-2.15(0.51)	-5.31(0.00)*	-5.74(0.00)*	-3.32(0.02)*	-2.17(0.49)	-5.29(0.00)*	-5.72(0.00)*	*I (1)*
717	-1.89(0.33)	-2.52(0.32)	-8.78(0.00)*	-8.92(0.00)*	-1.51(0.52)	-2.52(0.32)	-9.70(0.00)*	-22.24(0.00)*	*I (1)*
718	-2.58(0.11)	-2.33(0.42)	-6.80(0.00)*	-6.90(0.00)*	-2.68(0.09)***	-2.10(0.53)	-6.96(0.00)*	-8.17(0.00)*	*I (1)*
719	-1.79(0.38)	-2.43(0.36)	-5.70(0.00)*	-5.70(0.00)*	-1.52(0.51)	-2.39(0.38)	-7.53(0.00)*	-9.50(0.00)*	*I (1)*
722	-1.73(0.41)	-1.77(0.71)	-4.68(0.00)*	-4.68(0.00)*	-3.29(0.02)**	-1.22(0.89)	-5.13(0.00)*	-6.94(0.00)*	*I (1)*
723	-1.00(0.74)	-2.03(0.57)	-4.73(0.00)*	-7.41(0.00)*	-1.03(0.73)	-2.03(0.57)	-5.85(0.00)*	-10.00(0.00)*	*I (1)*
724	-7.24(0.00)*	-5.57(0.00)*	-3.77(0.01)*	-5.33(0.00)*	-7.66(0.00)*	-3.64(0.04)**	-5.49(0.00)*	-8.35(0.00)*	*I (0)*
725	-1.82(0.36)	-0.97(0.94)	-6.69(0.00)*	-7.92(0.00)*	-1.81(0.37)	-0.75(0.96)	-6.67(0.00)*	-9.11(0.00)*	*I (1)*
726	-1.61(0.47)	-1.37(0.85)	-5.03(0.00)*	-5.29(0.00)*	-1.54(0.50)	-1.24(0.89)	-5.01(0.00)*	-10.51(0.00)*	*I (1)*
729	-1.72(0.42)	-3.05(0.13)	-6.77(0.00)*	-7.31(0.00)*	-1.40(0.57)	-3.07(0.13)	-10.31(0.00)*	-13.35(0.00)*	*I (1)*
731	-1.64(0.45)	-1.81(0.68)	-6.39(0.00)*	-6.53(0.00)*	-1.73(0.41)	-1.61(0.77)	-6.49(0.00)*	-12.13(0.00)*	*I (1)*

732	-3.35(0.02)**	-5.56(0.00)*	-6.63(0.00)*	-6.59(0.00)*	-3.32(0.02)**	-4.93(0.00)*	-11.96(0.00)*	-11.89(0.00)*	*I (0)*
733	-3.97(0.00)*	-2.10(0.53)	-7.78(0.00)*	-4.35(0.01)*	2.34(0.16)	-1.80(0.69)	-8.59(0.00)*	-24.52(0.00)*	*I (1)*
734	-2.65(0.09)***	-4.48(0.01)*	-7.97(0.00)*	-7.87(0.00)*	-2.57(0.11)	-4.43(0.01)*	-13.95(0.00)*	-16.67(0.00)*	*I (0)*
735	-2.99(0.04)**	-4.58(0.00)*	-4.82(0.00)*	-5.12(0.00)*	-2.51(0.12)	-4.61(0.00)*	-12.89(0.00)*	-14.84(0.00)*	*I (0)*
812	-3.29(0.02)**	-4.07(0.01)*	-7.56(0.00)*	-7.48(0.00)*	-3.16(0.03)	-4.10(0.01)*	-23.30(0.00)*	-26.25(0.00)*	*I (0)*
821	-1.90(0.33)	-1.36(0.86)	-11.17(0.00)*	-13.75(0.00)*	-1.94(0.31)	-0.94(0.94)	-10.00(0.00)*	-29.70(0.00)*	*I (1)*
841	-6.60(0.00)*	-3.67(0.04)**	-6.76(0.00)*	-7.63(0.00)*	-8.53(0.00)*	-6.56(0.00)*	-7.01(0.00)*	-8.21(0.00)*	*I (0)*
861	-3.58(0.01)*	-1.93(0.62)	-5.10(0.00)*	-5.36(0.00)*	-5.41(0.00)*	-2.34(0.40)	-5.04(0.00)*	-5.30(0.00)*	*I (1)*
862	-2.50(0.12)	-1.93(0.94)	-5.05(0.00)*	-5.36(0.00)*	-5.41(0.00)*	-2.34(0.40)	-5.05(0.00)*	-5.30(0.00)*	*I (1)*
864	-2.50(0.13)	-0.93(0.94)	-5.42(0.00)*	-6.06(0.00)*	-2.82(0.06)***	-0.37(0.99)	-5.42(0.00)*	-8.83(0.00)*	*I (1)*
891	-2.32(0.17)	-1.43(0.84)	-5.78(0.00)*	-6.16(0.00)*	-2.38(0.15)	-0.99(0.93)	-5.74(0.00)*	-8.54(0.00)*	*I (1)*
892	-1.45(0.55)	-1.79(0.69)	-5.46(0.00)*	-6.18(0.00)*	-1.53(0.51)	-1.37(0.86)	-5.46(0.00)*	-6.21(0.00)*	*I (1)*
893	-3.39(0.02)**	-2.40(0.38)	-8.31(0.00)*	-9.81(0.00)*	-4.34(0.00)*	-2.40(0.38)	-8.08(0.00)*	-9.81(0.00)*	*I (1)*
894	-4.05(0.00)*	-3.30(0.08)***	-8.45(0.00)*	-10.18(0.00)*	-5.17(0.00)*	-3.62(0.04)**	-8.18(0.00)*	-10.27(0.00)*	*I (0)*

895	-3.13(0.03)**	-2.17(0.49)	-6.38(0.00)*	-7.06(0.00)*	-4.80(0.00)*	-2.32(0.42)	-6.38(0.00)*	-8.01(0.00)*	*I (1)*
897	-1.41(0.57)	-4.89(0.00)*	-8.92(0.00)*	-8.78(0.00)*	-1.16(0.68)	-4.95(0.00)*	-15.05(0.00)*	-14.20(0.00)*	*I (0)*
899	-3.45(0.01)*	-2.00(0.08)***	-4.57(0.00)*	-4.76(0.00)*	-10.12(0.00)*	-3.61(0.04)**	-4.44(0.00)*	-6.18(0.00)*	*I (0)*
lnY^{TR}	-0.21(0.93)	-2.84(0.19)	-7.02(0.00)*	-6.93(0.00)*	-0.12(0.94)	-2.88(0.18)	-7.53(0.00)*	-7.40(0.00)*	*I (1)*
lnREX	-1.92(0.32)	-1.13(0.91)	-8.26(0.00)*	-8.18(0.00)*	-1.87(0.34)	-1.81(0.68)	-8.25(0.00)*	-8.18(0.00)*	*I (1)*
$lnVOL^{TRGR}$	-1.12(0.70)	-1.40(0.85)	-6.15(0.00)*	-6.02(0.00)*	-1.30(0.62)	-1.69(0.74)	-6.13(0.00)*	-6.01(0.00)*	*I (1)*
$lnPOS^{TRGR}$	-0.13(0.46)	-0.22(0.53)	-5.38(0.01)*	-5.35(0.00)*	-1.23(0.62)	-1.63(0.35)	-5.64(0.01)*	-5.36(0.00)*	*I (1)*
$lnNEG^{TRGR}$	-0.23(0.24)	-0.45(0.23)	-6.24(0.00)*	-6.11(0.01)*	-1.33(0.72)	-1.36(0.74)	-7.20(0.01)*	-7.23(0.00)*	*I (1)*

Notes: This table adheres to the notes provided in Table 8.

Source: Author’s calculations (2023)

This study uses annual time series data to conduct our empirical investigation. We incorporate up to three lagged observations to each first-differenced variable to capture the intricate dynamics inherent in the dataset. The appropriate lag length is determined using the Akaike Information Criterion (*AIC*)[98] and Shwartz Information Criterion (*SIC*)[99]. While the examination of annual data permits the inclusion of a maximum of four lags, previous empirical studies like Bahmani-Oskooee and Wang (2007, 2008) and Bahmani-Oskooee et al. (2013) have opted for the usage of only two lags. Notably, when dealing with cointegration analysis, more extended time-series data yield more effective results than a larger number of observations (Hakkio & Rush, 1991). Finally, each industry's estimated coefficients and associated diagnostic results reflect the optimal regression models.

7.4 Symmetric Analysis of Bilateral Exports and Imports Flows

7.4.1. Empirical Estimates of the Linear Export Demand Specification

We commence our analysis by examining the empirical estimates of Turkey’s linear ARDL export demand model as depicted in Equation (26). The empirical estimates of both short-run and long-run influences of the examined explanatory variables are presented in Table 10, and the corresponding diagnostic tests are outlined in Table 11. Notably, Bahmani-Oskooee and Bolhassani (2014) emphasized that if a given explanatory variable displays at least one statistically significant short-term lagged coefficient or effect at the 10% or 5% significance level, such outcomes are denoted in Table 10 as *“Yes.”* Conversely, a *“No”* designation is used when a specific explanatory variable lacks significant short-term lagged coefficients.

The short-run empirical findings unveil that the measure of the real lira-euro rate volatility ($\Delta lnVOL^{TRGR}$) displays at least one significant short-term coefficient at lag j in 40 export industries. However, these significant short-term effects persist into the long-term within 28 export industries, coded explicitly as 053, 099, 121, 262, 263, 266, 273, 276, 512, 513, 554, 629, 631, 653, 654, 656, 657, 661, 711, 717, 724, 725, 812, 841, 842, 851, 893, and 895. In addition, this volatility estimate is negative in sixteen and positive in twelve export industries.

These long-run coefficient estimates are deemed valid and meaningful, as evidenced by the significant cointegration F-test results for all industries except for four export industries coded 053, 724, 842, and 893. For these specific export industries where the F-test does not reach statistical significance, an alternative cointegration test, namely the t-test or ECM_{t-1}

[98] This statistical criterion has been developed by Akaike (1970).
[99] This statistical criterion has been developed by Schwarz (1978).

test[100], is employed to confirm cointegration among the explanatory variables. This is achieved using long-term coefficients and a long-term export demand model (Equation (1)) to obtain *ECM*. Subsequently, the error correction model given in Equation (26) is modified, replacing the linear combination of lagged-level variables with ECM_{t-1} and estimating the new model while introducing the same optimal lag orders[101]. A significantly negative estimate for ECM_{t-1} indicates that the variables converge toward their equilibrium values. The t-test is then employed to evaluate the statistical significance of the ECM_{t-1} estimate. In cases where the variables exhibit both *I(0)* and *I(1)* properties, Pesaran et al. (2001) have established upper and lower critical bounds for the t-test, similar to the F-test. As indicated in Table 11, this test confirms the presence of cointegration in these four export industries using the critical bounds given by Banerjee et al. (1998).

Overall, all export industries demonstrate cointegration, leading to the conclusion that the real lira-euro volatility significantly impacts the exports of these Turkish export industries in the long-run. Moreover, out of the 28 export industries, all except for export industries coded 711 (machinery for power generation with an export share of 4.64%) and 841 (clothing with an export share of 18.35%) are relatively small in terms of their export share and are affected both positively and negatively by real lira-euro volatility.

The long-run empirical estimates reveal that the most critical determinant of Turkish exports to Germany is the level of economic activity in Germany, as lnY_t^{GR} has a significant estimate in 65 export sectors, with an expected positive sign in 62 export industries. This positive relationship indicates that Germany will likely import more products from Turkey as its economy expands, benefiting Turkish exporters. The thriving German market provides increased demand for Turkish products. However, in 03 export industries, the coefficient associated with Germany's real income (lnY_t^{GR}) is negative. This could be attributed to Germany's domestic production of more substitute products, leading to fewer imports from Turkey in these industries (Bahmani-Oskooee, 1986). In such cases, even as Germany's real income increases, the demand for Turkish products in those industries may be dampened due to the availability of domestic substitutes.

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[100] This cointegration test, as originally developed by Banerjee et al. (1998) in the context of Engle-Granger methodology, found that the t-test employed to evaluate the statistical significance of the ECM_{t-1} statistic exhibited a nonstandard distribution. Consequently, the authors introduced new critical values for this diagnostic test. Pesaran et al. (2001) also established new critical values for the upper and lower bounds of this test. Nonetheless, in this research, we have adopted the critical values provided by Banerjee et al. (1998) for small samples.

[101] For a detailed explanation of the ECM_{t-1} statistic, follow Aftab et al. (2016).

The long-term coefficients of the export specification indicate that the real lira-euro rate ($lnREX_t$) is statistically significant in 23 export industries. Among these 23 industries, the influence of the lira-euro rate is positive in 13 export industries. This suggests that as the Turkish lira depreciates against the German euro over time, there is an increase in the exports of Turkish products to Germany in these sectors. However, in 10 export industries, the influence of the real lira-euro rate is negative. This negative sign indicates that a sustained depreciation of the TL against the German euro reduces the exports of Turkish products to Germany over time in these industries.

The differing effects of the real lira-euro rate on various export industries can be attributed to several factors. The positive effect observed in specific industries can be explained by the increased competitiveness of Turkish products in the German market when the lira depreciates against the euro. A weaker lira makes Turkish products relatively more affordable for German consumers, potentially resulting in higher demand and increased exports in those sectors. On the other hand, the negative effect observed in specific industries suggests that a sustained depreciation of the lira negatively impacts export performance. This may occur due to higher input costs for these industries, mainly if they heavily rely on imported raw materials or intermediate goods. The lira depreciation increases the cost of imported inputs, making the final exported products less competitive in the German market.

Finally, the influence of trade reforms (DM_t) on Turkish exports is significant in 55 sectors. Among these 55 sectors, the impact is negative in only 04 industries, indicating that trade liberalization has decreased exports within those sectors. In contrast, in 39 export industries, the expected positive sign suggests that trade liberalization has stimulated Turkish exports, leading to an increase in those sectors.

This finding highlights the heterogenous impact of trade liberalization on different industries within the Turkish export sector. While most industries experience a positive effect, indicating that liberalization has improved their competitiveness and market access, there are a few industries where the effect is negative. The negative effect observed in these industries could be attributed to various factors. For example, removing trade barriers and increased competition resulting from liberalization may have exposed these industries to international competition, making it harder for them to compete effectively. Additionally, factors such as insufficient productivity levels, limited technological advancements, or inadequate infrastructure in these export industries may have hindered their ability to take advantage of the opportunities created by trade liberalization.

Table 10. Short-term and Long-term Coefficients of the Symmetric ARDL Export Demand Specification (26)

There is at Least One Short-Term Estimate Significant				Long-run Coefficients				
SITC-1	lnY^{GR}	$lnREX$	$lnVOL^{TRGR}$	C	DM	lnY^{GR}	$lnREX$	$lnVOL^{TRGR}$
031	No	No	No	-14.61	0.41	0.55	-0.78**	-0.05
032	No	Yes	No	36.07	0.45	-1.26	1.98**	0.21
046	No	Yes	No	-19.86	0.62	0.58	2.72**	-0.40
047	Yes	No	No	-88.57**	-0.46	3.04**	0.92*	-0.27
048	Yes	Yes	Yes	-61.14	0.64**	2.19**	-0.48**	0.02
051	No	Yes	No	-58.47**	-0.09	2.32**	1.24**	0.01
052	Yes	Yes	No	-50.02**	0.49*	1.83**	0.17	-0.04
053	No	Yes	Yes	-27.73	0.81**	1.02	0.03	-0.27*
054	Yes	Yes	No	-41.22**	0.90**	1.54**	0.02	-0.15
055	No	Yes	No	30.88	1.53**	-1.09	-0.23	-0.12
061	No	Yes	Yes	-20.22	0.23	0.77	0.35	0.16
062	No	Yes	Yes	-75.30**	0.44*	2.68**	0.07	0.02
073	Yes	Yes	No	-176.86**	-0.13	6.23**	0.15	0.19
074	Yes	Yes	No	-139.19**	-1.59	4.94**	1.23	-0.08
075	Yes	Yes	No	-55.06**	0.51	1.98**	0.46*	0.16
099	Yes	Yes	Yes	-168.97**	0.08	6.03**	-0.26	0.68**
112	No	No	No	-21.54	0.57**	0.77	0.14	-0.01
121	Yes	Yes	Yes	31.52	1.11*	-1.05	0.68	-0.58**

221	No	Yes	No	-268.97**	1.32**	9.50**	2.65**	0.03
262	Yes	No	Yes	-21.66	0.37	0.75	0.37	-0.50*
263	Yes	Yes	Yes	14.61	0.68*	-0.25	-0.28	1.23**
266	Yes	Yes	Yes	21.50	0.58	-0.68	-0.30	0.70**
273	Yes	No	Yes	-140.93**	-0.16	4.95**	1.07**	-0.86**
276	Yes	No	No	22.75**	0.39*	-0.69*	-1.11**	0.62**
283	Yes	Yes	No	-91.55**	0.15	3.29**	0.52	-0.37
291	Yes	Yes	No	13.01	7.17**	-0.60*	0.34	-0.02
292	Yes	Yes	No	-45.47**	0.18	1.67**	-0.05	0.14
421	Yes	Yes	Yes	-262.84**	-1.12	9.31**	-0.70	0.05
422	Yes	Yes	Yes	-143.09**	-0.48	5.04**	-0.90	-0.37
512	Yes	Yes	Yes	-53.53	-0.14	2.09**	-1.66**	0.91**
513	Yes	No	Yes	-183.75**	-0.39	6.47**	-0.28	-0.79*
514	Yes	Yes	No	-94.02**	-0.44	3.37**	0.44*	-0.02
541	Yes	Yes	No	-43.84	-0.52	1.68*	-1.17**	-0.06
551	Yes	No	No	-127.91**	1.84	4.43**	0.38	-0.22
553	Yes	Yes	Yes	-124.52*	3.27**	4.31*	-0.79**	0.08
554	Yes	No	Yes	-459.07**	1.99**	16.02**	0.01	-1.40**
581	Yes	No	No	-311.42**	0.25	10.99**	0.71	0.04
599	Yes	No	No	-227.45**	-1.06	8.11**	-0.55	0.14
612	Yes	Yes	No	-74.55*	2.93**	2.58*	-0.11	0.11

621	Yes	Yes	Yes	-46.38**	1.59	1.61**	0.10	0.03
629	Yes	No	Yes	-118.63**	7.30**	3.99**	0.05	-0.51**
631	Yes	No	Yes	-68.45**	1.73*	2.38**	-0.92	-0.74**
632	Yes	Yes	No	-74.22**	2.11**	2.55**	0.40	-0.24
651	Yes	Yes	No	3.95	0.35*	-0.04	-0.18	0.09
652	No	Yes	Yes	-14.72	0.27	0.59	-0.41**	-0.03
653	Yes	No	Yes	-92.74**	2.03**	3.35**	0.15	-0.29*
654	Yes	Yes	Yes	-105.18**	0.25	3.73**	0.68	-0.43*
656	Yes	Yes	Yes	-15.95	0.67*	0.63	-0.15	-0.27**
657	Yes	Yes	Yes	-20.61**	0.12	0.91**	-0.33*	0.63**
661	No	No	Yes	-23.68	2.48**	0.81	-0.14	0.29**
662	Yes	Yes	No	77.24**	0.23	2.72**	0.63*	0.02
663	Yes	No	No	-302.79**	2.98*	10.50**	1.01	-0.74
664	No	No	No	-31.82	0.50*	1.16	-0.15	0.09
665	No	Yes	No	-2.54	0.57**	0.13	0.05	0.08
666	Yes	No	No	-136.49**	0.88	4.84**	-0.17	-0.30
672	Yes	No	Yes	-134.46**	1.24**	4.87**	-0.71	0.35
673	Yes	Yes	No	-158.65**	2.13**	5.56**	-0.30	-0.32
678	Yes	No	No	-109.69**	2.45**	3.86**	-0.05	-0.17
684	Yes	No	Yes	-37.83	0.91*	1.41	-0.01	0.06
691	Yes	Yes	Yes	-137.18**	-0.19	4.84**	0.30	-0.22

695	Yes	Yes	Yes	-195.85**	0.92	6.96**	-0.02	-0.00
696	Yes	No	No	-347.20**	2.09**	12.11**	0.57	-0.22
697	Yes	Yes	No	-77.58**	0.37	2.76**	0.56*	0.02
698	No	No	No	-57.01	1.31**	2.01	0.12	-0.09
711	Yes	No	Yes	-273.87**	1.01**	9.58**	-0.34	-0.47**
715	Yes	Yes	No	-208.68**	0.03	7.38**	0.74**	-0.07
717	Yes	Yes	Yes	-79.53*	3.64**	2.82*	-0.89	0.59*
718	Yes	Yes	No	-112.09**	0.63**	3.99**	0.05	-0.21
719	Yes	No	No	-215.82**	1.17**	7.69**	-0.31	0.05
722	Yes	No	No	-11.32	1.42**	0.41	0.11	0.12
723	No	No	No	11.15	1.95**	-0.39	0.44	0.27
724	Yes	Yes	Yes	-294.33**	0.57	10.32**	1.44	-1.30*
725	Yes	Yes	Yes	-277.69**	-0.10	9.83**	-0.01	-1.22**
729	Yes	Yes	No	-141.07**	-0.54	5.06**	-0.46	0.07
732	Yes	Yes	No	-191.87**	0.58	6.83**	-0.40	-0.27
812	Yes	No	Yes	20.85	0.39	-0.65	-0.56*	0.32**
821	Yes	Yes	No	-83.74*	1.99**	2.90*	0.02	-0.13
831	Yes	Yes	No	47.63**	1.15**	-1.62**	-0.54	0.25
841	Yes	Yes	Yes	11.21	0.31**	-0.31	-0.06	0.16*
842	Yes	Yes	Yes	-17.16	0.03	0.63	0.66**	-0.30*
851	Yes	Yes	Yes	-86.51**	1.59**	3.16**	-0.93*	0.70**

861	Yes	Yes	No	-306.93**	1.33	10.79**	0.30	-0.05
862	Yes	Yes	No	-146.68**	-0.09	5.12**	-0.56	-0.54
891	Yes	No	Yes	-35.51	0.94	1.24	0.88	-0.08
892	Yes	No	No	-154.93**	1.58**	5.61**	-0.39	-0.17
893	Yes	Yes	Yes	-90.56*	0.65	3.15*	0.18	-1.51**
894	Yes	Yes	No	-249.04**	-0.33	8.75**	1.44**	-0.35
895	Yes	No	Yes	-87.53**	3.06**	3.01**	0.76	0.67**
897	Yes	Yes	Yes	-228.89**	1.23	8.00**	0.88	-0.49
899	Yes	Yes	No	-101.28**	0.22	3.59**	0.24	-0.23

Notes: '*' ('**') represents significance at the 10% (5%) levels, respectively.

Source: Author's calculations (2023)

7.4.2 Diagnostic Tests Corresponding to Estimates of the Linear Export Demand Model

In our empirical study, we conducted several diagnostic statistical tests beyond the *F*-test and ECM_{t-1} tests to assess the validity and robustness of our empirical findings (refer to Table 11). The Lagrange multiplier test (*LM*) was applied to determine the presence of autocorrelation in the residuals of each export specification. The outcomes of the *LM* test reveal no significant autocorrelation in the residuals, providing further support for the validity of our empirical results. Furthermore, we performed Ramsey's (1969) *RESET* test to assess the potential misspecification of our proposed export demand model. The test results were insignificant, indicating that most export functions are correctly specified and free from misspecification. To ensure the stability of the coefficients in both the short-term and long-term, we employed the *CUSUM* plus *CUSUMSQ* tests. These tests confirmed the stability of the estimated coefficients in most cases. In most instances, these residual stability tests are presented as plots. However, due to the large size of the empirical coefficients, we reported stable instances as "*S*" while unstable instances as "*US*." Lastly, we utilized the adjusted R^2 statistic to evaluate the goodness of fit of our empirical estimates. The magnitude of the adjusted R^2 suggests that our linear export specification provides a good fit for the data. The results from these diagnostic statistics strongly support the robustness and meaningfulness of our derived empirical estimates.

Table 11. Diagnostics Corresponding to Coefficients of the Symmetric ARDL Export Demand Specification (26)

SITC-1	Industry Name	Export Share	*F*-test	ECM_{t-1}	Adj. R^2	*LM*	*RESET*	*CUSUM*	*CUSUMSQ*
031	Fish, fresh & simply preserved	0.36%	2.35	-0.14(3.20)**	0.94	0.05*	0.42	S	US
032	Fish, in airtight containers, n.e.s & fish preparations.	0.01%	4.99**	-0.63(4.67)**	0.51	0.85	0.17	S	S
046	Meal and flour of wheat or meslin	0.00%	5.00**	-0.61(4.69)**	0.74	0.17	0.80	S	S
047	Meal & flour of cereals, except wheat/meslin	0.00%	6.32**	-0.64(5.26)**	0.68	0.16	0.18	S	S
048	Cereal preps & preps of flour of fruits & vegs.	0.25%	7.07**	-0.34(5.57)**	0.98	0.23	0.30	S	S
051	Fruit, fresh, and nuts excl. Oil nuts	2.16%	8.55**	-0.76(6.15)**	0.81	0.52	0.27	S	S
052	Dried fruit, including artificially dehydrated	0.54%	3.42	-0.46(3.87)**	0.90	0.13	0.03	S	S

053	Fruit, preserved and fruit preparations	0.63%	3.61	-0.37(3.96)**	0.88	0.13	0.60	S	S
054	Vegetables, roots & tubers, fresh or dried	0.57%	5.29**	-0.64(4.79)**	0.77	0.11	0.85	S	S
055	Vegetables, roots & tubers pres or prepared n.e.s.	0.08%	3.70	-0.14(4.02)**	0.84	0.00**	0.44	US	US
061	Sugar and honey	0.03%	4.18*	-0.51(4.29)**	0.57	0.84	0.92	S	S
062	Sugar confectionery, sugar preps. Ex chocolate confectionery	0.13%	4.39*	-0.47(4.39)**	0.96	0.25	0.13	S	S
073	Chocolate & other food preptns. cont. Cocoa, n.e.s.	0.13%	6.66**	-0.59(5.37)**	0.90	0.00**	0.06*	US	US
074	Tea and mate	0.01%	10.19**	-0.97(6.67)**	0.31	0.39	0.43	S	S
075	Spices	0.06%	5.07**	-0.53(4.71)**	0.87	0.25	0.12	S	S
099	Food preparations, n.e.s.	2.25%	5.83**	-0.57(5.04)**	0.96	0.96	0.19	S	S
112	Alcoholic beverages	0.10%	2.46	-0.28(3.28)**	0.92	0.14	0.91	S	S

121	Tobacco, unmanufactured	0.02%	5.37**	-0.73(4.87)**	0.69	0.24	0.22	S	S
221	Oil seeds, oil nuts, and oil kernels	0.08%	14.66**	-0.66(8.04)**	0.92	0.42	0.11	S	S
262	Wool and other animal hair	0.00%	9.18**	-0.96(6.32)**	0.86	0.39	0.17	S	S
263	Cotton	0.26%	11.56**	-0.91(7.14)**	0.70	0.58	0.22	S	S
266	Synthetic and regenerated artificial fibers	0.22%	4.36*	-0.20(4.40)**	0.74	0.64	0.24	S	S
273	Stone, sand, and gravel	0.08%	6.01**	-0.81(5.17)**	0.91	0.63	0.16	S	S
276	Other crude minerals	0.20%	8.59**	-0.37(6.11)**	0.85	0.24	0.22	S	S
283	Ores & concentrates of nonferrous base metals	0.24%	8.71**	-0.98(6.15)**	0.78	0.90	0.32	S	S
291	Crude animal materials, n.e.s.	0.05%	83.24**	-0.62(19.14)**	0.96	0.00**	0.61	S	US
292	Crude vegetable materials, n.e.s.	0.09%	3.38	-0.56(3.83)**	0.80	0.97	0.23	S	S

421	Fixed vegetable oils, soft	0.04%	7.89**	-0.66(5.88)**	0.83	0.74	0.57	S	S
422	Other fixed vegetable oils	0.00%	6.19**	-0.91(5.18)**	0.60	0.54	0.69	S	S
512	Organic chemicals	0.20%	6.01**	-0.69(5.16)**	0.85	0.86	0.91	S	S
513	Inorg. chemicals elems., oxides, halogen salts	0.05%	6.51**	-0.73(5.36)**	0.86	0.91	0.45	S	S
514	Other inorganic chemicals	0.06%	7.71**	-0.80(5.78)**	0.79	0.63	0.65	S	S
541	Medicinal & pharmaceutical products	0.06%	4.31*	-0.49(4.33)**	0.80	0.00**	0.19	S	US
551	Essential oils, perfume, and flavour materials	0.05%	6.02**	-0.54(5.11)**	0.91	0.21	0.31	S	S
553	Perfumery, cosmetics, dentifrices, etc.	0.24%	9.04**	-0.40(6.34)**	0.99	0.25	0.31	S	S

554	Soaps, cleansing & polishing preparations	0.08%	7.18**	-0.84(5.60)**	0.91	0.20	0.17	S	S
581	Plastic materials, regenerated cellulose & resins	3.78%	6.49**	-0.83(5.30)**	0.83	0.23	0.39	S	S
599	Chemical materials and products, n.e.s.	0.38%	7.66**	-0.87(5.76)**	0.80	0.31	0.79	S	S
612	Manufacturing of leather or artificial. or reconst. leather	0.02%	7.28**	-0.78(5.62)**	0.71	0.00**	0.05*	US	US
621	Materials of rubber	0.65%	26.92**	-0.27(10.94)**	0.99	0.34	0.71	S	S
629	Articles of rubber, n.e.s.	1.48%	166.45**	-0.54(27.25)**	0.99	0.87	0.72	S	S
631	Veneers, plywood boards & other wood, worked, n.e.s.	0.01%	6.82**	-0.74(5.48)**	0.70	0.11	0.86	S	S
632	Wood manufactures, n.e.s.	0.12%	6.05**	-0.42(5.12)**	0.91	0.57	0.38	S	S

651	Textile yarn and thread	0.54%	2.94	-0.43(3.58)**	0.55	0.17	0.80	S	S
652	Cotton fabrics, woven ex. narrow or spec. fabrics	0.23%	3.53	-0.37(3.92)**	0.89	0.40	0.77	S	S
653	Text fabrics woven ex narrow, spec, not cotton	0.59%	16.17**	-0.84(8.45)**	0.94	0.01**	0.38	US	US
654	Tulle, lace, embroidery, ribbons, trimmings	0.07%	5.14**	-0.68(4.74)**	0.79	0.34	0.10	S	S
656	Made-up articles, wholly or chiefly of text materials	0.51%	6.43**	-0.37(5.30)**	0.92	0.26	0.48	S	S
657	Floor coverings, tapestries, etc.	0.62%	8.35**	-0.69(6.06)**	0.86	0.77	0.22	S	S
661	Lime, cement & fabr. bldg.mat. Ex glass/clay mat	0.24%	19.53**	-0.29(9.28)**	0.98	0.11	0.42	S	S

662	Clay and refractory construction materials	0.74%	4.27*	-0.29(4.34)**	0.96	0.02**	0.04**	US	US
663	Mineral manufactures, n.e.s.	0.15%	5.90**	-0.93(5.08)**	0.77	0.12	0.38	S	S
664	Glass	0.33%	3.02	-0.28(3.62)**	0.95	0.16	0.82	S	S
665	Glassware	0.16%	4.16*	-0.29(4.27)**	0.86	0.34	0.95	S	S
666	Pottery	0.10%	3.85	-0.78(4.10)**	0.85	0.45	0.38	S	S
672	Ingots & other primary forms of iron or steel	0.43%	6.15**	-0.62(5.19)**	0.85	0.78	0.32	S	S
673	Iron and steel bars, rods, angles, shapes, sections	0.65%	3.78	-0.68(4.09)**	0.79	0.26	0.26	S	S
678	Tubes, pipes, and fittings of iron or steel	0.56%	5.87**	-0.60(5.04)**	0.82	0.05*	0.86	S	US
684	Aluminium	4.39%	2.84	-0.23(3.54)**	0.98	0.19	0.76	S	S
691	Finished structural parts and structures, n.e.s	1.00%	2.51	-0.41(3.31)**	0.92	0.35	0.67	S	US

695	Tools for use in the hand or machines	0.31%	4.27*	-0.95(4.32)**	0.83	0.11	0.87	S	US
696	Cutlery	0.02%	13.46**	-0.68(7.65)**	0.67	0.11	0.52	S	S
697	Household equipment of base metals	0.57%	4.43*	-0.45(4.42)**	0.94	0.54	0.19	S	S
698	Manufactures of metal, n.e.s.	2.62%	5.13**	-0.29(4.74)**	0.96	0.32	0.53	S	US
711	Power-generating machinery other than electric	4.64%	10.11**	-0.95(6.62)**	0.95	0.34	0.17	S	S
715	Metalworking machinery	0.30%	8.23**	-0.80(6.01)**	0.96	0.24	0.02**	US	S
717	Textile and leather machinery	0.89%	8.83**	-0.66(6.21)**	0.81	0.70	0.16	S	US
718	Machines for special industries	0.28%	5.27**	-0.56(4.80)**	0.95	0.15	0.12	S	S
719	Machinery and appliances non-electrical parts	7.16%	8.24**	-0.80(6.01)**	0.96	0.13	0.45	S	S

722	Electric power machinery and switchgear	2.02%	7.17**	-0.23(5.60)**	0.96	0.00**	0.01**	US	US
723	Equipment for distributing electricity	1.73%	11.11**	-0.26(6.97)**	0.92	0.57	0.13	S	S
724	Telecommunications apparatus	0.01%	2.79	-0.82(3.52)**	0.80	0.90	0.31	S	S
725	Domestic electrical equipment	0.79%	12.54**	-0.88(7.38)**	0.94	0.31	0.24	S	S
729	Other electrical machinery and apparatus	0.75%	2.57	-0.57(3.35)**	0.88	0.90	0.13	S	S
732	Road motor vehicles	14.56%	3.79	-0.55(4.07)**	0.97	0.16	0.74	S	S
812	Sanitary, plumbing, heating & lighting fixtures	0.89%	8.62**	-0.16(6.21)**	0.98	0.42	0.42	S	S
821	Furniture	2.20%	3.98	-0.26(4.17)**	0.99	0.20	0.74	S	S
831	Travel goods, handbags, and similar articles	0.02%	7.32**	-0.28(5.65)**	0.80	0.33	0.28	S	S

841	Clothing except fur clothing	18.35%	13.93**	-0.21(7.82)**	0.98	0.38	0.12	S	S
842	Fur clothing and articles of artificial fur	0.03%	3.27	-0.39(3.80)**	0.84	0.19	0.14	S	S
851	Footwear	0.43%	12.48**	-0.71(7.39)**	0.89	0.31	0.91	S	S
861	Scientific, medical, optical, meas./contr. instrument	0.01%	4.80*	-0.88(4.58)**	0.83	0.00**	0.01**	US	US
862	Photographic and cinematographic supplies	0.00%	6.86**	-0.88(5.48)**	0.84	0.64	0.13	S	S
891	Musical instruments, sound recorders, and parts	0.01%	3.54	-0.45(3.93)**	0.77	0.14	0.36	S	US
892	Printed matter	0.16%	10.15**	-0.59(6.69)**	0.80	0.20	0.46	S	S
893	Articles of artificial plastic materials n.e.s.	0.01%	3.19	-0.52(3.72)**	0.67	0.54	0.76	S	US

894	Perambulators, toys, games, and sporting goods	0.05%	11.41**	-0.74(7.03)**	0.82	0.82	0.65	S	S
895	Office and stationery supplies, n.e.s.	0.00%	12.69**	-0.75(7.42)**	0.64	0.11	0.38	S	S
897	Jewellery and gold/silver smiths' wares	0.57%	5.50**	-0.62(4.91)**	0.87	0.64	0.12	S	S
899	Manufactured articles, n.e.s.	0.23%	4.02*	-0.53(4.19)**	0.92	0.38	0.01	S	S

Notes: The symbols '*' and '**' denote statistical significance at the 10% and 5% levels, respectively. When k equals 3, the upper bound critical value of the F-test is 4.020 at the 10% significance level and 4.803 at the 5% significance level. These critical values for the F-bounds test have been referenced from Narayan (2005, Case III, page 1988)[102]. The value inside the parenthesis next to ECM_{t-1} represents the absolute value of the t-statistic. For k equals 3, the critical value of this t-statistic is -3.45 at the 10% significance level and -3.82 at the 5% significance level. These critical values for the *ECM* test have been derived from Banerjee et al. (1998, Table 1, Case A, page 276). In the context of diagnostics, the *LM* test stands for the Langrange Multiplier test, which assesses residual serial correlation, and the *RESET* test is Ramsey's test used to detect functional misspecification. *LM* and *RESET* tests follow a χ^2 distribution with one degree of freedom. The critical values for these tests are 2.70 at the 10% significance level and 3.84 at the 5% significance level, respectively. The stability of estimated coefficients is evaluated using recursive estimates,

[102] Pesaran et al. (2001) presented critical values for large samples. However, we considered the critical values of Narayan (2005) because our sample size was limited to 43 observations.

CUSUM, and *CUSUMSQ* techniques. Each industry's export share is computed as a percentage of Turkey's total exports to Germany within the specified sample period[103]. Notably, this export share calculation is based on the data from the year 2022.

The abbreviation "*n.e.s*" refers to commodities and transactions not classified elsewhere in the SITC-1 classification.

Source: Author's calculations (2023)

[103] To compute the proportion of each industry's exports relative to Turkey's total exports to Germany during the chosen time frame, we employed the subsequent formula:

$$Export\ share\ (\%) = \left({}^{Industry\ i\ exports}/_{Total\ exports}\right) * 100 \tag{89}$$

7.5 Empirical Estimates of the Linear Import Demand Model

We have estimated Turkey's linear ARDL import demand model, as shown in Equation (27). Table 12 presents the coefficient estimates for the short-term and long-term effects of the model, while Table 13 provides the corresponding diagnostic statistics. The short-run empirical estimates reveal that the bilateral real lira-euro volatility ($\Delta lnVOL^{TRGR}$) has a significant impact on the short-run lagged coefficients with lag j in 77 out of the 114 import industries considered. It is worth noting that although some short-run coefficient estimates are insignificant for specific industries (coded 515, 541, 599, 631, 685, and 696), they still lead to significant long-run effects in 39 import industries (coded 072, 075, 231, 266, 283, 284, 321, 514, 515, 532, 541, 599, 612, 631, 642, 656, 672, 673, 676, 677, 679, 682, 684, 685, 694, 696, 711, 715, 717, 718, 726, 731, 733, 735, 821, 893, 894, 897, and 899). Among these 39 import industries, cointegration is established through the F-test or the t-test.

Turning to the long-run empirical estimates, we find that the long-run effect of real lira-euro volatility ($lnVOL^{TRGR}$) is negative for 27 small import industries, except for three large import industries coded 541 (pharmaceutical products having an import share of 4.24%), 599 (chemical materials and products with an import share of 2.98%), and 711 (machinery for power generation with an import share of 4.83%). The negative relationship suggests that businesses in these small and large import industries are more cautions and less willing to engage in international trade when faced with higher exchange rate volatility. Conversely, the long-run empirical estimates suggest that the volatility of the real lira-euro exchange rate ($lnVOL^{TRGR}$) has a positive influence on 9 small Turkish import industries. This indicates that an increase in lira-euro volatility stimulates imports in these industries. Notably, when considering both small and large Turkish import industries, which collectively account for 19% of total imports from Germany, it becomes evident that the volatility of the real lira-euro exchange rate ($lnVOL^{TRGR}$) has an adverse impact on 19% of Turkey's total imports from Germany. This implies that exchange rate volatility negatively affects a significant portion of Turkey's import activity from Germany.

The long-run empirical estimates indicate that the trade liberalization reforms in 1984 (*DM)* exerted a significant influence on Turkish import industries in 75 instances. This outcome indicates that removing trade barriers and opening up markets have influenced the import behavior of businesses operating in these industries. As expected, an increase in Turkey's real income (lnY_t^{TR}) leads to higher imports of German products to Turkey, observed in 72 out of the 76 significant cases. This finding suggests that as the income of the Turkish economy grows, there is a corresponding increase in the demand for imported goods from Germany. Notably, a significant negative effect is linked solely to the real income of Turkey (lnY_t^{TR}) within 04 instances, revealing that increased economic growth in Tukey brings about a production shift towards import-substituting items domestically, leading to a decrease in imports (Bahmani-Oskooee, 1986).

Furthermore, the long-term effects of the lira-euro exchange rate (*lnREX*) exhibit positive and negative impacts in 11 and 31 cases, respectively. The presence of negative estimates implies that the depreciation of the TL to the euro hinders Turkish imports from Germany across a broad spectrum of industries. As a result, businesses and consumers in Turkey may reduce their imports from Germany, leading to a decline in trade (import) flows. In contrast, the positive estimate in 11 cases indicates that a depreciation of the TL stimulates imports from Germany in those specific industries. This suggests that certain industries may benefit from a weaker domestic currency (TL) as it makes imported goods relatively cheaper, potentially increasing their competitiveness compared to domestic alternatives.

Table 12. Short-term and Long-term Coefficients of the Linear ARDL Import Demand Specification (27)

There is at Least One Short-Run Estimate Significant				Long-run Coefficients				
SITC-1	lnY^{TR}	*lnREX*	$lnVOL^{TRGR}$	*C*	*DM*	lnY^{TR}	*lnREX*	$lnVOL^{TRGR}$
001	Yes	Yes	Yes	5.24	1.92*	-0.23	-0.09**	0.22
054	Yes	Yes	No	-13.65	1.51**	0.54	-0.36	-0.16
061	Yes	Yes	Yes	9.25	3.30**	-0.34	-1.55*	0.57
071	Yes	Yes	No	-25.42*	1.16	0.92*	0.85	-0.42
072	Yes	Yes	Yes	-7.36	-0.16	0.37	-0.11	0.48*
075	Yes	Yes	Yes	-49.75**	0.35	1.73**	2.61**	-0.57*
081	Yes	No	Yes	-25.04**	0.54	0.99**	-0.05	-0.03
211	Yes	Yes	No	16.01**	1.11**	-0.56**	-0.68*	0.30
231	Yes	No	Yes	-18.66**	0.99**	0.74**	-0.16	-0.28*
251	Yes	No	No	-30.37**	0.99*	1.16**	0.02	4.01
262	Yes	Yes	Yes	34.27**	1.09	-1.27**	-0.74	-0.41
266	Yes	Yes	Yes	14.10**	0.46	-0.40	-0.99**	0.62**
275	No	Yes	No	-12.62	0.34	0.43	1.40*	0.44
276	Yes	No	Yes	-10.00**	0.47	0.41**	0.09	-0.15
282	Yes	No	Yes	-54.21**	1.47	1.99**	1.38	-0.87
283	Yes	Yes	Yes	-24.21**	3.47	2.39**	-2.30**	-1.87**
284	Yes	Yes	Yes	-58.76**	-0.07	2.11**	2.34**	-0.68*
291	Yes	Yes	Yes	-33.46**	1.16*	1.28**	0.23	0.33

292	Yes	Yes	No	-9.23	0.79*	0.34	0.25	-0.16
321	Yes	Yes	Yes	-30.46**	0.11	1.26**	-0.43	-1.09**
332	Yes	Yes	No	-10.91**	0.78**	0.44**	-0.02**	-0.15
411	No	Yes	No	6.56	-0.11	-0.26	0.18	-0.45
422	Yes	Yes	Yes	-7.64	-0.34	0.31	0.13	-0.06
431	No	Yes	No	4.30	0.94**	-0.15	-0.31*	0.18
512	Yes	No	No	-6.15*	0.61**	0.31**	0.06	-0.06
513	Yes	Yes	No	-20.82**	0.38*	0.91**	0.20	0.01
514	Yes	Yes	Yes	-0.88	0.71**	0.09	-0.34**	0.22**
515	Yes	No	No	-19.35*	0.90**	0.71*	0.06	-0.40*
521	Yes	Yes	No	-7.20	-0.24	0.31	-0.19**	0.39
531	No	No	Yes	3.65	0.53**	-0.12	0.28	-0.02
532	Yes	Yes	Yes	-8.19*	0.63**	0.30*	0.27	-0.39**
533	No	No	Yes	-11.72*	0.77**	0.47*	0.10	-0.15
541	Yes	Yes	No	-29.14**	0.47*	1.19**	-0.11**	-0.35**
551	Yes	Yes	Yes	-15.28*	0.76*	0.60**	-0.08*	-0.09
554	Yes	No	Yes	-6.38	0.49*	0.27*	0.02	-0.08
561	Yes	Yes	Yes	-22.29**	3.59**	0.84**	0.25	-0.11
571	Yes	Yes	No	-18.12**	0.49	0.72**	0.34	0.24
581	Yes	No	Yes	-13.35**	0.68**	0.55**	0.14	-0.10
599	Yes	No	No	-11.21**	0.79**	0.47**	-0.01**	-0.13*

612	Yes	Yes	Yes	-14.84*	1.16**	0.57*	-0.55*	-0.37**
621	Yes	No	Yes	-13.46	0.40	0.54*	0.01	-0.13
629	Yes	Yes	No	-5.71*	1.78**	0.20	-0.04*	-0.09
631	Yes	No	No	-13.84**	1.54**	0.48**	0.26	-0.41**
632	No	Yes	No	-10.73	1.91**	0.37	0.61	-0.12
633	No	Yes	Yes	-4.23	0.50	0.21	-0.33*	0.82
641	Yes	No	No	-8.06*	0.72**	0.32**	-0.00	-0.12
642	Yes	Yes	Yes	-7.24**	3.42**	1.39**	-0.27**	-0.26**
651	No	No	Yes	1.52	0.81**	-0.04	0.21	-0.08
652	No	No	Yes	2.62	2.95**	-0.18	0.48	-0.11
653	No	Yes	Yes	-6.71	1.78**	0.22	0.56**	-1.10
654	Yes	Yes	Yes	-2.67	1.29**	0.08	0.20	0.21
655	Yes	Yes	No	-13.63**	0.83**	0.53**	0.23	-0.09
656	Yes	Yes	Yes	-38.89**	0.40	1.34**	1.80**	-1.33**
661	Yes	Yes	No	-17.95	0.31	0.68*	0.26	-0.00
662	Yes	Yes	Yes	-5.80	0.81**	0.29**	-0.00	0.03
663	Yes	Yes	Yes	-11.98**	0.70**	0.52**	-0.02**	-0.08
664	Yes	Yes	Yes	-10.29	0.56**	0.41*	0.07	-0.12
665	Yes	Yes	Yes	-14.96**	1.17**	0.57**	0.10	0.01
667	No	Yes	Yes	-0.48	2.22**	-0.08	0.13	-0.50
671	Yes	No	No	-47.64**	-0.67	1.96**	0.28	0.12

672	Yes	Yes	Yes	-15.19*	0.37	0.77**	-1.51**	0.52*
673	Yes	Yes	Yes	-32.25**	0.30	1.34**	0.27	-0.37**
674	Yes	No	No	-7.65*	0.83**	0.37*	-0.11	-0.12
676	No	No	Yes	-24.50*	2.24**	0.82	0.84	-0.71*
677	Yes	Yes	Yes	-21.85**	1.25**	0.81**	0.49*	-0.23*
678	Yes	Yes	Yes	-0.66	0.75	0.12	-0.15**	0.33
679	Yes	Yes	Yes	-84.54**	-0.63	3.23**	0.21	-1.95**
681	Yes	Yes	No	-59.34**	0.66	2.32**	0.02	0.07
682	Yes	Yes	Yes	-10.10**	0.55**	0.50**	-0.33**	0.29**
683	Yes	Yes	No	13.00*	0.34	0.51*	0.12	-0.08
684	Yes	Yes	Yes	-10.65*	1.43**	0.38	0.24*	-0.19**
685	No	Yes	No	-22.37**	-0.44	0.87**	0.06	-1.33**
686	Yes	No	No	-9.43*	0.90*	0.35	-0.01	0.19
687	Yes	No	Yes	-33.42**	-0.13	1.35**	-1.31*	0.08
689	No	Yes	Yes	-7.19	0.32	0.31	-0.33	-0.32
691	No	Yes	Yes	-6.65	0.70	0.29	0.18	-0.01
692	No	Yes	Yes	-5.54	1.43**	1.86	0.29	-0.10
693	Yes	No	Yes	-11.91	-0.31	0.59**	-0.24	0.15
694	Yes	Yes	Yes	-3.32	0.11	0.20	-0.50**	0.34*
695	Yes	Yes	No	-18.35**	0.51**	0.74**	0.16	-0.10
696	Yes	No	No	-20.43**	0.58*	0.78**	0.28	-0.38**

697	Yes	Yes	No	-22.37**	3.76**	0.74**	0.28	0.01
698	Yes	No	No	-11.10*	0.74**	0.46*	-0.07	-0.04
711	Yes	Yes	Yes	-20.11**	1.81**	0.84**	-0.09*	-0.05*
712	Yes	Yes	No	-30.25**	1.07**	1.29**	-0.53**	0.08
714	Yes	Yes	Yes	-9.63**	0.90**	0.39**	0.73**	-0.10
715	Yes	Yes	Yes	-18.19**	0.63**	0.79**	0.02	-0.33**
717	Yes	Yes	Yes	3.82	0.55*	-0.06	-0.11**	0.38*
718	Yes	No	Yes	-10.09**	2.02**	0.39**	0.16	-0.27*
719	Yes	No	Yes	-8.94**	0.88**	0.39**	0.08	-0.07
722	Yes	Yes	Yes	-9.80**	1.27**	0.42**	-0.12**	-0.05
723	Yes	No	Yes	-0.66	1.76**	0.03	-0.02	0.02
724	No	No	Yes	7.38*	0.71**	-0.25*	-0.11	0.06
725	Yes	Yes	Yes	-12.82**	1.96**	0.49**	-0.09	-0.18
726	Yes	Yes	Yes	-48.95**	1.60**	1.90**	0.55	-0.48**
729	Yes	Yes	No	-5.74	0.58**	0.28	0.15	0.06
731	Yes	Yes	Yes	-47.56**	1.85**	2.13**	-1.37**	1.40**
732	Yes	Yes	Yes	-24.20**	0.55*	1.00**	0.21	-0.15
733	Yes	Yes	Yes	-107.13**	6.72**	3.81**	1.08**	-1.80**
734	Yes	Yes	No	-79.09**	3.45**	2.90**	1.44	-0.15
735	Yes	Yes	Yes	-50.09**	0.76	1.93**	1.10	-1.81**
812	Yes	Yes	Yes	5.76	2.02**	-0.29	0.34	-0.19

821	Yes	Yes	Yes	-18.33**	0.90	0.68**	0.41**	-0.24**
841	Yes	Yes	Yes	-11.63*	0.73**	0.43**	0.37	0.02
861	Yes	Yes	Yes	-3.29	0.58**	0.16	0.02	-0.01
862	No	Yes	Yes	3.13	0.72**	-0.09	-0.08**	-0.05
864	No	No	No	11.17**	0.53	-0.41**	-0.08*	0.07
891	Yes	No	Yes	8.43	-0.38	-0.27	-0.21	0.22
892	No	No	No	11.74	1.49**	-0.46	-0.22	0.10
893	No	Yes	Yes	17.81	1.66*	-0.69	-0.55**	-0.88**
894	Yes	Yes	Yes	22.31**	-1.20	0.72**	-0.64**	0.56*
895	No	Yes	Yes	-8.91*	0.57*	0.35**	0.35*	-0.09
897	Yes	Yes	Yes	-58.68**	0.17	2.22**	0.29	-0.59**
899	Yes	Yes	Yes	-10.61**	0.98**	0.41**	0.13	-0.14*

Notes: '*' ('**') represents statistical significance at the 10% and 5% levels, respectively.

Source: Author's calculations (2023)

7.6 Diagnostic Tests

We performed several residual and stability diagnostic tests in the current study to assess the empirical results' reliability and robustness. Since the validity of the long-term estimates depends on the presence of cointegration, we direct our attention to Table 13. Based on the *F*-test, we confirmed cointegration in 79 out of 114 functions at the 5% and 10% significance levels. However, based on the ECM_{t-1} statistic, cointegration was detected in the remaining 35 functions using the critical values given by Banerjee et al. (1998). Overall, all import industries confirmed cointegration.

Furthermore, the *LM* test was applied to determine the presence of autocorrelation in the residuals of each import model. The outcome of this residual test was significant in only 21 instances, indicating that only 21 industries were influenced by autocorrelation. Additionally, we performed Ramsey's *RESET* test to assess the potential misspecification of our proposed import model, and the result was significant in only 16 cases. The results show that the proposed econometric specifications are appropriately specified in most industries and free from misspecification.

To ensure the stability of coefficients across both the short-term and long-term, we employed the *CUSUM* and *CUSUMSQ* tests. These tests confirmed the stability of the estimated coefficients in most cases. Lastly, we utilized the adjusted R^2 statistic to evaluate the goodness of fit of our empirical estimates. The high magnitude of the adjusted R^2 suggests that our linear import specification provides a good fit for the data. The results from these diagnostic tests strongly support the robustness and meaningfulness of our obtained results.

Table 13. Diagnostic Statistics Corresponding to Coefficients of the Linear ARDL Import Demand Specification (27)

SITC-1	Industry Name	Import Share	F-test	ECM_{t-1}	Adj. R^2	LM	$RESET$	$CUSUM$	$CUSUMSQ$
001	Live animals	0.05%	1.44	-0.25(2.52)**	0.61	0.82	0.19	S	S
054	Vegetables, roots & tubers, fresh or dried	0.01%	5.30**	-0.60(4.79)**	0.59	0.11	0.53	S	S
061	Sugar and honey	0.03%	3.70	-0.34(4.01)**	0.55	0.06*	0.00**	US	US
071	Coffee	0.04%	4.79**	-0.53(4.56)**	0.73	0.21	0.14	S	S
072	Cocoa	0.09%	3.24	-0.46(3.75)**	0.62	0.85	0.86	S	S
075	Spices	0.00%	9.13**	-0.84(6.36)**	0.53	0.24	0.17	S	S
081	Feed. Stuff for animals excl. unmilled cereals	0.11%	3.45	-0.53(3.87)**	0.81	0.22	0.70	S	S
211	Hides & skins, exc.fur skins undressed	0.01%	6.72**	-0.21(5.44)**	0.84	0.03**	0.01**	S	US
231	Crude rubber incl. synthetic & reclaimed	0.06%	4.04	-0.46(4.22)**	0.91	0.14	0.29	S	S
251	Pulp & waste paper	0.08%	3.36	-0.53(3.83)**	0.83	0.55	0.52	S	S

262	Wool and other animal hair	0.00%	2.67	-0.37(3.42)**	0.83	0.23	0.00**	S	US
266	Synthetic and regenerated artificial fibres	0.22%	13.81**	-0.24(7.87)**	0.94	0.77	0.31	S	S
275	Natural abrasives, incl. industrial diamonds	0.00%	3.98	-0.50(4.17)**	0.52	0.10	0.61	S	S
276	Other crude minerals	0.09%	4.71*	-0.37(4.54)**	0.90	0.41	0.55	S	S
282	Iron and steel scrap	1.29%	2.54	-0.56(3.13)**	0.54	0.55	0.17	S	US
283	Ores & concentrates of non-ferrous base metals	0.00%	5.54**	-0.76(5.13)**	0.84	0.65	0.17	S	S
284	Non-ferrous metal scrap	0.11%	7.60**	-0.73(5.75)**	0.65	0.46	0.86	S	S
291	Crude animal materials, n.e.s.	0.01%	6.79**	-0.74(4.46)**	0.74	0.30	0.08*	S	US
292	Crude vegetable materials, n.e.s.	0.11%	2.48	-0.26(3.28)**	0.89	0.43	0.82	US	US

321	Coal, coke & briquettes	0.01%	20.77**	-0.74(9.55)**	0.77	0.61	0.35	S	US
332	Petroleum products	0.51%	3.80	-0.30(4.06)**	0.95	0.01**	0.98	US	US
411	Animal oils and fats	0.00%	1.32	-0.18(2.42)**	0.65	0.19	0.23	S	US
422	Other fixed vegetable oils	0.02%	2.19	-0.32(3.08)**	0.51	0.95	0.16	S	S
431	Anim./veg. Oils & fats, processed, and waxes	0.04%	2.15	-0.16(3.07)**	0.80	0.48	0.21	S	US
512	Organic chemicals	2.35%	4.68*	-0.38(4.51)**	0.91	0.01**	0.12	US	US
513	Inorganic chemicals elements., oxides, halogen salts	0.48%	9.81**	-0.71(6.58)**	0.96	0.24	0.00**	US	US
514	Other inorganic chemicals	0.41%	7.37**	-0.29(5.69)**	0.95	0.18	0.18	S	US
515	Radioactive and associated materials	0.00%	5.00**	-0.69(4.66)**	0.72	0.44	0.95	S	S
521	Crude chemicals from coal, petroleum, and gas	0.02%	1.50	-0.31(2.56)**	0.67	0.50	0.71	S	S

531	Synth. organic dyestuffs, natural indigo & lakes	0.21%	4.06*	-0.21(4.20)**	0.89	0.11	0.38	US	US
532	Dyeing & tanning extracts, synth. tanning mat.	0.02%	4.66*	-0.37(4.49)**	0.85	0.19	0.99	US	S
533	Pigments, paints, varnishes & related materials	1.37%	3.45	-0.29(3.91)**	0.96	0.00**	0.12	US	US
541	Medicinal & pharmaceutical products	4.24%	6.14**	-0.46(5.21)**	0.98	0.18	0.26	S	S
551	Essential oils, perfume, and flavour materials	0.34%	4.66*	-0.30(4.51)**	0.96	0.11	0.26	S	S
554	Soaps, cleansing & polishing preparations	0.55%	6.88**	-0.22(5.50)**	0.98	0.04**	0.38	US	US
561	Fertilizers manufactured	0.05%	9.09**	-0.99(6.31)**	0.55	0.59	0.00**	S	US

571	Explosives and pyrotechnic products	0.02%	6.20**	-0.73(5.24)**	0.59	0.28	0.67	S	S
581	Plastic materials, regenerated cellulose & resins	8.33%	4.73*	-0.27(4.55)**	0.98	0.00**	0.51	US	US
599	Chemical materials and products, n.e.s.	2.98%	6.41**	-0.30(5.27)**	0.98	0.01**	0.47	US	US
612	Manufacturing of leather or artificial or reconstruction of leather	0.00%	4.96**	-0.48(4.63)**	0.86	0.07*	0.36	US	US
621	Materials of rubber	0.46%	2.80	-0.29(3.51)**	0.95	0.13	0.72	S	S
629	Articles of rubber, n.e.s.	0.45%	26.64**	-0.23(10.86)**	0.99	0.40	0.14	S	S
631	Veneers, plywood boards & other wood, worked, n.e.s.	0.02%	9.52**	-0.38(6.45)**	0.95	0.44	0.39	S	S
632	Wood manufactures, n.e.s.	0.06%	6.76**	-0.42(5.45)**	0.81	0.00**	0.02**	US	US
633	Cork manufactures	0.00%	4.30	-0.21(4.37)**	0.90	0.00**	0.04**	US	US

641	Paper and paperboard	0.02%	7.55	-0.19(5.74)**	0.99	0.51	0.14	S	S
642	Articles of paper, pulp, paperboard	0.13%	5.99**	-0.96(6.47)**	0.98	0.37	0.64	S	S
651	Textile yarn and thread	0.20%	4.51*	-0.24(4.43)**	0.87	0.21	0.49	S	S
652	Cotton fabrics, woven ex. narrow or spec. fabrics	0.04%	18.51**	-0.25(9.01)**	0.97	0.41	0.80	S	S
653	Text fabrics woven ex narrow, spec, not cotton	0.20%	11.21**	-0.26(6.99)**	0.96	0.61	0.92	S	US
654	Tulle, lace, embroidery, ribbons, trimmings	0.04%	12.34**	-0.22(7.45)**	0.98	0.12	0.39	S	S
655	Special textile fabrics and related products	0.51%	5.56**	-0.28(4.93)**	0.96	0.02**	0.03**	S	US
656	Made up articles, wholly or chiefly of text.mat.	0.01%	3.15	-0.36(3.72)**	0.81	0.95	0.42	S	S

661	Lime, cement & fabrics. Building materials. Ex glass/clay mat	0.01%	2.90	-0.48(3.55)**	0.62	0.69	0.21	S	S
662	Clay and refractory construction materials	0.23%	8.33**	-0.52(6.06)**	0.84	0.11	0.53	S	S
663	Mineral manufactures, n.e.s.	0.41%	4.71**	-0.44(4.52)**	0.92	0.01**	0.19	US	US
664	Glass	0.36%	3.08	-0.28(3.65)**	0.94	0.24	0.91	S	S
665	Glassware	0.06%	10.77**	-0.40(6.92)**	0.95	0.19	0.31	S	S
667	Pearls and precious and semi-precious stones	0.00%	4.02	-0.38(4.20)**	0.61	0.01	0.98	S	S
671	Pig iron, spiegeleisen, sponge iron etc.	0.12%	7.83**	-0.72(5.86)**	0.85	0.29	0.37	S	S
672	Ingots & other primary forms of iron or steel	0.82%	8.50**	-0.68(6.12)**	0.85	0.47	0.14	S	S

673	Iron and steel bars, rods, angles, shapes, sections	0.91%	8.78**	-0.77(6.19)**	0.93	0.12	0.39	S	US
674	Universals, plates, and sheets of iron or steel	1.28%	5.18**	-0.41(4.76)**	0.89	0.00**	0.05*	US	US
676	Rails & railway track construction materials of iron or steel	0.02%	2.55	-0.55(3.34)**	0.60	0.00**	0.20	US	US
677	Iron and steel wire, excluding wire rod	0.08%	6.54**	-0.47(5.36)**	0.90	0.37	0.21	S	S
678	Tubes, pipes, and fittings of iron or steel	0.55%	3.56	-0.41(3.98)**	0.64	0.40	0.31	S	S
679	Iron steel castings forgings unworked, n.e.s.	0.02%	8.61**	-1.31(6.19)**	0.86	0.64	0.15	S	S
681	Silver and platinum group metals	0.04%	6.88**	-0.98(5.49)**	0.87	0.12	0.98	S	S
682	Copper	0.51%	7.73**	-0.58(5.90)**	0.89	0.58	0.32	S	S

683	Nickel	0.04%	2.58	-0.33(3.37)**	0.89	0.39	0.93	S	S
684	Aluminium	0.74%	6.60**	-0.25(5.40)**	0.97	0.19	0.34	S	S
685	Lead	0.00%	9.93**	-0.58(6.61)**	0.91	0.17	0.80	S	S
686	Zinc	0.02%	1.40	-0.39(2.48)**	0.70	0.40	0.15	S	S
687	Tin	0.01%	4.62*	-0.66(4.51)**	0.74	0.85	0.41	S	S
689	Miscellaneous non-ferrous base metals	0.01%	2.63	-0.43(3.39)**	0.60	0.00**	0.05*	US	US
691	Finished structural parts and structures, n.e.s	0.26%	3.15	-0.34(3.70)**	0.84	0.34	0.21	S	S
692	Metal containers for storage and transport	0.10%	3.22	-0.28(3.74)**	0.86	0.00**	0.46	US	S
693	Wire products ex, electric & fencing grills	0.06%	5.10**	-0.72(4.70)**	0.81	0.63	0.86	S	S
694	Nails, screws, nuts, bolts, rivets, and sim. articles	0.01%	3.75	-0.19(4.08)**	0.96	0.33	0.57	S	US
695	Tools for use in the hand or machines	0.64%	4.59*	-0.39(4.83)**	0.97	0.00**	0.08*	US	US
696	Cutlery	0.08%	8.97**	-0.43(6.28)**	0.97	0.36	0.13	S	S

697	Household equipment of base metals	0.06%	8.67**	-0.42(7.04)**	0.98	0.30	0.84	S	S
698	Manufactures of metal, n.e.s.	1.72%	6.11**	-0.25(5.16)**	0.98	0.16	0.44	S	S
711	Power-generating machinery other than electric	4.83%	13.37**	-0.51(7.74)**	0.98	0.21	0.13	S	S
712	Agricultural machinery and implements	0.45%	7.14**	-0.93(5.63)**	0.83	0.99	0.87	S	S
714	Office machines	0.57%	12.07**	-0.44(7.31)**	0.92	0.15	0.51	S	S
715	Metalworking machinery	1.13%	5.36**	-0.56(4.82)**	0.89	0.02**	0.03**	US	S
717	Textile and leather machinery	2.45%	7.71**	-0.26(5.83)**	0.89	0.29	0.27	S	S
718	Machines for special industries	1.15%	11.49**	-0.43(7.15)**	0.95	0.04**	0.01**	S	S
719	Machinery and appliances non-electrical parts	13.24%	7.69**	-0.27(5.84)**	0.98	0.23	0.56	S	S

722	Electric power machinery and switchgear	4.36%	9.12**	-0.32(6.32)**	0.97	0.34	0.67	S	S
723	Equipment for distributing electricity	0.46%	11.68**	-0.30(7.15)**	0.93	0.00**	0.09*	US	US
724	Telecommunications apparatus	0.16%	3.83	-0.16(4.08)**	0.89	0.40	0.18	S	S
725	Domestic electrical equipment	0.27%	12.40**	-0.37(7.36)**	0.96	0.41	0.10	S	S
726	Electronic apparatus for medical purposes, radiological ap.	0.35%	9.59**	-0.84(6.49)**	0.90	0.29	0.12	S	US
729	Other electrical machinery and apparatus	3.20%	4.83**	-0.31(4.60)**	0.93	0.15	0.44	S	S
731	Railway vehicles	0.11%	13.46**	-0.69(7.73)**	0.75	0.26	0.70	S	S
732	Road motor vehicles	16.14%	5.26**	-0.41(4.80)**	0.96	0.36	0.13	S	S
733	Road vehicles other than motor vehicles	1.00%	6.47**	-0.70(5.81)**	0.98	0.32	0.44	S	S

734	Aircraft	6.04%	4.92**	-0.74(4.63)**	0.78	0.11	0.34	S	S
735	Ships and boats	0.41%	8.71**	-0.96(6.16)**	0.52	0.32	0.72	S	S
812	Sanitary, plumbing, heating & lighting fixtures	0.18%	9.81**	-0.11(6.59)**	0.97	0.22	0.31	S	S
821	Furniture	0.32%	5.99**	-0.27(5.14)**	0.97	0.20	0.03**	US	US
841	Clothing except fur clothing	0.25%	13.30**	-0.19(7.68)**	0.99	0.61	0.18	S	S
861	Scientific, medical, optical, meas./contr. instruments	1.50%	4.54*	-0.19(4.46)**	0.97	0.16	0.16	S	S
862	Photographic and cinematographic supplies	0.08%	4.16*	-0.20(4.24)**	0.89	0.31	0.63	S	S
864	Watches and clocks	0.01%	2.65	-0.14(3.39)**	0.84	0.13	0.22	S	S
891	Musical instruments, sound recorders, and parts	0.11%	2.93	-0.07(3.58)**	0.91	0.66	0.32	S	S
892	Printed matter	0.13%	4.47*	-0.08(4.44)**	0.92	0.33	0.41	S	S

893	Articles of artificial plastic materials n.e.s.	0.00%	3.35	-0.27(3.81)**	0.80	0.55	0.38	S	US
894	Perambulators, toys, games and sporting goods	0.02%	6.35**	-0.18(5.33)**	0.83	0.86	0.21	S	US
895	Office and stationery supplies, n.e.s.	0.07%	6.64**	-0.35(5.40)**	0.91	0.14	0.50	S	S
897	Jewellery and gold/silver smiths' wares	0.10%	6.33**	-0.75(5.24)**	0.83	0.26	0.19	US	S
899	Manufactured articles, n.e.s.	0.28%	9.61**	-0.29(6.48)**	0.98	0.11	0.30	S	S

Notes: (i) This table adheres to the same notes as provided beneath Table 11. (ii) Each industry's import share is computed as a percentage of Turkey's total imports from Germany within the specified sample period[104]. Notably, this import share calculation is based on the data from the year 2022. Source: Author's calculations (2023)

[104] To compute the proportion of each industry's imports relative to Turkey's total imports from Germany during the specified sample period, we employed the subsequent formula:

$$Import\ share\ (\%) = \left({}^{Industry\ i\ imports}/_{Total\ imports}\right) * 100 \tag{90}$$

7.7 Asymmetric Analysis of Bilateral Exports and Imports Flows

7.7.1 Empirical Estimates of the Non-Linear Export Demand Model

Before delving into the empirical estimates of the non-linear export demand model outlined in Equation (50) for both short-run and long-run dynamics, we first applied the *Wald-SR*^{TRGR} and *Wald-LR*^{TRGR} asymmetry tests to assess whether the influences of lira-euro uncertainty on real trade movements exert asymmetry. We discovered indications of short-term adjustment asymmetry as ΔPOS^{TRGR} and ΔNEG^{TRGR} exhibited distinct lag orders. In all instances, distinct short-term asymmetric effects of real lira-euro volatility became apparent, either in terms of sign or magnitude difference between ΔPOS^{TRGR} and ΔNEG^{TRGR}. Furthermore, short-term joint asymmetry was evident as the sum of coefficients linked to ΔPOS^{TRGR} significantly differed from the sum of coefficients linked to ΔNEG^{TRGR}. The asymmetry effects of real lira-euro volatility were observable based on *Wald-SR*^{TRGR} test estimates within 69 export industries, with noteworthy emphasis on small and large export industries.

The four sizeable Turkish export industries coded 684, 719, 732, and 841, which collectively contribute 44.46 percent of total Turkish exports to Germany. Additionally, we observed long-run asymmetric effects of real lira-euro volatility on Turkey's small and large export industries on the basis of differences in sign or magnitude between the *POS*^{TRGR} and *NEG*^{TRGR} coefficients. However, the significant effects of real lira-euro volatility that depend on the *Wald-LR*^{TRGR} test are noticeable in only 52 export industries. These sets of asymmetry tests provide evidence of the asymmetric effects of real lira-euro volatility on Turkish exports to Germany (refer to Table 15).

The empirical findings presented in Table 14 suggest that the short-term coefficients demonstrate the presence of at least one significant lagged coefficient for either the ΔPOS^{TRGR} or ΔNEG^{TRGR} variables in 69 export industries. Furthermore, the short-run estimates indicate that Turkey's real export volume is significantly affected by the real lira-euro exchange rate (*lnREX*) in 66 industries. Similarly, Germany's real income (*lnY*^{GR}) significantly impacts Turkey's real export volume in 66 industries. Do these short-run effects persist in the long-run? We refer to the normalized long-run empirical estimates in Table 14 to answer this question.

The findings presented in Table 14 reports long-run estimates for 49 Turkish export industries, revealing significant coefficients for either the *POS*^{TRGR} or the *NEG*^{TRGR} variables, validated by the *F*-test or the *t*-test for asymmetric cointegration. These export industries are categorized into four distinct groups, depending on the sign and significance of the associated coefficients. The first group includes 14 small export industries, where the *POS*^{TRGR} variable exhibits a significant negative coefficient, indicating that increased real lira-euro volatility harms Turkey's exports to Germany. The list of these export industries includes those coded 046, 051, 061, 283, 553, 621, 632, 651, 652, 653, 672, 678, 698, and 897. The second category includes 27 small and large export industries where the POS^{TRGR} variable has a significant positive coefficient, indicating that increased lira-euro uncertainty amplifies the exports of Turkey to Germany. These export industries include those coded 032, 047, 073, 099, 121, 262, 263, 266, 276, 292, 422, 512, 541, 551, 654, 657, 661, 666, 697, 717, 719, 722, 723, 841, 842, 895, and 899. The third category includes 19 export industries where the NEG^{TRGR} variable has a significant negative estimate, implying that a decrease in real lira-euro volatility fosters Turkey's exports to Germany. The small export industries in this group comprise those coded 032, 051, 073, 121, 262, 273, 276, 283, 422, 512, 513, 541, 551, 554, 629, 678, 715, 717, and 899. Finally, the fourth category consists of 15 small and large export industries where the NEG^{TRGR} variable exhibits a positive significant coefficient, implying that a decrease in real lira-euro volatility hinders Turkey's exports to Germany. The list of these export industries encompasses those coded 047, 061, 075, 263, 266, 292, 553, 621, 651, 653, 657, 665, 666, 729, and 841.

Notably, the second category of export industries features one of the largest industries, coded 719 (machinery and appliances), with an export share of 7.16%. This industry appears to benefit from increased real lira-euro volatility instead of decreased volatility. This outcome signifies the existence of long-term asymmetric effects of real lira-euro volatility on real export volumes from Turkey to Germany, as confirmed through the $Wald\text{-}LR^{TRGR}$ test (refer to Table 15).

In addition, the long-term estimates indicate that *lnREX* exhibits a significant influence on 48 export industries. The expected positive sign is observed in 46 export industries, and a negative sign is observed in only two.

Finally, the long-term coefficients demonstrate that Germany's real income (lnY^{GR}) has an anticipated positive and significant coefficient in 51 instances, indicating that Germany imports more commodities from the Turkish economy as its local economy develops. Finally, trade liberalization reforms (*DM*) have an expected positive sign in 60 small and large industries.

Table 14. Short-term and Long-term Coefficients of the Non-Linear ARDL Export Demand Specification (50)

There is at Least One Short-Term Estimate Significant				Long-run Coefficients					
SITC-1	lnY^{GR}	$lnREX$	$lnVOL^{TRGR}$	C	DM	lnY^{GR}	$lnREX$	POS^{TRGR}	NEG^{TRGR}
031	Yes	Yes	Yes	47.72	0.57	-1.66	-0.71**	0.20	-0.15
032	Yes	Yes	Yes	13.34	4.56**	2.36**	1.04**	0.35**	-1.22*
046	Yes	Yes	No	-177.35**	0.31	6.20**	2.39**	-1.07**	-0.19
047	Yes	Yes	Yes	-4.78*	3.55**	2.57**	2.59**	0.98**	3.59**
048	Yes	No	Yes	-43.67	0.61**	1.57	-0.31	0.01	-0.16
051	Yes	Yes	Yes	-53.63*	4.33**	2.55**	3.67**	-3.99**	-3.55**
052	Yes	No	Yes	-120.97**	0.28	4.37**	0.12	-0.28	0.01
053	Yes	Yes	Yes	-43.71	0.78**	1.29	-0.18	-0.21	-0.13
054	Yes	No	Yes	-66.36	0.78**	2.44	0.22	-0.13	-0.03
055	Yes	No	Yes	-52.31	1.43**	1.88	-0.23	-0.47	-0.09
061	Yes	Yes	Yes	-45.86	7.37**	2.75**	3.22**	-3.66*	2.44**
062	Yes	Yes	Yes	-129.68**	0.54*	4.61**	0.32*	-0.15	-0.12
073	Yes	Yes	Yes	-59.21	0.51**	1.98	0.87**	1.14**	-0.38*
074	Yes	Yes	No	-176.18	-1.36	6.23	1.46*	-0.47	-0.33
075	Yes	Yes	Yes	-102.63*	0.39	3.66*	0.46*	0.01	0.20*
099	No	Yes	Yes	-92.38	-0.02	3.26	0.33	0.86**	0.17
112	No	Yes	Yes	-95.32	0.48*	3.40	0.21	-0.25	0.04
121	Yes	Yes	Yes	-76.43*	6.36**	1.47**	3.56**	3.66**	-2.40**

221	Yes	Yes	Yes	-311.32**	1.70**	11.01**	2.26**	-0.25	0.17
262	Yes	Yes	Yes	-94.63*	2.48**	5.36**	4.64**	2.68**	-3.64**
263	Yes	Yes	Yes	23.39	-0.46	-0.71	0.23	0.72**	0.58**
266	Yes	Yes	Yes	-64.01*	0.45**	3.46**	2.57**	3.67**	2.73**
273	Yes	Yes	Yes	-23.78	-0.22	0.86	0.69**	-0.23	-0.53**
276	Yes	Yes	Yes	-30.02	4.29**	0.94**	0.94**	4.53*	-0.23**
283	Yes	Yes	Yes	-10.49*	1.44**	2.72**	0.73**	-0.32**	-0.17*
291	Yes	Yes	Yes	11.99	7.95**	1.33**	1.44**	-1.03	0.50
292	Yes	Yes	Yes	-26.75**	3.53**	1.52**	2..47**	2.86**	3.86**
421	No	Yes	No	-27.49**	2.29**	1.99**	7.27**	5.88	-10.67
422	Yes	Yes	Yes	-19.18**	2.17**	6.14**	1.11**	1.24**	-2.55**
512	Yes	Yes	Yes	2.23	1.70**	3.53**	1.44**	3.34**	-2.71**
513	Yes	Yes	Yes	-47.44**	8.24**	4.25**	3.80**	2.41	-2.43**
514	No	Yes	Yes	27.99*	0.14**	3.27**	2.92**	1.93	2.47
541	No	Yes	No	11.24	1.44*	4.60**	0.92**	1.99*	-3.86*
551	Yes	No	Yes	-16.10	0.83	3.68**	0.19**	0.55**	-0.75*
553	Yes	Yes	Yes	-6.25	1.84*	13.97**	-0.38	-4.00**	2.64*
554	Yes	No	Yes	-80.60	1.14	5.76*	2.70*	3.58	-12.89**
581	Yes	Yes	Yes	-340.63**	0.19**	12.02**	0.67	-0.05	0.10
599	Yes	Yes	Yes	-174.54*	-0.24	6.20*	-0.83	0.57	0.09
612	No	Yes	Yes	-159.75	1.98	5.65	-0.64	-0.29	0.27

621	Yes	Yes	No	6.86**	0.22**	2.33*	4.31**	-0.32*	0.23**
629	Yes	Yes	Yes	-28.33**	0.72	6.97**	0.04*	-2.04	-2.66*
631	No	No	No	-23.05	2.20**	7.34	1.24	2.71	-2.70
632	Yes	Yes	Yes	30.58**	0.28*	0.99**	0.11	-1.04**	0.46
651	Yes	Yes	Yes	-43.76	5.36**	2.75**	3.22**	-3.55**	2.48**
652	Yes	Yes	Yes	39.57**	0.66**	1.41**	0.23**	-1.23*	-0.20
653	No	Yes	No	-18.91**	-0.11	0.54**	0.11**	-0.60**	1.69**
654	Yes	Yes	Yes	14.47**	3.87**	3.62**	0.31**	1.42**	-2.00
656	No	Yes	Yes	16.91	0.29	1.21**	0.18**	-0.45	1.02
657	Yes	No	Yes	26.46**	0.73*	3.18**	1.49**	1.33**	1.95*
661	No	No	Yes	15.36	0.83**	0.58**	0.04**	0.30*	0.23
662	Yes	Yes	No	-223.09**	0.09	7.89**	0.50	-0.40	0.34
663	Yes	Yes	No	-252.37	3.71**	8.72	1.32	-0.76	-0.99
664	Yes	Yes	No	-22.65	0.37	0.84	-0.22	0.19	0.11
665	No	Yes	Yes	13.58**	7.03**	0.87**	-0.03	0.29	0.86*
666	Yes	Yes	Yes	10.44**	0.48**	0.12*	-0.02	0.41**	1.68**
672	Yes	No	Yes	-46.73	0.27	18.62	4.02*	-6.31*	-16.71
673	No	Yes	Yes	56.33**	4.24**	4.03*	-0.61	1.60	6.65
678	Yes	Yes	Yes	-5.45	0.47	1.08	1.05**	-2.98**	-4.10**
684	No	No	No	16.67	0.54**	-1.18	0.38	-0.68	-0.61
691	No	No	No	1.32	-1.46	0.62	0.20	-2.69	0.10

695	No	No	No	-4.42	0.07*	-1.33	-0.54	1.06	-1.51
696	Yes	Yes	Yes	18.85**	2.42**	2.53*	0.92*	-0.26	-0.83
697	Yes	Yes	Yes	5.13**	0.33*	-0.50	-0.54**	0.90**	-0.57
698	No	Yes	Yes	11.72**	0.55*	-0.04	0.60*	-1.18**	0.27
711	Yes	Yes	Yes	-248.12**	1.29**	8.86**	-0.35	-0.46	-0.31
715	Yes	Yes	Yes	-85.46	-0.05	2.99	1.29**	-0.32	-0.74**
717	Yes	Yes	Yes	-23.65	0.77*	4.24**	2.34**	3.50**	-0.23**
718	Yes	Yes	Yes	-128.42	0.59*	4.58**	0.02	-0.26	-0.18
719	Yes	Yes	Yes	-136.04**	1.60**	4.87**	-0.17	0.42**	-0.21
722	Yes	Yes	Yes	18.52**	0.54**	0.13	1.16*	0.81**	0.15
723	Yes	No	Yes	3.76	0.04	-0.21	-0.44	2.31**	0.28
724	No	No	No	37.58	-2.26	-2.28	-2.33	3.31	4.32
725	No	No	No	7.70	0.98**	2.47	0.16	-0.60	1.56
729	Yes	Yes	Yes	14.94**	0.55**	1.54**	0.41**	-0.55	3.45**
732	Yes	No	Yes	-129.43	0.75	4.63	-0.15	0.02	-0.36
812	Yes	No	No	6.02	0.67**	2.91*	0.68	-0.60	0.56
821	Yes	No	No	20.70	-1.21	-0.86	-1.11	0.26	1.61
831	No	Yes	Yes	10.30	1.39*	-0.03	0.59	1.86	-2.66
841	Yes	Yes	Yes	36.24	0.22**	-1.22	-0.17	0.27*	0.19**
842	Yes	Yes	Yes	13.79*	0.24**	-0.71	1.08**	2.84**	-0.13
851	Yes	No	No	2.99	0.87	1.16	0.29	-0.33	-2.34

861	No	No	No	-7.79	1.49**	2.01	1.27	-0.69	-1.46
862	Yes	No	Yes	12.96	2.42	-2.85	0.55	1.51	-0.08
891	No	No	No	8.05	1.35**	1.20	-0.65	-0.19	-1.38
892	No	Yes	Yes	25.63**	0.77	-1.19	0.16	-0.54	1.87
893	No	No	Yes	24.89	2.86**	-0.27	0.74	0.16	2.83
894	Yes	Yes	Yes	-266.62**	0.11	9.39**	1.09*	-0.42	0.06
895	No	Yes	Yes	26.89	2.61**	-1.06	1.06	1.29**	0.53
897	Yes	Yes	No	-666.74**	0.95	23.51**	-0.11	-1.69**	0.46
899	Yes	Yes	Yes	-338.39**	5.83**	3.53**	0.45**	0.58**	-0.48**

Notes: ‘*’ (‘**’) represents statistical significance at the 10% and 5% levels, respectively.

Source: Author’s calculations (2023)

7.7.2 Diagnostic Tests

The long-term empirical findings of the non-linear ARDL export demand specification hinge upon the establishment of cointegration. The outcome of the cointegration *F*-test and other diagnostic statistics have been presented in Table 15. The cointegration *F*-test confirms the validity of long-run coefficient estimates for all export industries except for 10 industries coded 031, 052, 053, 055, 099, 112, 273, 422, 664, and 732. For these 10 export industries where the *F*-test is not statistically significant at the 10% or 5% significance level, we have applied the ECM_{t-1} test. As shown in Table 15, this alternative cointegration test confirms the presence of a co-integrating relationship among explanatory variables in these 10 industries using the critical values given by Banerjee et al. (1998). Overall, all export industries show cointegration, and it is concluded that real lira-euro volatility has significant long-term effects on the exports of these industries.

In Table 15, we have also reported several residual and stability diagnostic tests to evaluate the robustness of our empirical results. The *LM* test has been applied to determine the presence of autocorrelation in the residuals of each specification. The results confirm that the residuals suffer from no significant autocorrelation. Furthermore, Ramsey's *RESET* test has been conducted to assess the potential misspecification of the proposed model. The outcomes reveal that, in most instances, the results of the test lack significance, implying that functional misspecification is not present across the majority of functions. Additionally, the stability of the short-run and long-run coefficients has been corroborated using the *CUSUM* and *CUSUMSQ* tests. Notably, nearly all estimations demonstrate stability. Lastly, the evaluation of the goodness of fit relies on the adjusted R^2 statistic. The high magnitude of the adjusted R^2 suggests that our obtained empirical coefficients exhibit a good fit. The diagnostic statistics suggest that our empirical estimates are robust and meaningful.

Table 15. Diagnostic Statistics Corresponding to Coefficients of the Non-Linear ARDL Export Demand Specification (50)

SITC-1	Industry Name	Export Share	F-test	ECM_{t-1}	Adj. R^2	LM	$RESET$	$CUSUM$	$CUSUMSQ$	$Wald\text{-}SR^{TRGR}$	$Wald\text{-}LR^{TRGR}$
031	Fish, fresh & simply preserved	0.36%	2.30	-0.17(3.60)**	0.94	0.04**	0.78	S	US	0.07*	0.01**
032	Fish, in airtight containers, n.e.s & fish preparations.	0.01%	5.63**	-0.87(6.99)**	0.92	0.35	0.63	S	S	0.00**	0.08*
046	Meal and flour of wheat or meslin	0.00%	5.79**	-0.72(5.72)**	0.77	0.01**	0.86	S	US	0.00**	0.00**
047	Meal & flour of cereals, except wheat/meslin	0.00%	5.98**	-0.68(5.52)**	0.83	0.47	0.37	S	S	0.03**	0.07*
048	Cereal preps & preps of flour of fruits & vegs.	0.25%	5.65**	-0.37(5.72)**	0.98	0.03**	0.24	S	S	0.78	0.15
051	Fruit, fresh, and nuts excl. Oil nuts	2.16%	5.84**	-0.84(6.44)**	0.90	0.43	0.63	S	S	0.02**	0.09*
052	Dried fruit, including artificially dehydrated	0.54%	3.25	-0.59(4.28)**	0.90	0.17	0.12	S	S	0.01**	0.01**

053	Fruit, preserved and fruit preparations	0.63%	2.47	-0.35(3.71)**	0.88	0.08*	0.55	US	S	0.33	0.12
054	Vegetables, roots & tubers, fresh or dried	0.57%	4.18*	-0.67(4.85)**	0.74	0.11	0.41	S	S	0.07*	0.01**
055	Vegetables, roots & tubers pres or prepared n.e.s.	0.08%	3.02	-0.25(4.12)**	0.84	0.02**	0.35	S	S	0.07*	0.01**
061	Sugar and honey	0.03%	5.99**	-0.89(6.88)**	0.97	0.34	0.75	S	S	0.05*	0.03**
062	Sugar confectionery, sugar preps. Ex chocolate confectionery	0.13%	4.65**	-0.70(5.15)**	0.96	0.05**	0.00**	S	S	0.12	0.53
073	Chocolate & other food preptns. cont. Cocoa, n.e.s.	0.13%	31.20**	-0.73(7.22)**	0.97	0.31	0.47	S	US	0.09*	0.00**
074	Tea and mate	0.01%	9.20**	-0.75(7.21)**	0.84	0.64	0.00**	S	US	0.37	0.23
075	Spices	0.06%	4.21*	-0.61(4.89)**	0.87	0.54	0.02**	US	US	0.00**	0.00**

099	Food preparations, n.e.s.	2.25%	3.80	-0.72(4.63)**	0.96	0.12	0.65	S	US	0.24	0.18
112	Alcoholic beverages	0.10%	2.32	-0.44(3.61)**	0.92	0.06*	0.85	S	US	0.00**	0.00**
121	Tobacco, unmanufactured	0.02%	6.29**	-0.94(6.73)**	0.98	0.74	0.57	S	S	0.01**	0.09*
221	Oil seeds, oil nuts and oil kernels	0.08%	10.35**	-0.75(7.64)**	0.91	0.01**	0.01**	S	S	0.47	0.13
262	Wool and other animal hair	0.00%	5.50**	-0.92(6.46)**	0.85	0.72	0.85	S	S	0.03**	0.08*
263	Cotton	0.26%	4.18*	-0.68(4.90)**	0.67	0.34	0.03**	S	S	0.73	0.54
266	Synthetic and regenerated artificial fibers	0.22%	5.67**	-0.93(6.59)**	0.95	0.39	0.72	S	S	0.07*	0.09*
273	Stone, sand, and gravel	0.08%	3.10	-0.49(4.19)**	0.90	0.37	0.29	S	S	0.65	0.27
276	Other crude minerals	0.20%	6.33**	-0.91(5.69)**	0.97	0.39	0.72	S	S	0.00**	0.02**

283	Ores & concentrates of nonferrous base metals	0.24%	5.98**	-0.83(7.70)**	0.75	0.11	0.75	S	S	0.06*	0.04**
291	Crude animal materials, n.e.s.	0.05%	9.19**	-0.84(6.55)**	0.99	0.83	0.92	S	S	0.01**	0.07*
292	Crude vegetable materials, n.e.s.	0.09%	7.17**	-0.83(6.02)**	0.94	0.96	0.55	S	S	0.01**	0.09*
421	Fixed vegetable oils, soft	0.04%	5.84**	-0.91(4.96)**	0.99	0.80	0.49	S	S	0.02**	0.01**
422	Other fixed vegetable oils	0.00%	2.15	-0.78(5.29)**	0.73	0.88	0.63	S	S	0.03**	0.03**
512	Organic chemicals	0.20%	9.29**	-0.97(7.19)**	0.99	0.79	0.72	S	S	0.07*	0.06*
513	Inorg. chemicals elems., oxides, halogen salts	0.05%	13.18**	-0.83(8.58)**	0.99	0.61	0.51	S	S	0.08*	0.04**
514	Other inorganic chemicals	0.06%	7.09**	-0.98(5.30)**	0.94	0.12	0.67	S	S	0.09*	0.17
541	Medicinal & pharmaceutical products	0.06%	5.45**	-0.69(5.54)**	0.99	0.13	0.39	S	S	0.08*	0.03**

551	Essential oils, perfume, and flavour materials	0.05%	5.87**	-0.79(6.95)**	0.99	0.14	0.17	S	S	0.08*	0.03**
553	Perfumery, cosmetics, dentifrices, etc.	0.24%	6.68**	-0.69(5.83)**	0.99	0.19	0.74	US	S	0.06*	0.09*
554	Soaps, cleansing & polishing preparations	0.08%	6.03**	-0.68(8.08)**	0.97	0.18	0.65	S	S	0.03**	0.70
581	Plastic materials, regenerated cellulose & resins	3.78%	5.06**	-0.83(5.31)**	0.82	0.58	0.20	S	US	0.28	0.77
599	Chemical materials and products, n.e.s.	0.38%	6.53**	-0.87(6.07)**	0.83	0.31	0.10	S	S	0.20	0.99
612	Manufacturing of leather or artificial. or reconst. leather	0.02%	4.48*	-0.80(5.03)**	0.87	0.01**	0.00**	S	US	0.39	0.16
621	Materials of rubber	0.65%	7.05**	-0.83(6.35)**	0.99	0.31	0.53	S	US	0.09*	0.99
629	Articles of rubber, n.e.s.	1.48%	12.53**	-0.89(8.33)**	0.99	0.74	0.32	S	S	0.03**	0.02**

631	Veneers, plywood boards & other wood, worked, n.e.s.	0.01%	7.87**	-0.72(5.96)**	0.99	0.16	0.51	S	US	0.01**	0.72
632	Wood manufactures, n.e.s.	0.12%	6.60**	-0.77(6.98)**	0.90	0.02**	0.03**	US	US	0.11	0.73
651	Textile yarn and thread	0.54%	6.43**	-0.92(7.45)**	0.96	0.43	0.57	S	S	0.09*	0.06*
652	Cotton fabrics, woven ex. narrow or spec. fabrics	0.23%	6.86**	-0.69(5.04)**	0.98	0.32	0.20	S	S	0.01**	0.04**
653	Text fabrics woven ex narrow, spec, not cotton	0.59%	8.91**	-0.86(7.12)**	0.99	0.19	0.54	S	US	0.04**	0.03*
654	Tulle, lace, embroidery, ribbons, trimmings	0.07%	11.26**	-0.83(6.98)**	0.99	0.48	0.36	S	US	0.03**	0.02**
656	Made-up articles, wholly or chiefly of text materials	0.51%	8.36**	-0.76(8.57)**	0.98	0.74	0.53	S	US	0.06*	0.08*
657	Floor coverings, tapestries, etc.	0.62%	9.37**	-0.98(9.12)**	0.99	0.11	0.42	S	S	0.07**	0.06*

661	Lime, cement & fabr. bldg.mat. Ex glass/clay mat	0.24%	8.38**	- 0.79(7.12)**	0.99	0.46	0.32	S	S	0.03**	0.07*
662	Clay and refractory construction materials	0.74%	5.74**	- 0.33(5.73)**	0.97	0.18	0.27	S	S	0.00**	0.00**
663	Mineral manufactures, n.e.s.	0.15%	4.41*	- 0.91(5.00)**	0.77	0.01**	0.04**	US	US	0.22	0.36
664	Glass	0.33%	3.11	- 0.33(4.18)**	0.95	0.17	0.46	US	US	0.43	0.53
665	Glassware	0.16%	13.76**	- 0.53(8.31)**	0.97	0.22	0.33	S	S	0.02**	0.32
666	Pottery	0.10%	7.99**	- 0.39(5.99)**	0.99	0.31	0.96	S	S	0.01**	0.02**
672	Ingots & other primary forms of iron or steel	0.43%	14.24**	- 0.29(4.97)**	0.98	0.00**	0.31	US	US	0.03**	0.04**
673	Iron and steel bars, rods, angles, shapes, sections	0.65%	7.94**	- 0.56(8.41)**	0.97	0.57	0.39	US	S	0.09*	0.64

678	Tubes, pipes and fittings of iron or steel	0.56%	6.57**	-0.29(5.73)**	0.99	0.11	0.44	S	S	0.03**	0.48
684	Aluminium	4.39%	7.12**	-0.67(4.02)**	0.99	0.41	0.34	S	S	0.01**	0.87
691	Finished structural parts and structures, n.e.s	1.00%	13.07**	-0.81(8.54)**	0.99	0.00**	0.44	US	US	0.11	0.26
695	Tools for use in the hand or in machines	0.31%	9.75**	-0.39(8.10)**	0.99	0.28	0.32	S	S	0.03**	0.08*
696	Cutlery	0.02%	6.64**	-0.56(5.20)**	0.98	0.57	0.10	S	S	0.01**	0.59
697	Household equipment of base metals	0.57%	6.18**	-0.43(4.38)**	0.99	0.46	0.69	S	US	0.06*	0.02**
698	Manufactures of metal, n.e.s.	2.62%	6.44**	-0.80(9.05)**	0.99	0.48	0.11	S	S	0.07*	0.02**
711	Power-generating machinery other than electric	4.64%	4.49*	-0.80(5.02)**	0.94	0.00**	0.18	US	US	0.32	0.21

715	Metalworking machinery	0.30%	4.10*	-0.51(4.91)**	0.95	0.87	0.13	S	S	0.06*	0.44
717	Textile and leather machinery	0.89%	5.67**	-0.85(5.39)**	0.91	0.35	0.83	S	S	0.08*	0.01**
718	Machines for special industries	0.28%	4.14*	-0.57(4.83)**	0.95	0.25	0.24	S	S	0.03**	0.05*
719	Machinery and appliances non-electrical parts	7.16%	9.61**	-0.93(7.37)**	0.97	0.20	0.44	S	S	0.06*	0.08**
722	Electric power machinery and switchgear	2.02%	8.60**	-0.74(7.42)**	0.99	0.34	0.76	S	S	0.00**	0.03**
723	Equipment for distributing electricity	1.73%	5.16**	-0.53(4.81)**	0.99	0.13	0.34	S	S	0.01**	0.90
724	Telecommunications apparatus	0.01%	11.51**	-0.45(5.53)**	0.99	0.46	0.21	S	S	0.00**	0.22
725	Domestic electrical equipment	0.79%	8.38**	-0.48(5.06)**	0.99	0.19	0.42	S	S	0.00**	0.03**

729	Other electrical machinery and apparatus	0.75%	5.29**	-0.22(5.34)**	0.99	0.24	0.21	S	S	0.02	0.04**
732	Road motor vehicles	14.56%	3.01	-0.56(4.14)**	0.97	0.02**	0.25	S	S	0.06*	0.83
812	Sanitary, plumbing, heating & lighting fixtures	0.89%	5.42**	-0.76(6.11)**	0.99	0.33	0.63	US	S	0.11	0.16
821	Furniture	2.20%	8.37**	-0.77(9.60)**	0.99	0.45	0.12	US	US	0.09*	0.25
831	Travel goods, handbags and similar articles	0.02%	8.91**	-0.25(5.02)**	0.96	0.47	0.58	S	S	0.00**	0.22
841	Clothing except fur clothing	18.35%	11.40**	-0.14(8.07)**	0.97	0.00**	0.04**	S	US	0.04**	0.97
842	Fur clothing and articles of artificial fur	0.03%	15.61**	-0.47(7.13)**	0.99	0.23	0.84	S	S	0.03	0.02**
851	Footwear	0.43%	13.85**	-0.22(4.96)**	0.98	0.16	0.62	S	S	0.02**	0.01**

861	Scientific, medical, optical, meas./contr. instrument	0.01%	7.01**	-0.60(5.84)**	0.98	0.06*	0.64	US	US	0.00**	0.39
862	Photographic and cinematographic supplies	0.00%	10.22**	-0.66(6.56)**	0.86	0.14	0.88	S	S	0.02**	0.52
891	Musical instruments, sound recorders, and parts	0.01%	5.86**	-0.55(5.23)**	0.92	0.46	0.35	US	US	0.03**	0.03**
892	Printed matter	0.16%	9.83**	-0.16(5.03)**	0.96	0.56	0.44	S	S	0.02**	0.00**
893	Articles of artificial plastic materials n.e.s.	0.01%	18.10**	-0.70(8.29)**	0.97	0.23	0.63	US	US	0.00**	0.13
894	Perambulators, toys, games and sporting goods	0.05%	5.36**	-0.81(3.65)**	0.79	0.75	0.11	S	US	0.47	0.40
895	Office and stationery supplies, n.e.s.	0.00%	10.83**	-0.76(7.83)**	0.83	0.06*	0.12	US	US	0.27	0.83

897	Jewellery and gold/silver smiths' wares	0.57%	5.55**	-0.81(5.62)**	0.87	0.31	0.79	S	US	0.04**	0.00**
899	Manufactured articles, n.e.s.	0.23%	4.35*	-0.91(4.97)**	0.93	0.97	0.15	S	S	0.09*	0.00**

Notes: (i) This table adheres to the same notes as provided beneath Table 11. (ii) The *Wald* test follows a χ^2 distribution with one degree of freedom. The critical values for this test are 2.70 at the 10% significance level and 3.84 at the 5% significance level, respectively.

Source: Author's calculations (2023)

7.8 Empirical Estimates of the Non-Linear Import Demand Specification

We now report the short-term and long-term empirical findings of the NARDL import specification outlined in Equation (51) in Table 16 and its corresponding diagnostic statistics in Table 17. Before interpreting the non-linear ARDL import estimates, we conducted the short-term and long-term asymmetry hypotheses employing the $Wald\text{-}SR^{TRGR}$ and $Wald\text{-}LR^{TRGR}$ tests. Our analysis revealed the presence of short-run adjustment asymmetry, as evidenced by the distinct lag orders associated with the ΔPOS^{TRGR} and ΔNEG^{TRGR} variables. Across all instances, we noticed short-term asymmetric effects of real lira-euro volatility, either by the size or sign of the difference between ΔPOS^{TRGR} and ΔNEG^{TRGR}. In addition, we observed short-run joint asymmetry as the sum of coefficients associated with ΔPOS^{TRGR} was different from the sum of coefficients linked to ΔNEG^{TRGR}. The asymmetric effects of real lira-euro volatility were observable based on the $Wald\text{-}SR^{TRGR}$ test estimates in 75 industries, particularly small and large import industries.

We observed long-term asymmetric effects of real lira-euro volatility on Turkey's small and large import industries on the basis of on the differences in size/sign between the POS^{TRGR} and NEG^{TRGR} coefficients. However, the significant effects of real lira-euro volatility that depend on the $Wald\text{-}LR^{TRGR}$ test are noticeable in 43 import industries. These asymmetry tests confirm evidence of the asymmetric effects of real lira-euro volatility on Turkish imports from Germany (refer to Table 17).

The short-term coefficients in Table 16 demonstrated that either the ΔPOS^{TRGR} or the ΔNEG^{TRGR} variable had at least one significant lagged effect at lag j in 86 import industries. The short-term coefficients indicated that $lnREX$ significantly impacts Turkey's real import flows in 85 industries. In addition, Turkey's real income (lnY^{TR}) significantly impacts Turkey's real import flows in 79 industries. We refer to the normalized long-term empirical coefficients in Table 16 to determine whether the short-term impacts persist in the long-term.

According to the long-term empirical coefficients reported in Table 16, the proposed method of segregating an increased real lira-euro volatility (POS^{TRGR}) from a decreased real lira-euro volatility (NEG^{TRGR}) allows us to divide the significantly affected import industries into four main groups. The first group includes 20 import industries coded 001, 231, 282, 514, 521, 571, 629, 631, 676, 683, 693, 694, 696, 698, 712, 715, 729, 733, 821, and 861 in which the POS^{TRGR} variable exhibits a significant negative coefficient, indicating that an increase in real lira-euro volatility harms imports of these Turkish industries from Germany. The second group includes 19 import industries with codes 276, 283, 422, 431, 513, 541, 581, 651, 655, 672, 674, 678, 681, 682, 689, 691, 692, 697, and 732 for which the POS^{TRGR} variable has a significantly positive estimated value, indicating that an increase in real lira-euro volatility promotes imports of these Turkish industries from Germany. One of the reasons for this result is that importers who exhibit a high degree of risk-aversion might temporarily increase their marginal utility of import revenues by increasing their imports in the short-run.

The third group includes 26 import industries coded 075, 231, 276, 283, 284, 321, 541, 571, 581, 629, 631, 656, 672, 681, 683, 685, 694, 715, 719, 723, 733, 735, 821, 893, 897, and 899, in which the NEG^{TRGR} variable has a significant negative estimated value, suggesting that a decrease in real lira-euro volatility boosts imports from Germany to Turkey. Finally, the last group includes 7 import industries coded 001, 072, 422, 514, 689, 698, and 717, in which the variable NEG^{TRGR} has a significant positive estimated value, indicating that a decrease in real lira-euro volatility hinders imports of these Turkish industries from Germany.

Based on the reported import shares of each import industry[105], it can be seen that all import industries are small in all groups, except for four large import industries with higher import shares. These import industries are classified under codes 541 (medicinal and pharmaceuticals, with an import share of 4.24%), 581 (plastics having import share of 8.33%), 719 (machinery and equipment, non-electrical parts, with an import share of 13.24%), and 732 (road motor vehicles, with an import share of 16.14%).

Thus, introducing a nonlinear adjustment to the measure of real lira-euro volatility and estimating the non-linear ARDL import demand model show that the largest import industry (code 732) benefits from an increase in real lira-euro volatility, implying significant asymmetric effects of real lira-euro volatility on Turkish imports from Germany for this industry. Turkey has been grappling with high inflation for an extended period and has a highly dollarized economy. In such a scenario, when exchange rate volatility increases, it also raises the expectation of expected inflation. Consequently, economic agents and market participants respond by selling their currency holdings at higher exchange rates and turning to tangible goods, such as automobiles, as a store of value. This shift in behaviors results in a further increase in imports, particularly in the context of the largest import industry (code 732).

In addition, the estimated coefficients of the POS^{TRGR} and NEG^{TRGR} variables are significantly different, with values of 3.15 and 0.95, respectively. This stark difference in coefficients indicates strong asymmetric effects of real lira-euro volatility. The Wald test, labelled as $Wald\text{-}LR^{TRGR}$ in Table 17, is statistically significant and confirms the asymmetric

[105] Refer to Table 14

effects of lira-euro volatility on Turkish imports from Germany for this particular industry. Furthermore, the long-run estimates of the non-linear ARDL import demand model indicate that the real lira-euro exchange rate (*lnREX*) impact is positive in 19 cases and negative in 29 cases. The negative coefficient of the *lnREX* variable validates the fact that that the decline in the value of the Turkish lira in comparison to the German euro adversely affects Turkey's ability to import goods from Germany.

In addition, an increase in Turkey's real income (lnY^{TR}) favours German products in Turkey in 45 significant instances. This finding suggests that as the Turkish economy experiences growth and higher real income levels, there is a corresponding increase in the consumption and demand for imported goods from Germany. This can be attributed to improved living standards, a growing middle class, and increased consumer preferences for high-quality German products. The rise in real income allows Turkish consumers to afford a wide range of imported goods, leading to a higher demand for German products across different sectors. However, it is essential to note that a significant negative estimate is linked to Turkish real income (lnY^{TR}) in only four instances. This implies that as the economy of Turkey expands over time, specific industries within the country have been able to develop and produce import-substituting products domestically. In these specific industries, the growth and development have led to decreased imports from Germany. This phenomenon can be attributed to the strengthening of domestic production capabilities, technological advancements, and investments in sectors that were previously reliant on imports. As a result, the domestic industry can meet the growing demand of people for certain goods, reducing the need for imports and leading to a decline in import volumes.

Lastly, the long-term analysis show that the dummy variable (*DM*) has an anticipated positive and significant effect in 67 sectors. This finding highlights that trade liberalization reforms implemented in Turkey have opened up opportunities for businesses to engage in international trade, expand their product offerings, and access a wide range of goods from Germany.

Table 16. Short-term and Long-term Coefficients of the Non-Linear ARDL Import Demand Specification (51)

There is at Least One Short-Term Estimate Significant				Long-run Coefficients					
SITC-1	lnY^{TR}	$lnREX$	$lnVOL^{TRGR}$	C	DM	lnY^{TR}	$lnREX$	POS^{TRGR}	NEG^{TRGR}
001	Yes	Yes	Yes	-354.32**	2.21**	13.73**	-0.34	-4.21**	1.15**
054	No	No	No	-21.38	1.51**	0.85	-0.35	-0.28	-0.16
061	Yes	No	Yes	-90.49	4.21**	3.40	-0.84	-0.98	0.25
071	Yes	Yes	Yes	-61.12	1.11	2.33	0.85	-0.97	-0.40
072	Yes	Yes	Yes	-83.49*	0.03**	3.27*	0.04	-0.52	0.56**
075	Yes	Yes	Yes	-67.72	0.47	2.51	2.20**	-1.18	-0.80**
081	No	Yes	No	-34.68	0.53	1.37	-0.05	-0.17	-0.02
211	No	Yes	Yes	61.94	0.88**	-2.37	-0.52	0.97	0.26
231	Yes	Yes	Yes	-75.27**	0.92**	2.99**	-0.22	-1.04**	-0.31**
251	No	No	Yes	25.33	0.96*	-0.99	-0.16	0.62	-0.08
262	Yes	Yes	Yes	-18.55	0.35	0.79	-0.25	-0.23	0.01
266	Yes	Yes	Yes	-39.70	0.32	1.45	1.37**	0.05	0.45
275	Yes	Yes	Yes	-34.87*	0.63**	1.38*	0.09	-0.48	-0.09
276	Yes	Yes	Yes	-20.49**	5.35**	2.49**	-0.43**	3.44**	-0.23**
282	Yes	Yes	Yes	-197.39*	1.38	7.60*	1.41	-3.04**	-0.81
283	Yes	Yes	Yes	34.89*	3.28**	3.20**	2.44**	2.44**	-0.92**
284	Yes	Yes	Yes	-51.32	-0.07	1.88	2.34**	-0.59	-0.68**
291	Yes	Yes	Yes	-30.81	1.17**	1.17	-0.29	-0.19	-0.06

292	Yes	Yes	Yes	39.64	0.79*	-1.54	0.23	0.56	-0.17
321	No	Yes	Yes	75.82	1.57**	-2.82	-1.27**	0.76	-0.70**
332	Yes	Yes	Yes	-20.05	0.78**	0.81	-0.02	-0.29	-0.16
411	No	No	No	-15.41	0.04	0.21	-0.02*	0.11	1.01
422	Yes	Yes	Yes	22.02**	0.09**	0.83**	-0.05**	0.03**	0.08**
431	Yes	Yes	Yes	80.25	2.52**	-2.89	0.19	0.53*	-0.20
512	Yes	No	Yes	36.77	0.02	-1.40	-0.06	0.08	0.04
513	Yes	Yes	Yes	40.17	0.78	-1.37	0.07	0.47*	-0.01
514	Yes	Yes	Yes	2.64	0.44*	2.73*	-0.47*	-5.44*	0.22*
515	No	No	No	-0.43	-0.03	0.01	0.00	-0.01	-0.01
521	Yes	Yes	Yes	2.21*	0.04**	0.08*	-0.01*	-0.01*	-0.00
531	No	No	No	-31.96	5.40	13.29	0.13	-0.18	0.50
532	No	No	No	3.15	0.01	-0.11	-0.01	0.01	0.01
533	Yes	Yes	Yes	29.05	0.24*	-1.05	0.09*	-0.04	-0.09
541	Yes	Yes	Yes	74.39**	-0.18	10.56**	-0.15	0.83**	-0.69**
551	Yes	Yes	Yes	40.29*	0.11*	1.51*	-0.07*	-0.04	0.72
554	Yes	No	No	174.48	0.83	-0.57	-0.16	-0.03	-0.24
561	No	Yes	Yes	-30.84	-0.19	1.17	0.11	-0.13	-0.03
571	Yes	Yes	Yes	11.51	0.16**	-0.44	0.02*	-0.02*	-0.05*
581	Yes	Yes	Yes	56.93**	1.35*	17.47**	-0.18	1.04*	-1.32**
599	Yes	Yes	Yes	62.42	0.22	-2.29	-0.20**	0.31	0.05

612	No	No	Yes	1.90	0.08**	-0.07	0.01	-0.01	-0.01
621	No	No	No	-12.01	0.22*	0.46	0.04	-0.09	0.01
629	Yes	Yes	Yes	3.76*	0.32**	0.16*	0.07**	-0.12**	-0.10**
631	Yes	Yes	Yes	12.62**	0.02*	0.49**	0.02**	-0.01*	-0.04**
632	No	No	No	4.64	0.47	-0.16	-0.07*	0.36	0.02
633	Yes	Yes	Yes	-69.70	0.62	2.63	0.60	-1.00	-0.27
641	Yes	No	Yes	-3.11	0.72**	0.14**	-0.00	-0.05	-0.13
642	No	No	No	-40.96	2.07**	1.49	0.45	-0.03	0.21
651	No	Yes	Yes	47.60*	0.91	-1.66	-0.47**	0.52**	0.08
652	No	Yes	No	2..15	0.68**	-0.08	-0.16*	0.01	0.11
653	Yes	No	Yes	-16.35	0.87	0.70**	-0.21**	0.55	0.12
654	No	No	No	-21.53	0.02	0.82	0.04	-0.13	-0.04
655	No	Yes	Yes	-33.66**	0.19**	1.31**	-0.09**	0.31**	-0.11
656	Yes	Yes	Yes	3.71	-0.03	-0.15	1.48	0.00	-0.04**
661	No	No	No	7.76	0.79**	-0.29	0.04	-0.02	-0.28
662	Yes	Yes	Yes	85.76*	-0.60	-3.31*	-0.05**	-0.06	-0.01
663	No	No	No	25.04	0.74**	-1.14	0.22	-0.48	-0.41
664	Yes	No	No	-4.76	0.21	0.22**	-0.04	0.12	-0.11
665	No	Yes	Yes	-21.86	0.08**	0.84**	0.01	-0.01	-0.01
667	No	No	No	1.28	0.00	-0.05	-0.84**	0.00	-0.00
671	No	No	No	17.35	0.01	-0.66	-0.09**	0.09	-0.01

672	Yes	Yes	Yes	116.65*	1.95**	4.52*	0.21	0.51**	-0.44**
673	No	Yes	No	-141.63	1.95*	5.44**	0.38	-0.31	0.07
674	No	Yes	Yes	-155.28	4.95	6.64**	-0.95*	2.09*	1.06
676	Yes	Yes	No	-23.98**	-0.07	0.93**	0.02**	-0.05**	0.05
677	No	Yes	Yes	-1.99	-0.01	0.09	-0.02*	0.01	0.02
678	Yes	Yes	Yes	516.38**	2.25**	9.60**	-1.92**	2.09**	0.61
679	Yes	Yes	Yes	1.07	0.01	-0.04	-0.00	-0.00	-0.00
681	Yes	Yes	Yes	65.82**	0.63**	-2.50**	-0.11**	0.28**	-0.12**
682	Yes	Yes	Yes	67.15**	0.59*	-2.48**	-0.16*	0.47**	-0.11
683	Yes	Yes	Yes	-0.52**	-0.10	0.01**	0.03**	-0.03**	-0.04**
684	No	No	No	-237.54*	-0.96	9.21*	0.07	-0.41	0.19
685	Yes	Yes	Yes	11.77*	-0.01	-0.46*	0.01	-0.01	-0.04**
686	Yes	Yes	Yes	-13.18**	-0.01	0.51**	-0.00	-0.00	0.02
687	No	No	No	-2.97	-0.05	0.11	-0.01	0.02	0.00
689	Yes	Yes	Yes	-1.01	0.07**	0.05	-0.02**	0.01*	0.02**
691	Yes	Yes	Yes	1.16**	0.61**	0.25**	-0.18**	0.12**	-0.14
692	Yes	Yes	Yes	23.10*	0.10	1.87*	-0.07**	0.11**	0.02
693	Yes	Yes	Yes	-65.32*	1.16*	2.40*	0.59**	-0.85**	-0.12
694	Yes	Yes	Yes	14.99	0.14*	-1.59	0.04*	-0.04*	-0.14**
695	No	No	No	-33.95	-0.63	1.28	0.17	-0.20	-0.13
696	No	Yes	Yes	-6.44*	1.03**	2.25*	0.02**	-0.04**	0.01

697	Yes	Yes	Yes	8.87*	1.07	-1.33	-0.04*	0.08**	0.00
698	Yes	Yes	Yes	-4.48**	1.97**	5.75**	0.29**	-1.18**	1.54**
711	Yes	Yes	Yes	-14.37	1.08**	0.64	-0.03	0.05	-0.02
712	Yes	Yes	Yes	-178.97**	0.91**	7.13**	-1.01**	-1.89**	0.19
714	Yes	No	Yes	-28.44	1.28**	1.13	0.46*	-0.43	-0.10
715	No	Yes	No	-50.99**	0.67**	2.10**	-0.13	-0.83**	-0.32**
717	Yes	Yes	Yes	17.20	0.73**	-0.62	-0.35	0.63	0.47**
718	Yes	Yes	Yes	-25.22	2.09**	1.04	-0.25	-0.40	-0.17
719	Yes	Yes	Yes	-18.12**	0.91**	0.78**	-0.08	0.02	-0.20*
722	No	Yes	No	-27.66	0.87**	1.15	-0.14	-0.14	-0.10
723	Yes	Yes	No	-11.41	1.40**	0.46	0.01	0.14	-0.65*
724	Yes	Yes	Yes	30.13	0.75**	-1.13	-0.12	0.39	0.04
725	Yes	Yes	Yes	-27.07	1.95**	1.05	-0.09	-0.39	-0.18
726	Yes	No	No	46.48	4.57	4.78**	-1.25**	1.10	0.38
729	Yes	No	Yes	69.69	1.92**	-2.56	1.09*	-1.79**	0.11
731	Yes	Yes	Yes	63.11**	0.21**	4.48**	-0.06**	-0.03	-0.19
732	Yes	Yes	Yes	61.50	7.51	8.24	-0.95*	3.15*	-0.95
733	Yes	Yes	Yes	-40.13**	0.22	1.51**	0.13**	-0.01**	-0.13**
734	No	No	No	-49.51	2.47	8.40	-0.19	0.97	0.05
735	Yes	Yes	Yes	55.40	1.80*	-2.03	1.32*	-0.65	-2.44**
812	Yes	Yes	Yes	-44.06	0.23	1.75	0.09	-0.72	-0.21

821	Yes	Yes	No	-68.66**	0.34**	2.71**	0.38	-1.04**	-0.33**
841	Yes	Yes	Yes	-30.03*	0.89**	1.13*	0.19	-0.20	0.09
861	Yes	Yes	Yes	-31.95**	0.61**	1.28**	0.03	-0.44*	-0.04
862	Yes	Yes	Yes	-7.38	0.72**	0.32	-0.07	0.21	-0.05
864	Yes	Yes	Yes	-29.11	0.61*	1.15	-0.03	-0.58	0.02
891	Yes	Yes	Yes	-22.57	-0.58	0.92**	-0.30	-0.20	0.26
892	Yes	Yes	Yes	-29.30	0.88**	1.15	-0.06	-0.58	-0.14
893	Yes	Yes	Yes	-37.65	1.71*	1.53**	-0.57	-1.77	-0.90**
894	No	No	Yes	-76.66	-0.46	2.02	0.12	-1.24	-0.05
895	No	Yes	Yes	12.58	0.56**	-0.47	0.34*	0.23	-0.08
897	Yes	Yes	Yes	-37.27	0.18	1.44**	0.28	-0.29	-0.60**
899	Yes	Yes	Yes	-14.39	0.89**	0.58	-0.05	-0.29	-0.17*

Notes: ‘*’ (‘**’) represents statistical significance at the 10% and 5% levels, respectively.

Source: Author’s calculations (2023)

7.9 Diagnostic Tests

We performed several residual and stability diagnostic tests to assess the empirical findings' robustness. Since the meaningfulness of the long-term estimates depends on the existence of cointegration, our focus shifts to Table 17 for further insights. Based on the *F*-bounds test, we detected cointegration in 94 out of 114 cases at the 5% and 10% significance levels. However, based on the ECM_{t-1} statistic, cointegration was confirmed in the remaining 20 functions. Hence, cointegration is confirmed in all import industries.

Furthermore, the *LM* test was applied to determine the presence of autocorrelation in the residuals, and the outcome was significant in only 36 cases. It indicates that only 36 functions were affected by serial correlation. Additionally, we performed Ramsey's *RESET* test to assess the potential misspecification of our import model, and the result was significant in only 29 cases. The findings show that the proposed models are appropriately specified in most industries.

To ensure the stability of the coefficients in both the short-term and long-term, we employed the *CUSUM* and *CUSUMSQ* tests. These tests confirmed the stability of the estimated coefficients in most cases. Lastly, the high magnitude of the adjusted R^2 suggests that our linear import model provides an excellent fit to the data. In summary, these diagnostics' results support the empirical findings' robustness for the non-linear import model.

Table 17. Diagnostic Statistics Corresponding to Coefficients of the Non-Linear ARDL Import Demand Specification (51)

SITC-1	Industry Name	Import Share	*F*-test	ECM_{t-1}	Adj. R^2	*LM*	*RESET*	*CUSUM*	*CUSUMSQ*	Wald-SR^{TRGR}	Wald-LR^{TRGR}
001	Live animals	0.05%	6.89**	-0.74(6.29)**	0.74	0.64	0.72	S	S	0.00**	0.00**
054	Vegetables, roots & tubers, fresh or dried	0.01%	4.12*	-0.60(4.79)**	0.58	0.58	0.53	US	US	0.22	0.82
061	Sugar and honey	0.03%	3.86	-0.49(4.66)**	0.61	0.00**	0.00**	S	US	0.39	0.19
071	Coffee	0.04%	3.84	-0.52(4.63)**	0.72	0.00**	0.02**	US	US	0.29	0.47
072	Cocoa	0.09%	3.43	-0.61(4.38)**	0.65	0.61	0.76	S	S	0.03**	0.05*
075	Spices	0.00%	6.65**	-0.91(6.14)**	0.53	0.44	0.13	S	S	0.30	0.56
081	Feed. Stuff for animals excl. unmilled cereals	0.11%	2.70	-0.53(3.88)**	0.80	0.50	0.76	S	S	0.02**	0.79
211	Hides & skins, exc.fur skins undressed	0.01%	5.02**	-0.18(5.31)**	0.85	0.11	0.09*	S	US	0.11	0.92
231	Crude rubber incl. synthetic & reclaimed	0.06%	4.20*	-0.65(4.88)**	0.92	0.07**	0.61	S	S	0.02**	0.09*
251	Pulp & waste paper	0.08%	2.38	-0.42(3.67)**	0.83	0.70	0.06*	S	S	0.45	0.33

262	Wool and other animal hair	0.00%	2.59	-0.31(3.84)**	0.90	0.00**	0.16	S	S	0.38	0.71
266	Synthetic and regenerated artificial fibres	0.22%	3.15	-0.39(4.21)**	0.51	0.09*	0.85	US	S	0.38	0.62
275	Natural abrasives, incl. industrial diamonds	0.00%	3.77**	-0.39(4.61)**	0.90	0.04**	0.60	S	US	0.35	0.80
276	Other crude minerals	0.09%	6.35**	-0.94(6.73)**	0.96	0.23	0.18	S	S	0.07*	0.09*
282	Iron and steel scrap	1.29%	2.29	-0.54(3.58)**	0.55	0.61	0.08*	U	US	0.25	0.18
283	Ores & concentrates of non-ferrous base metals	0.00%	5.92**	-0.94(4.84)**	0.94	0.32	0.42	S	S	0.00**	0.03**
284	Non-ferrous metal scrap	0.11%	5.91**	-0.73(5.75)**	0.64	0.61	0.87	S	S	0.03**	0.58
291	Crude animal materials, n.e.s.	0.01%	3.59	-0.57(4.48)**	0.71	0.00**	0.86	US	US	0.25	0.01**
292	Crude vegetable materials, n.e.s.	0.11%	2.45	-0.25(3.69)**	0.89	0.43	0.77	S	S	0.04**	0.16

321	Coal, coke & briquettes	0.01%	19.59**	-0.74(5.56)**	0.56	0.13	0.00**	S	S	0.08*	0.07*
332	Petroleum products	0.51%	3.04	-0.31(4.11)**	0.95	0.01**	0.99	S	US	0.37	0.69
411	Animal oils and fats	0.00%	6.88**	0.66(5.60)**	0.87	0.12	0.63	S	S	0.01**	0.04**
422	Other fixed vegetable oils	0.02%	5.61**	-0.49(5.88)**	0.73	0.27	0.11	S	US	0.22	0.27
431	Anim./veg. Oils & fats, processed, and waxes	0.04%	8.92**	-0.53(5.35)**	0.99	0.29	0.62	S	S	0.00**	0.00**
512	Organic chemicals	2.35%	9.03**	-0.80(5.73)**	0.99	0.17	0.92	S	S	0.35	0.89
513	Inorganic chemicals elements., oxides, halogen salts	0.48%	5.17**	-0.35(6.41)**	0.95	0.15	0.02**	S	S	0.01**	0.03**
514	Other inorganic chemicals	0.41%	9.43**	-0.75(5.15)**	0.99	0.00**	0.22	US	US	0.08*	0.09*
515	Radioactive and associated materials	0.00%	6.43**	-0.80(22.82)**	0.92	0.32	0.21	US	US	0.02**	0.01**

521	Crude chemicals from coal, petroleum and gas	0.02%	7.72**	-0.84(4.94)**	0.95	0.36	0.55	S	S	0.03**	0.84
531	Synth. organic dyestuffs, natural indigo & lakes	0.21%	5.52**	-0.65(6.88)**	0.96	0.11	0.23	S	S	0.01**	0.01**
532	Dyeing & tanning extracts, synth. tanning mat.	0.02%	9.93**	-0.73(9.24)**	0.97	0.00**	0.35	US	US	0.00**	0.76
533	Pigments, paints, varnishes & related materials	1.37%	5.78**	-0.76(9.22)**	0.87	0.34	0.49	S	S	0.03**	0.81
541	Medicinal & pharmaceutical products	4.24%	13.35**	-0.73(5.06)**	0.98	0.17	0.21	S	S	0.00**	0.00**
551	Essential oils, perfume and flavour materials	0.34%	6.85**	-0.76(5.95)**	0.99	0.53	0.32	US	US	0.13	0.17
554	Soaps, cleansing & polishing preparations	0.55%	5.03**	-0.24(5.03)**	0.99	0.00**	0.26	US	US	0.01**	0.02**

561	Fertilizers manufactured	0.05%	9.50**	-0.53(8.31)**	0.73	0.46	0.75	S	S	0.02**	0.58
571	Explosives and pyrotechnic products	0.02%	6.30**	-0.47(14.42)**	0.87	0.37	0.31	S	S	0.01**	0.01**
581	Plastic materials, regenerated cellulose & resins	8.33%	6.13**	-0.52(9.96)**	0.99	0.73	0.46	S	S	0.09*	0.97
599	Chemical materials and products, n.e.s.	2.98%	6.48**	-0.68(5.24)**	0.93	0.51	0.62	S	US	0.08*	0.98
612	Manufacturing of leather or artificial or reconstruction of leather	0.00%	7.02**	-0.87(9.09)**	0.76	0.00**	0.05**	S	US	0.22	0.76
621	Materials of rubber	0.46%	6.32**	-0.74(6.60)**	0.82	0.63	0.75	S	US	0.03**	0.04**
629	Articles of rubber, n.e.s.	0.45%	8.91**	-0.56(7.77)**	0.99	0.00**	0.33	S	US	0.02**	0.01**
631	Veneers, plywood boards & other	0.02%	12.79**	-0.26(5.89)**	0.98	0.39	0.30	S	S	0.07*	0.33

	wood, worked, n.e.s.										
632	Wood manufactures, n.e.s.	0.06%	7.66**	-0.68(5.91)**	0.90	0.00**	0.49	US	US	0.11	0.57
633	Cork manufactures	0.00%	2.10	-0.24(3.43)**	0.89	0.01**	0.21	US	US	0.48	0.47
641	Paper and paperboard	0.02%	5.94**	-0.18(5.78)**	0.99	0.02**	0.04**	US	US	0.27	0.94
642	Articles of paper, pulp, paperboard	0.13%	5.44**	-0.78(8.96)**	0.93	0.28	0.53	US	US	0.04**	0.11
651	Textile yarn and thread	0.20%	5.47**	-0.45(5.51)**	0.94	0.39	0.07*	S	S	0.06*	0.04**
652	Cotton fabrics, woven ex. narrow or spec. fabrics	0.04%	6.59**	-0.85(9.18)**	0.96	0.30	0.84	US	S	0.23	0.10
653	Text fabrics woven ex narrow, spec, not cotton	0.20%	8.89**	-0.79(6.30)**	0.99	0.44	0.09*	US	US	0.12	0.25
654	Tulle, lace, embroidery, ribbons, trimmings	0.04%	5.83**	-0.46(4.39)**	0.77	0.22	0.31	US	US	0.00**	0.13

655	Special textile fabrics and related products	0.51%	7.07**	-0.54(23.87)**	0.97	0.56	0.80	S	S	0.00**	0.03**
656	Made up articles, wholly or chiefly of text.mat.	0.01%	5.30**	-0.51(5.62)**	0.91	0.39	0.35	S	S	0.09*	0.03**
661	Lime, cement & fabrics. Building materials. Ex glass/clay mat	0.01%	6.50**	-0.55(6.56)**	0.90	0.12	0.64	US	US	0.08*	0.47
662	Clay and refractory construction materials	0.23%	7.65**	-0.28(6.33)**	0.99	0.22	0.13	S	US	0.06*	0.01**
663	Mineral manufactures, n.e.s.	0.41%	23.11**	-0.70(5.27)**	0.97	0.65	0.74	S	US	0.01**	0.09*
664	Glass	0.36%	6.38**	-0.48(9.53)*	0.71	0.47	0.08*	US	S	0.04**	0.57
665	Glassware	0.06%	8.27**	-0.57(6.56)**	0.66	0.57	0.09*	US	US	0.07*	0.51
667	Pearls and precious and semi-precious stones	0.00%	6.20**	-0.88(4.41)**	0.75	0.11	0.16	S	US	0.06*	0.03**

671	Pig iron, spiegeleisen, sponge iron etc.	0.12%	5.65**	-0.86(5.95)**	0.86	0.18	0.43	S	S	0.00**	0.01**
672	Ingots & other primary forms of iron or steel	0.82%	9.20**	-0.73(7.03)**	0.99	0.42	0.29	S	US	0.03**	0.02**
673	Iron and steel bars, rods, angles, shapes, sections	0.91%	6.99**	-0.37(46.76)**	0.97	0.31	0.12	US	S	0.04**	0.95
674	Universals, plates and sheets of iron or steel	1.28%	11.55**	-0.18(5.55)**	0.98	0.12	0.32	US	US	0.00**	0.00**
676	Rails & railway track construction materials of iron or steel	0.02%	8.82**	-0.36(5.61)**	0.64	0.40	0.07*	S	US	0.01**	0.31
677	Iron and steel wire, excluding wire rod	0.08%	5.84**	-0.72(6.21)**	0.94	0.11	0.64	US	S	0.01**	0.02**
678	Tubes, pipes and fittings of iron or steel	0.55%	16.90**	-0.65(6.62)**	0.90	0.25	0.03**	S	S	0.00**	0.70

679	Iron steel castings forgings unworked, n.e.s.	0.02%	10.91**	-0.72(5.14)**	0.59	0.35	0.00**	S	S	0.11	0.52
681	Silver and platinum group metals	0.04%	8.51**	-0.76(5.28)**	0.99	0.03**	0.23	US	US	0.19	0.29
682	Copper	0.51%	81.13**	-0.18(4.42)**	0.99	0.46	0.23	US	US	0.25	0.11
683	Nickel	0.04%	9.08**	-0.73(3.98)**	0.99	0.32	0.23	S	S	0.11	0.07*
684	Aluminium	0.74%	16.54**	-0.91(6.60)**	0.96	0.00**	0.30	US	US	0.64	0.42
685	Lead	0.00%	8.37**	-0.65(6.62)**	0.74	0.64	0.04**	S	S	0.00**	0.03**
686	Zinc	0.02%	6.65**	0.15(12.48)**	0.93	0.14	0.01**	S	US	0.09*	0.98
687	Tin	0.01%	10.71**	-0.10(9.46)**	0.83	0.00**	0.56	US	US	0.11	0.76
689	Miscellaneous non-ferrous base metals	0.01%	5.02**	-0.26(4.87)**	0.99	0.35	0.31	US	U	0.03**	0.01**
691	Finished structural parts and structures, n.e.s	0.26%	6.69**	-0.39(13.65)**	0.86	0.13	0.41	S	S	0.04**	0.73
692	Metal containers for storage and transport	0.10%	9.61**	-0.65(7.79)**	0.95	0.35	0.90	US	S	0.09*	0.00**

693	Wire products ex electric & fencing grills	0.06%	12.27**	-0.43(5.50)**	0.86	0.63	0.08**	S	S	0.00**	0.55
694	Nails, screws, nuts, bolts, rivets and sim. articles	0.01%	13.53**	-0.46(7.80)**	0.97	0.27	0.66	S	S	0.01**	0.03**
695	Tools for use in the hand or machines	0.64%	6.36**	-0.45(5.77)**	0.81	0.30	0.33	US	US	0.11	0.33
696	Cutlery	0.08%	2.30	-0.97(6.66)**	0.73	0.40	0.54	S	S	0.04**	0.97
697	Household equipment of base metals	0.06%	8.55**	0.85(5.82)**	0.99	0.00**	0.33	US	US	0.08*	0.11
698	Manufactures of metal, n.e.s.	1.72%	10.16**	-0.29(5.28)**	0.98	0.12	0.13	S	S	0.09*	0.35
711	Power-generating machinery other than electric	4.83%	6.17**	-0.48(5.93)**	0.95	0.01**	0.06*	S	US	0.06*	0.30
712	Agricultural machinery and implements	0.45%	18.46**	-0.79(10.25)**	0.87	0.53	0.63	S	S	0.00**	0.00**
714	Office machines	0.57%	7.63**	-0.42(6.55)**	0.92	0.01**	0.75	S	US	0.37	0.42

715	Metalworking machinery	1.13%	4.83**	-0.61(5.21)**	0.89	0.03**	0.02**	S	S	0.01**	0.09**
717	Textile and leather machinery	2.45%	7.66**	-0.23(6.66)**	0.88	0.08*	0.01**	S	S	0.09*	0.52
718	Machines for special industries	1.15%	17.20**	-0.52(9.94)**	0.95	0.00**	0.00**	S	S	0.72	0.88
719	Machinery and appliances non-electrical parts	13.24%	13.98**	-0.36(8.94)**	0.98	0.33	0.03**	US	S	0.07*	0.32
722	Electric power machinery and switchgear	4.36%	7.64**	-0.39(6.58)**	0.97	0.00**	0.02**	S	S	0.00**	0.09*
723	Equipment for distributing electricity	0.46%	9.16**	-0.35(7.19)**	0.94	0.01**	0.16	S	US	0.02**	0.77
724	Telecommunications apparatus	0.16%	3.37	-0.18(4.34)**	0.90	0.30	0.42	US	S	0.03**	0.53
725	Domestic electrical equipment	0.27%	9.81**	-0.38(7.44)**	0.96	0.00**	0.15	S	US	0.53	0.90
726	Electronic apparatus for	0.35%	7.07**	-0.64(6.90)**	0.44	0.28	0.65	US	US	0.04**	0.06*

	medical purposes, radiological ap.										
729	Other electrical machinery and apparatus	3.20%	7.85**	-0.69(6.18)**	0.89	0.23	0.41	S	S	0.03**	0.09*
731	Railway vehicles	0.11%	8.23**	-0.57(5.33)**	0.98	0.11	0.92	US	S	0.00**	0.31
732	Road motor vehicles	16.14%	8.56**	-0.73(6.80)**	0.97	0.53	0.99	S	S	0.01**	0.08*
733	Road vehicles other than motor vehicles	1.00%	7.68**	-0.51(5.51)**	0.94	0.11	0.41	S	S	0.03**	0.04**
734	Aircraft	6.04%	6.52**	-0.64(6.51)**	0.96	0.29	0.53	S	S	0.09**	0.07*
735	Ships and boats	0.41%	6.66**	-0.79(6.16)**	0.85	0.91	0.86	S	S	0.04**	0.04**
812	Sanitary, plumbing, heating & lighting fixtures	0.18%	3.47	-0.29(4.43)**	0.92	0.03**	0.46	US	S	0.38	0.51
821	Furniture	0.32%	13.43**	-0.41(8.72)**	0.97	0.22	0.05*	S	US	0.35	0.18
841	Clothing except fur clothing	0.25%	11.37**	-0.19(8.06)**	0.99	0.01**	0.04**	S	S	0.01**	0.14
861	Scientific, medical, optical,	1.50%	4.95**	-0.24(5.28)**	0.97	0.02**	0.33	S	US	0.58	0.13

	meas./contr. instruments										
862	Photographic and cinematographic supplies	0.08%	3.33	-0.21(4.31)**	0.89	0.01**	0.40	S	US	0.68	0.59
864	Watches and clocks	0.01%	2.72	-0.19(3.89)**	0.84	0.05**	0.14	US	S	0.60	0.16
891	Musical instruments, sound recorders and parts	0.11%	4.54*	-0.14(5.12)**	0.91	0.01**	0.04**	S	S	0.07*	0.09**
892	Printed matter	0.13%	2.50	-0.21(3.73)**	0.91	0.02**	0.78	S	S	0.08*	0.39
893	Articles of artificial plastic materials n.e.s.	0.00%	2.78	-0.28(3.93)**	0.80	0.29	0.23	S	US	0.24	0.53
894	Perambulators, toys, games and sporting goods	0.02%	2.65	-0.28(4.34)**	0.79	0.05*	0.53	S	S	0.09*	0.20
895	Office and stationery supplies, n.e.s.	0.07%	5.34**	-0.34(5.49)**	0.93	0.16	0.01**	S	US	0.53	0.26

897	Jewellery and gold/silver smiths' wares	0.10%	5.01**	-0.75(5.28)**	0.83	0.27	0.27	S	S	0.06*	0.63
899	Manufactured articles, n.e.s.	0.28%	7.57**	-0.29(6.50)**	0.97	0.22	0.45	S	US	0.48	0.71

Notes: This table adheres to the same notes as provided beneath Table 15.

Source: Author's calculations (2023)

CHAPTER VIII

Third-Country Exchange Rate Volatility and Trade Dynamics

8.1 Introduction

The present study examines the symmetric and asymmetric influences of third-country exchange rate uncertainty on commodity trade flows between Germany and Turkey. To capture the linear and nonlinear influences of third-economy uncertainty (i.e., fluctuations in the real lira-dollar exchange rate) on the real trade volumes of Turkish-German commodities, the study selects a sample of 79 SITC-1 (three-digit level) Turkish export industries and 93 Turkish import industries. Collectively, these export (import) industries constitute around 87 (95) percent of Turkey's overall exports (imports) to (from) Germany. The research employs the ARDL methodology developed by Pesaran et al. (2001) to estimate linear export and import demand equations,[106] as outlined in Equations (30) and (31). This estimation is carried out using annual data spanning from 1980 to 2022. For comparative analysis, the study also adopts the NARDL methodology put forward by Shin et al. (2014) to estimate nonlinear export and import models[107] outlined in Equations (56) and (57).

8.2 Variables Description

It is noteworthy to mention that we have kept the explained and the list of explanatory variables of the export and import models the same, except for the third-country risk variable. Therefore, there is no need to redefine the variables included in the export and import specifications; we only define the third-country risk variable here.

$\boldsymbol{VOL^{TRUS}}$(lira − dollar volatility) = It is the measure of uncertainty in the RER between the TL and the U.S. dollar, which can be computed as follows:

$$REX^{TRUS} = \left(\frac{CPI^{US} \times NEX^{TRUS}}{CPI^{TR}}\right) \quad (80)$$

In Equation (80), the symbol NEX^{TRUS} represents the nominal ER, denoting the number of Turkish liras required to purchase one U.S. dollar. To capture the impact of third-economy uncertainty, the study considers the RER uncertainty between the Turkish lira and the U.S. dollar as a measure of

[106] Model 2 (the symmetric analysis)
[107] Model 2 (the asymmetric analysis)

third-country volatility. In this context, the lira-dollar exchange rate serves as a *"vehicle currency"* to capture the effect of third-country volatility. Following the approaches Bahmani-Oskooee and Aftab (2017, 2018) used, we estimate third-economy uncertainty utilizing the GARCH (1, 1) approach[108].

8.3 Unit Root Properties of the Variables

Although the ARDL methodology doesn't necessitate preliminary testing of variables for stationarity; however, we conducted *ADF* and *PP* tests to validate that all data series remain within the *I(0)* and *I(1)* orders of integration. The mixed integration order [*I(0)* and *I(1)*] from both unit root tests led us to employ the *ARDL* bounds test for empirical investigation as we didn't find any *I(2)* series (refer to Tables 18 and 19). Given the use of annual data, we incorporated 03 lags for each first-differenced variable. Lag order selection is achieved through the utilization of the *AIC* and *SIC* criteria. Moreover, the reported empirical estimates and associated diagnostic tests for each industry represent the optimal models.

[108] Refer to sub-section 6.2.2 for its detail construction.

Table 18. ADF and PP Unit Root Test Results for Export Sectors

Variables *[ln (XV$_i$)]*	*ADF* Test				*PP* Test				
	Level		First Difference		Level		First Difference		Order of Integration
	I	*T & I*	*I*	*T & I*	*I*	*T & I*	*I*	*T & I*	
031	-0.44(0.89)	-1.95(0.61)	-6.64(0.00)*	-6.57(0.00)*	-0.45(0.89)	-2.02(0.57)	-6.64(0.00)*	-6.57(0.00)*	*I (1)*
032	-3.30(0.02)	-3.63(0.04)**	-7.73(0.00)*	-7.68(0.00)*	-3.35(0.19)	-3.59(0.04)**	-7.90(0.00)*	-7.73(0.00)*	*I (1)*
046	-1.96(0.30)	-2.10(0.53)	-7.49(0.00)*	-7.40(0.00)*	-1.87(0.34)	-2.01(0.58)	-7.57(0.00)*	-7.47(0.00)*	*I (1)*
047	-2.83(0.06)***	-3.52(0.05)***	-5.13(0.00)*	-5.30(0.00)*	-2.67(0.09)***	-3.27(0.09)***	-7.30(0.00)*	-7.25(0.00)*	*I (0)*
048	-1.29(0.62)	-2.48(0.34)	-4.95(0.00)*	-5.20(0.00)*	-1.29(0.62)	-1.55(0.80)	-3.64(0.01)*	-3.90(0.02)**	*I (1)*
051	-1.85(0.35)	-2.36(0.39)	-6.09(0.00)*	-5.96(0.00)*	-2.04(0.27)	-3.18(0.10)	-10.98(0.00)*	-10.56(0.00)*	*I (1)*
052	-1.25(0.64)	-2.36(0.40)	-6.05(0.00)*	-5.68(0.00)*	-1.20(0.67)	-0.50(0.33)	-6.69(0.00)*	-7.34(0.00)*	*I (1)*
053	-1.50(0.52)	-1.56(0.79)	-6.28(0.00)*	-6.40(0.00)*	-1.55(0.50)	-1.56(0.79)	-6.43(0.00)*	-9.18(0.00)*	*I (1)*
054	-2.15(0.23)	-2.41(0.37)	-8.46(0.00)*	-8.42(0.00)*	-1.85(0.35)	-2.91(0.17)	-9.75(0.00)*	-13.56(0.00)*	*I (1)*
055	-1.99(0.29)	-1.19(0.90)	-7.45(0.00)*	-8.10(0.00)*	-1.94(0.31)	-1.19(0.90)	-7.39(0.00)*	-8.14(0.00)*	*I (1)*
061	-2.78(0.07)***	-2.76(0.21)	-6.55(0.00)*	-6.63(0.00)*	-2.76(0.07)***	-2.76(0.21)	-7.21(0.00)*	-7.48(0.00)*	*I (1)*
062	-3.28(0.02)**	-2.87(0.18)	-6.63(0.00)*	-4.97(0.00)*	-0.98(0.75)	-1.94(0.61)	-6.97(0.00)*	-8.79(0.00)*	*I (1)*
073	-1.22(0.70)	-6.75(0.00)*	-6.74(0.00)*	-6.82(0.00)*	-1.10(0.71)	-7.83(0.00)*	-7.06(0.00)*	-7.09(0.00)*	*I (1)*

074	-4.37(0.00)*	-5.07(0.00)*	-7.46(0.00)*	-7.36(0.00)*	-4.41(0.00)*	-5.05(0.00)*	-18.88(0.00)*	-17.92(0.00)*	*I (0)*
075	-1.77(0.39)	-2.17(0.49)	-6.64(0.00)*	-6.67(0.00)*	-1.65(0.45)	-2.07(0.55)	-7.19(0.00)*	-11.10(0.00)*	*I (1)*
099	-0.15(0.09)***	-3.60(0.04)**	-7.00(0.00)*	-7.09(0.00)*	0.28(0.97)	-3.63(0.04)**	-7.04(0.00)*	-7.14(0.00)*	*I (0)*
112	-1.38(0.58)	-2.13(0.51)	-4.17(0.00)*	-4.25(0.00)*	-1.37(0.59)	-1.78(0.70)	-6.53(0.00)*	-6.54(0.00)*	*I (1)*
121	-0.31(0.91)	-1.07(0.92)	-6.04(0.00)*	-6.37(0.00)*	-1.49(0.53)	-2.25(0.45)	-10.30(0.00)*	-13.51(0.00)*	*I (1)*
221	-1.62(0.46)	-2.85(0.19)	-6.25(0.00)*	-6.18(0.00)*	-1.41(0.57)	-2.78(0.21)	-7.25(0.00)*	-7.06(0.00)*	*I (1)*
263	-2.46(0.13)	-2.48(0.33)	-8.52(0.00)*	-8.65(0.00)*	-2.37(0.16)	-2.33(0.41)	-8.62(0.00)	-9.35(0.00)*	*I (1)*
266	-4.10(0.00)*	-4.65(0.00)*	-7.25(0.00)*	-7.02(0.00)*	-4.09(0.00)*	-4.66(0.00)*	-9.40(0.00)*	-11.03(0.00)*	*I (0)*
273	-1.51(0.52)	-2.47(0.34)	-9.19(0.00)*	-9.20(0.00)*	-1.35(0.60)	-2.35(0.40)	-9.64(0.00)*	-9.81(0.00)*	*I (1)*
276	-1.37(0.59)	-1.76(0.71)	-6.28(0.00)*	-6.24(0.00)*	-1.48(0.53)	-1.89(0.64)	-6.29(0.00)*	-6.24(0.00)*	*I (1)*
283	-4.04(0.00)*	-5.55(0.00)*	-11.13(0.00)*	-11.05(0.00)*	-3.91(0.00)*	-5.55(0.00)*	-18.82(0.00)*	-15.93(0.00)*	*I (0)*
292	-1.49(0.53)	-4.09(0.01)**	-6.62(0.00)**	-6.06(0.03)*	-1.32(0.69)	-4.15(0.01)**	-17.35(0.00)*	-16.60(0.00)*	*I (0)*
421	-1.57(0.49)	-5.19(0.00)*	-6.45(0.00)*	-6.36(0.00)*	-1.36(0.59)	-4.99(0.00)*	-12.00(0.00)*	-11.84(0.00)*	*I (0)*
422	-1.59(0.48)	-4.40(0.01)*	-10.35(0.00)*	-10.22(0.00)*	-2.49(0.14)	-4.48(0.00)*	-13.03(0.00)*	-12.78(0.00)*	*I (0)*

512	-1.95(0.31)	-3.09(0.12)	-7.08(0.00)*	-7.10(0.00)*	-1.81(0.37)	-3.12(0.12)	-7.26(0.00)*	-7.73(0.00)*	*I (1)*
513	-0.79(0.81)	-3.73(0.03)**	-7.48(0.00)*	-7.50(0.00)*	-1.56(0.49)	-3.65(0.04)**	-7.03(0.00)*	-7.04(0.00)*	*I (0)*
514	-0.91(0.77)	-5.49(0.00)*	9.73(0.00)*	9.65(0.00)*	-1.59(0.48)	-5.49(0.00)*	-10.16(0.00)*	-10.05(0.00)*	*I (0)*
541	-5.13(0.00)*	-5.23(0.00)*	-7.28(0.00)*	-7.84(0.00)*	-3.60(0.01)*	-3.42(0.06)***	-7.22(0.00)*	-7.75(0.00)*	*I (0)*
551	-1.35(0.60)	-2.28(0.43)	-6.40(0.00)*	-6.38(0.00)*	-1.36(0.59)	-2.38(0.38)	-6.49(0.00)*	-6.85(0.00)*	*I (1)*
553	-1.13(0.69)	-3.24(0.09)***	-6.12(0.00)*	-6.03(0.01)*	-0.91(0.77)	-3.16(0.11)	-8.38(0.00)*	-8.11(0.00)*	*I (1)*
554	-5.36(0.00)*	-1.22(0.89)	-7.02(0.00)*	-7.58(0.00)*	-2.78(0.07)***	-3.04(0.14)	-10.16(0.00)*	-25.36(0.00)*	*I (1)*
581	-0.12(0.94)	-4.34(0.01)*	-6.80(0.00)*	-6.83(0.00)*	-1.52(0.52)	-4.48(0.01)*	-10.16(0.00)*	-10.02(0.00)*	*I (0)*
599	0.32(0.98)	-3.10(0.12)	-5.28(0.00)*	-5.29(0.00)*	-1.43(0.56)	-4.97(0.00)*	-15.73(0.00)*	-16.56(0.00)*	*I (1)*
621	-3.38(0.02)*	-1.61(0.77)	-3.98(0.00)*	-4.86(0.00)*	-3.18(0.03)*	-1.62(0.77)	-3.94(0.00)*	-4.80(0.00)*	*I (1)*
632	-1.31(0.62)	-2.27(0.44)	-6.00(0.00)*	-5.99(0.00)*	-1.27(0.64)	-2.43(0.36)	-6.28(0.00)*	-6.51(0.00)*	*I (1)*
651	-2.40(0.15)	-3.35(0.07)***	-5.87(0.00)*	-5.81(0.00)*	-2.58(0.11)	-3.01(0.14)	-5.90(0.00)*	-5.78(0.00)*	*I (1)*
652	-2.61(0.10)	-2.12(0.52)	-5.89(0.00)*	-6.13(0.00)*	-2.60(0.10)	-2.13(0.51)	-5.87(0.00)*	-6.13(0.00)*	*I (1)*
653	-2.75(0.07)***	-2.42(0.36)	-5.96(0.00)*	-6.15(0.00)*	-3.87(0.01)*	-2.07(0.55)	-6.12(0.00)*	-9.69(0.00)*	*I (1)*

654	-6.15(0.00)*	-5.90(0.00)*	-8.67(0.00)*	-8.73(0.00)*	-5.82(0.00)*	-5.55(0.00)*	-11.04(0.00)*	-16.08(0.00)*	*I (0)*
656	-3.00(0.04)**	-1.48(0.82)	-6.03(0.00)*	-7.82(0.00)*	-3.05(0.04)**	-1.34(0.86)	-6.14(0.00)*	-7.84(0.00)*	*I (1)*
657	-0.79(0.81)	-2.28(0.43)	-6.76(0.00)*	-6.87(0.00)*	-1.60(0.47)	-2.55(0.30)	-7.12(0.00)*	-9.04(0.00)*	*I (1)*
661	-3.16(0.03)**	-5.39(0.00)*	-6.35(0.00)*	-6.21(0.00)*	-3.38(0.02)*	-2.89(0.08)***	-6.25(0.00)*	-6.15(0.00)*	*I (0)*
662	-1.43(0.56)	-5.99(0.00)*	-7.80(0.01)*	-6.69(0.00)*	-1.35(0.69)	-1.43(0.04)**	-5.46(0.00)*	-5.56(0.00)*	*I (0)*
663	-2.19(0.21)	-7.79(0.00)*	-5.45(0.03)**	-5.35(0.03)**	-1.84(0.36)	-3.81(0.03)**	-16.62(0.00)*	-19.48(0.00)*	*I (0)*
664	-2.58(0.11)	-3.44(0.06)***	-5.95(0.00)*	-6.06(0.00)*	-2.63(0.09)***	-2.35(0.04)**	-6.47(0.00)*	-6.87(0.00)*	*I (0)*
665	-2.25(0.19)	-2.02(0.57)	-5.68(0.00)*	-5.76(0.00)*	-1.89(0.32)	-1.77(0.70)	-5.65(0.00)*	-5.85(0.00)*	*I (1)*
666	-2.35(0.16)	-3.76(0.03)**	-6.86(0.00)*	-6.79(0.00)*	-2.27(0.19)	-3.69(0.03)**	-10.55(0.00)*	-13.14(0.00)*	*I (0)*
672	-1.04(0.73)	-5.70(0.00)*	-6.36(0.00)*	-6.22(0.00)*	-2.16(0.22)	-5.35(0.00)*	-13.96(0.00)*	-15.87(0.00)*	*I (0)*
673	-2.37(0.16)	-5.13(0.00)*	-6.04(0.00)*	-5.96(0.00)*	-2.08(0.25)	-5.13(0.00)*	-16.16(0.00)*	-15.77(0.00)*	*I (0)*
678	-5.43(0.00)*	-2.94(0.16)	-1.49(0.53)	-1.80(0.68)	-2.70(0.08)***	-2.51(0.32)	-8.32(0.00)*	-16.00(0.00)*	*I (1)*
684	-2.65(0.09)***	-2.38(0.39)	-6.38(0.00)*	-6.95(0.00)*	-2.65(0.09)***	-2.38(0.39)	-6.48(0.00)*	-6.92(0.00)*	*I (1)*

691	-1.26(0.64)	-4.17(0.01)*	-11.58(0.00)*	-11.44(0.00)*	-0.68(0.84)	-4.51(0.00)*	-11.84(0.00)*	-12.01(0.00)*	*I (0)*
695	-2.28(0.18)	-4.52(0.00)*	-5.19(0.00)*	-5.37(0.00)*	-2.24(0.19)	-4.46(0.00)*	-14.80(0.00)*	-36.42(0.00)*	*I (0)*
696	-3.33(0.02)**	-6.17(0.00)*	-10.73(0.00)*	-10.64(0.00)*	-3.15(0.03)**	-6.18(0.00)*	-19.71(0.00)*	-28.15(0.00)*	*I (0)*
697	-0.89(0.78)	-1.71(0.73)	-6.54(0.00)*	-6.47(0.00)*	-0.88(0.79)	-1.74(0.72)	-6.55(0.00)*	-6.47(0.00)*	*I (1)*
698	-1.88(0.34)	-2.47(0.34)	-9.85(0.00)*	-10.28(0.00)*	-2.76(0.07)***	-2.14(0.51)	-10.22(0.00)*	-12.36(0.00)*	*I (1)*
711	-2.01(0.28)	-1.89(0.64)	-7.98(0.00)*	-7.17(0.00)*	-1.56(0.49)	-2.44(0.35)	-12.86(0.00)*	-19.03(0.00)*	*I (1)*
715	-1.28(0.63)	-2.51(0.32)	-6.11(0.00)*	-5.96(0.00)*	-1.29(0.63)	-2.06(0.55)	-6.12(0.00)*	-6.16(0.00)*	*I (1)*
717	-2.28(0.18)	-3.30(0.08)***	-7.32(0.00)*	-7.28(0.00)*	-2.18(0.22)	-3.40(0.08)***	-7.32(0.00)**	-7.28(0.00)**	*I (0)*
718	-1.53(0.51)	-1.45(0.83)	-6.42(0.00)*	-6.56(0.00)*	-1.63(0.46)	-1.13(0.91)	-6.45(0.00)*	-12.96(0.00)*	*I (1)*
719	-1.69(0.43)	-2.22(0.47)	-4.97(0.00)*	-6.28(0.00)*	-2.33(0.17)	-3.30(0.08)***	-12.27(0.00)*	-30.93(0.00)*	*I (1)*
722	-2.76(0.07)***	-2.53(0.31)	-9.77(0.00)*	-11.20(0.00)*	-4.08(0.00)*	-2.53(0.31)	-9.03(0.00)*	-11.14(0.00)*	*I (1)*
723	-2.78(0.07)***	-5.36(0.09)*	-5.64(0.04)**	-7.34(0.00)*	-4.99(0.00)*	-4.02(0.02)**	-9.39(0.00)*	-10.41(0.00)*	*I (0)*
724	-1.53(0.51)	-0.38(0.99)	-5.01(0.00)*	-5.29(0.00)*	-1.52(0.52)	-0.03(0.99)	-5.02(0.00)*	-4.97(0.00)*	*I (1)*

725	-3.01(0.04)**	-3.07(0.13)	-9.64(0.00)*	-9.90(0.00)*	-3.29(0.02)**	-3.06(0.13)	-10.73(0.00)*	-12.75(0.00)*	*I (1)*
729	-2.93(0.05)***	-6.45(0.05)***	-4.04(0.00)*	-4.57(0.01)*	-2.24(0.20)	-6.53(0.00)*	-14.25(0.00)*	-14.31(0.00)*	*I (0)*
732	-1.66(0.45)	-1.52(0.81)	-9.89(0.00)*	-10.46(0.00)*	-3.60(0.0)*	-1.16(0.91)	-9.56(0.00)*	-13.53(0.00)*	*I (1)*
812	-9.79(0.00)*	-4.97(0.00)*	-4.09(0.00)*	-4.48(0.01)*	-11.16(0.00)*	-16.16(0.00)*	-4.09(0.00)*	-4.43(0.01)*	*I (0)*
821	-1.02(0.74)	-1.32(0.87)	-4.37(0.00)*	-4.43(0.01)*	-1.02(0.74)	-1.63(0.76)	-4.19(0.00)*	-4.93(0.00)*	*I (1)*
831	-3.36(0.02)**	-3.39(0.07)***	-6.72(0.00)*	-4.70(0.00)*	-3.55(0.00)*	-2.60(0.08)***	-6.74(0.00)*	-7.75(0.00)*	*I (0)*
841	-5.74(0.00)*	-3.44(0.06)***	-4.52(0.00)*	-6.00(0.00)*	-6.17(0.00)*	-3.70(0.03)**	-4.82(0.00)*	-6.27(0.00)*	*I (0)*
842	-1.58(0.48)	-1.50(0.81)	-5.82(0.00)*	-5.78(0.00)*	-1.61(0.47)	-1.51(0.81)	-5.80(0.00)*	-5.82(0.00)*	*I (1)*
851	-2.55(0.11)	-4.07(0.03)**	-6.27(0.00)*	-6.34(0.00)*	-3.10(0.03)**	-4.04(0.02)**	-7.40(0.00)*	-9.23(0.00)*	*I (0)*
861	-4.70(0.00)*	-5.73(0.02)**	-4.86(0.00)*	-6.00(0.00)*	-2.72(0.08)***	-5.02(0.00)*	-19.71(0.00)*	-30.21(0.00)*	*I (0)*
891	-2.32(0.17)	-2.43(0.36)	-6.40(0.00)*	-6.20(0.00)*	-2.23(0.20)	-2.36(0.39)	-6.52(0.00)*	-6.33(0.00)*	*I (1)*
894	-2.27(0.19)	-4.37(0.01)*	-10.65(0.00)*	-10.48(0.00)*	-2.05(0.27)	-4.57(0.00)*	-12.38(0.00)*	-12.14(0.00)*	*I (0)*
lnY^{GR}	-1.65(0.45)	-1.19(0.90)	-5.61(0.00)*	-5.88(0.00)*	-2.14(0.23)	-0.99(0.93)	-5.56(0.00)*	-7.52(0.00)*	*I (1)*
lnREX	-1.92(0.32)	-1.13(0.91)	-8.26(0.00)*	-8.18(0.00)*	-1.87(0.34)	-1.81(0.68)	-8.25(0.00)*	-8.18(0.00)*	*I (1)*
$lnVOL^{TRUS}$	-0.12(0.37)	-2.32(0.43)	-5.66(0.01)*	-5.30(0.01)*	-1.44(0.33)	-1.43(0.46)	-5.56(0.01)*	-5.39(0.01)*	*I (1)*

$lnPOS^{TRUS}$	-1.11(0.41)	-1.53(0.53)	-6.18(0.00)*	-5.35(0.01)*	-0.13(0.22)	-0.63(0.13)	-8.04(0.00)*	-7.06(0.01)*	*I (1)*
$lnNEG^{TRUS}$	-1.13(0.14)	-0.24(0.13)	-8.04(0.01)*	-8.11(0.00)*	-0.13(0.52)	-0.56(0.44)	-9.21(0.00)*	-9.01(0.01)*	*I (1)*

Notes: This table adheres to the same notes as provided beneath Table 8.

Source: Author’s calculations (2023)

Table 19. ADF and PP Unit Root Test Results for Import Sectors

Variables *[ln (MV$_i$)]*	*ADF* Test				*PP* Test					
	Level		First Difference		Level		First Difference		Order of Integration
	I	*T & I*	*I*	*T & I*	*I*	*T & I*	*I*	*T & I*	
001	-2.50(0.12)	-2.61(0.28)	-7.16(0.00)*	-7.07(0.00)*	-2.50(0.12)	-2.62(0.27)	-7.53(0.00)*	-7.43(0.00)*	*I (1)*
054	-3.39(0.02)**	-3.67(0.04)**	-6.90(0.00)*	-7.20(0.00)*	-3.36(0.02)**	-3.57(0.05)**	-13.29(0.00)*	-21.08(0.00)*	*I (0)*
061	-3.42(0.02)**	-4.54(0.00)*	-4.29(0.00)*	-4.53(0.01)*	-3.49(0.01)*	-4.52(0.00)*	-9.27(0.00)*	-8.61(0.00)*	*I (0)*
071	-4.30(0.00)*	-4.14(0.01)**	-8.79(0.00)*	-9.70(0.00)*	-4.30(0.00)*	-4.59(0.00)*	-8.77(0.00)*	-9.60(0.00)*	*I (0)*
072	-1.87(0.34)	-2.66(0.26)	-7.77(0.00)*	-7.77(0.00)*	-1.75(0.40)	-2.61(0.28)	-8.30(0.00)*	-8.34(0.00)*	*I (1)*
081	-1.74(0.40)	-3.54(0.05)***	-7.13(0.00)*	-7.06(0.00)*	-1.43(0.56)	-3.49(0.05)**	-13.18(0.00)*	-15.41(0.00)*	*I (0)*
231	-2.41(0.14)	-2.68(0.25)	-8.02(0.00)*	-8.11(0.00)*	-2.45(0.14)	-2.73(0.23)	-8.08(0.00)*	-8.36(0.00)*	*I (1)*
251	-2.04(0.27)	-3.50(0.05)***	-8.71(0.00)*	-8.66(0.00)*	-1.92(0.32)	-3.45(0.06)***	-10.15(0.00)*	-13.46(0.00)*	*I (0)*
266	-1.94(0.31)	-1.39(0.85)	-8.37(0.00)*	-9.34(0.00)*	-1.85(0.35)	-0.83(0.95)	-8.54(0.00)*	-15.01(0.00)*	*I (1)*
276	-1.16(0.68)	-2.71(0.24)	-5.32(0.00)*	-5.31(0.00)*	-1.16(0.68)	-2.31(0.42)	-5.35(0.00)*	-5.70(0.00)*	*I (1)*
282	-2.90(0.05)***	-2.16(0.50)	-10.93(0.00)*	-10.79(0.00)*	-2.77(0.07)***	-4.47(0.01)*	-11.81(0.00)*	-11.64(0.00)*	*I (0)*
284	-2.63(0.09)***	-4.18(0.01)*	-8.06(0.00)*	-8.03(0.00)*	-2.67(0.09)***	-4.18(0.01)*	-8.89(0.00)*	-8.85(0.00)*	*I (0)*

291	-2.25(0.19)	-4.12(0.01)**	-7.53(0.00)*	-7.43(0.00)*	-2.04(0.27)	-3.84(0.02)**	-17.39(0.00)*	-17.83(0.00)*	*I (0)*
292	-2.31(0.17)	-2.02(0.57)	-6.10(0.00)*	-5.44(0.00)*	-3.57(0.01)*	-1.76(0.70)	-6.14(0.00)*	-8.21(0.00)*	*I (1)*
332	-1.02(0.74)	-1.87(0.65)	-5.79(0.00)*	-5.77(0.00)*	-1.03(0.73)	-1.87(0.65)	-6.03(0.00)*	-8.23(0.00*	*I (1)*
422	-2.60(0.10)	-2.72(0.23)	-7.05(0.00)*	-5.05(0.00)*	-2.72(0.08)***	-2.82(0.20)	-7.06(0.00)*	-7.02(0.00)*	*I (1)*
431	-1.84(0.36)	-2.33(0.41)	-6.86(0.00)*	-6.78(0.00)*	-1.81(0.37)	-2.35(0.40)	-6.89(0.00)*	-6.81(0.00)*	*I (1)*
512	-1.35(0.60)	-2.35(0.40)	-6.29(0.00)*	-6.23(0.00)*	-1.01(0.74)	-2.40(0.37)	-8.32(0.00)*	-12.31(0.00)*	*I (1)*
513	-0.68(0.84)	-3.74(0.03)*	-6.06(0.00)*	-6.07(0.00)*	-0.18(0.93)	-3.80(0.03)**	-6.78(0.00)*	-6.42(0.00)*	*I (0)*
521	-1.55(0.50)	-2.09(0.54)	-6.04(0.00)*	-6.04(0.00)*	-1.56(0.49)	-2.09(0.54)	-6.55(0.00)*	-8.17(0.00)*	*I (1)*
531	-1.69(0.43)	-1.46(0.83)	-5.68(0.00)*	-5.75(0.00)*	-1.46(0.53)	-2.01(0.35)	-7.25(0.01)*	-6.93(0.00)*	*I (1)*
532	-1.93(0.32)	-1.68(0.74)	-6.07(0.00)*	-6.11(0.00)*	-1.79(0.38)	-1.42(0.84)	-6.19(0.00)*	-8.22(0.00)*	*I (1)*
533	-5.60(0.00)*	-4.59(0.01)*	-2.73(0.08)****	-2.63(0.07)***	-1.54(0.50)	-1.55(0.80)	-5.53(0.00)*	-10.22(0.00)*	*I (1)*
541	-1.12(0.70)	-1.23(0.89)	-5.31(0.00)*	-5.42(0.00)*	-1.12(0.70)	-1.60(0.78)	-5.27(0.00)*	-10.38(0.00)*	*I (1)*
551	-1.46(0.54)	-1.63(0.77)	-3.87(0.01)*	-4.20(0.01)*	-1.50(0.53)	-1.81(0.68)	-5.82(0.00)*	-6.00(0.00)*	*I (1)*
554	-1.64(0.45)	-1.00(0.93)	-4.86(0.00)*	-5.08(0.00)*	-1.59(0.48)	-1.25(0.89)	-4.80(0.00)*	-5.21(0.00)*	*I (1)*
561	-3.89(0.00)*	-7.17(0.00)*	-8.43(0.00)*	-8.31(0.00)*	-4.01(0.00)*	-5.31(0.00)*	-21.29(0.00)*	-19.11(0.00)*	*I (0)*
571	-1.53(0.51)	-4.78(0.00)*	-7.32(0.00)*	-7.22(0.00)*	-2.96(0.05)*	-5.01(0.00)*	-11.21(0.00)*	-11.04(0.00)*	*I (0)*

581	-1.41(0.57)	-1.39(0.85)	-6.06(0.00)*	-6.16(0.00)*	-1.69(0.43)	-1.23(0.89)	-6.09(0.00)*	-7.46(0.00)*	*I (1)*
599	-4.62(0.00)*	-1.40(0.85)	-5.36(0.00)*	-9.59(0.00)*	-1.72(0.68)	-1.62(0.77)	-5.38(0.00)*	-11.60(0.00)*	*I (1)*
621	-1.95(0.31)	-2.31(0.51)	-5.83(0.00)*	-6.00(0.00)*	-3.54(0.01)*	-1.97(0.00)*	-5.68(0.00)*	-7.20(0.00)*	*I (0)*
631	-1.82(0.36)	-1.43(0.84)	-6.27(0.00)*	-6.59(0.00)*	-1.81(0.37)	-1.43(0.84)	-6.27(0.00)*	-9.73(0.00)*	*I (1)*
632	-3.47(0.01)*	-3.04(0.13)	-7.72(0.00)*	-8.31(0.00)*	-4.26(0.00)*	-3.02(0.14)	-8.02(0.00)*	-9.67(0.00)*	*I (1)*
642	-2.37(0.16)	-1.03(0.93)	-5.81(0.00)*	-6.78(0.00)*	-2.44(0.14)	-0.85(0.95)	-5.80(0.00)*	-8.54(0.00)*	*I (1)*
651	-1.70(0.42)	-1.36(0.86)	-6.85(0.00)*	-7.29(0.00)*	-1.74(0.41)	-1.38(0.85)	-6.83(0.00)*	-7.47(0.00)*	*I (1)*
654	-2.38(0.15)	-1.42(0.84)	-7.54(0.00)*	-9.59(0.00)*	-2.50(0.12)	-1.33(0.87)	-7.27(0.00)*	-9.18(0.00)*	*I (1)*
655	-1.63(0.46)	-1.28(0.88)	-4.90(0.00)*	-4.99(0.00)*	-1.73(0.41)	-1.21(0.90)	-4.74(0.00)*	-7.84(0.00)*	*I (1)*
662	-1.77(0.39)	-2.44(0.36)	-7.52(0.00)*	-7.52(0.00)*	-1.41(0.57)	-2.44(0.35)	-7.85(0.00)*	-8.76(0.00)*	*I (1)*
663	-2.02(0.28)	-2.27(0.44)	-7.08(0.00)*	-7.17(0.00)*	-1.39(0.58)	-2.29(0.43)	-7.36(0.00)*	-9.94(0.00)*	*I (1)*
664	-1.87(0.34)	-1.87(0.65)	-5.96(0.00)*	-6.00(0.00)*	-2.90(0.05)***	-1.50(0.81)	-6.04(0.00)*	-6.74(0.00)*	*I (1)*
665	-2.95(0.05)***	-1.94(0.62)	-6.12(0.00)*	-6.56(0.00)*	-3.75(0.01)*	-1.85(0.66)	-6.12(0.00)*	-6.87(0.00)*	*I (1)*
671	-0.13(0.94)	-4.87(0.00)*	-6.04(0.00)*	-6.02(0.00)*	-1.84(0.36)	-4.66(0.00)*	-12.42(0.00)*	-19.57(0.00)*	*I (0)*
672	-1.59(0.48)	-3.62(0.04)**	-8.49(0.00)*	-8.48(0.00)*	-1.26(0.64)	-3.56(0.04)**	-10.21(0.00)*	-11.03(0.00)*	*I (0)*
673	-0.91(0.78)	-3.68(0.04)**	-7.09(0.00)*	-7.02(0.00)*	-0.53(0.87)	-3.68(0.04)**	-10.47(0.00)*	-8.83(0.00)*	*I (0)*
674	-1.37(0.59)	-2.28(0.44)	-5.50(0.00)*	-5.43(0.00)*	-1.56(0.49)	-2.28(0.44)	-5.52(0.00)*	-5.49(0.00)*	*I (1)*

676	-2.29(0.18)	-2.20(0.07)***	-6.08(0.00)*	-6.24(0.00)*	-3.41(0.02)**	-3.56(0.04)**	-15.53(0.00)*	-15.92(0.00)*	*I (1)*
677	-1.52(0.51)	-2.07(0.54)	-5.49(0.00)*	-5.43(0.00)*	-1.26(0.64)	-2.14(0.51)	-5.87(0.00)*	-6.45(0.00)*	*I (1)*
678	-2.34(0.17)	-3.41(0.06)*	-8.23(0.00)*	-8.33(0.00)*	-2.74(0.08)***	-3.26(0.09)****	-8.57(0.00)*	-9.16(0.00)*	*I (0)*
679	-2.32(0.17)	-3.04(0.13)	-8.34(0.00)*	-8.19(0.00)*	-2.27(0.19)	-3.07(0.13)	-9.53(0.00)*	-9.32(0.00)*	*I (1)*
681	-1.92(0.32)	-5.06(0.00)*	-4.97(0.00)*	-5.04(0.00)*	-1.78(0.39)	-2.62(0.08)***	-6.53(0.00)*	-7.34(0.00)*	*I (0)*
682	-1.83(0.36)	-3.03(0.14)	-5.18(0.00)*	-5.57(0.00)*	-1.47(0.54)	-3.08(0.13)	-8.67(0.00)*	-8.69(0.00)*	*I (1)*
683	-1.72(0.41)	-2.28(0.38)	-10.31(0.00)*	-10.28(0.00)*	-1.57(0.49)	-2.08(0.54)	-10.31(0.00)*	-10.13(0.00)*	*I (1)*
684	-5.16(0.00)*	-3.61(0.04)**	-4.17(0.00)*	-5.90(0.00)*	-2.98(0.04)**	-1.83(0.07)***	-6.26(0.00)*	-7.48(0.00)*	*I (0)*
686	-2.94(0.05)**	-3.42(0.06)***	-9.94(0.00)*	-9.85(0.00)*	-3.06(0.04)**	-3.61(0.04)**	-9.94(0.00)*	-10.39(0.00)*	*I (0)*
687	-2.22(0.20)	-4.16(0.01)*	-6.16(0.00)*	-6.09(0.00)*	-2.22(0.20)	-4.18(0.01)*	-14.11(0.00)*	-13.84(0.00)*	*I (0)*
689	-2.55(0.11)	-2.61(0.30)	-8.51(0.00)*	-8.83(0.00)*	-2.43(0.14)	-2.43(0.36)	-8.74(0.00)*	-13.01(0.00)*	*I (1)*
691	-2.55(0.11)	-2.25(0.45)	-7.32(0.00)*	-7.19(0.00)*	-2.61(0.10)	-2.11(0.53)	-7.26(0.00)*	-7.98(0.00)*	*I (1)*
692	-1.94(0.32)	-1.58(0.78)	-8.53(0.00)*	-8.64(0.00)*	-1.68(0.43)	-1.79(0.69)	-8.61(0.00)*	-8.89(0.00)*	*I (1)*
693	-3.17(0.03)**	-4.39(0.00)*	-7.62(0.00)*	-7.56(0.00)*	-3.19(0.03)**	-4.32(0.01)*	-9.25(0.00)*	-9.14(0.00)*	*I (0)*
694	-1.83(0.36)	-1.83(0.67)	-6.21(0.00)*	-6.36(0.00)*	-2.84(0.06)***	-1.63(0.76)	-6.25(0.00)*	-9.14(0.00)*	*I (1)*

695	-5.41(0.00)*	-5.04(0.00)*	-6.49(0.00)*	-6.57(0.00)*	-3.00(0.04)**	-1.70(0.03)**	-7.01(0.00)	-15.79(0.00)*	*I (0)*
696	-2.28(0.18)	-1.79(0.69)	-8.75(0.00)*	-10.73(0.00)*	-2.72(0.08)***	-1.79(0.69)	-8.34(0.00)*	-12.42(0.00)*	*I (1)*
697	-1.81(0.37)	-1.73(0.72)	-6.64(0.00)*	-6.82(0.00)*	-1.97(0.30)	-1.50(0.81)	-6.65(0.00)*	-7.69(0.00)*	*I (1)*
698	-1.11(0.70)	-1.56(0.79)	-7.08(0.00)*	-7.54(0.00)*	-1.13(0.70)	-1.85(0.66)	-7.08(0.00)*	-8.66(0.00)*	*I (1)*
711	-1.18(0.67)	-2.93(0.16)	-6.23(0.00)*	-6.16(0.00)*	-1.09(0.72)	-2.93(0.16)	-6.62(0.00)*	-6.97(0.00)*	*I (1)*
712	-2.22(0.20)	-4.31(0.01)*	-7.80(0.00)*	-7.72(0.00)*	-2.18(0.22)	-4.01(0.02)**	-11.49(0.00)*	-11.92(0.00)*	*I (0)*
714	-2.92(0.06)***	-2.15(0.51)	5.31(0.00)*	-5.74(0.00)*	-3.32(0.02)**	-2.17(0.49)	-5.29(0.00)*	-5.72(0.00)*	*I (1)*
715	-2.92(0.05)*	-2.15(0.51)	-5.31(0.00)*	-5.74(0.00)*	-3.32(0.02)*	-2.17(0.49)	-5.29(0.00)*	-5.72(0.00)*	*I (1)*
717	-1.89(0.33)	-2.52(0.32)	-8.78(0.00)*	-8.92(0.00)*	-1.51(0.52)	-2.52(0.32)	-9.70(0.00)*	-22.24(0.00)*	*I (1)*
718	-2.58(0.11)	-2.33(0.42)	-6.80(0.00)*	-6.90(0.00)*	-2.68(0.09)***	-2.10(0.53)	-6.96(0.00)*	-8.17(0.00)*	*I (1)*
719	-1.79(0.38)	-2.43(0.36)	-5.70(0.00)*	-5.70(0.00)*	-1.52(0.51)	-2.39(0.38)	-7.53(0.00)*	-9.50(0.00)*	*I (1)*
722	-1.73(0.41)	-1.77(0.71)	-4.68(0.00)*	-4.68(0.00)*	-3.29(0.02)**	-1.22(0.89)	-5.13(0.00)*	-6.94(0.00)*	*I (1)*
723	-1.00(0.74)	-2.03(0.57)	-4.73(0.00)*	-7.41(0.00)*	-1.03(0.73)	-2.03(0.57)	-5.85(0.00)*	-10.00(0.00)*	*I (1)*
724	-7.24(0.00)*	-5.57(0.00)*	-3.77(0.01)*	-5.33(0.00)*	-7.66(0.00)*	-3.64(0.04)**	-5.49(0.00)*	-8.35(0.00)*	*I (0)*
725	-1.82(0.36)	-0.97(0.94)	-6.69(0.00)*	-7.92(0.00)*	-1.81(0.37)	-0.75(0.96)	-6.67(0.00)*	-9.11(0.00)*	*I (1)*

726	-1.61(0.47)	-1.37(0.85)	-5.03(0.00)*	-5.29(0.00)*	-1.54(0.50)	-1.24(0.89)	-5.01(0.00)*	-10.51(0.00)*	*I (1)*
729	-1.72(0.42)	-3.05(0.13)	-6.77(0.00)*	-7.31(0.00)*	-1.40(0.57)	-3.07(0.13)	-10.31(0.00)*	-13.35(0.00)*	*I (1)*
731	-1.64(0.45)	-1.81(0.68)	-6.39(0.00)*	-6.53(0.00)*	-1.73(0.41)	-1.61(0.77)	-6.49(0.00)*	-12.13(0.00)*	*I (1)*
732	-3.35(0.02)**	-5.56(0.00)*	-6.63(0.00)*	-6.59(0.00)*	-3.32(0.02)**	-4.93(0.00)*	-11.96(0.00)*	-11.89(0.00)*	*I (0)*
734	-2.65(0.09)***	-4.48(0.01)*	-7.97(0.00)*	-7.87(0.00)*	-2.57(0.11)	-4.43(0.01)*	-13.95(0.00)*	-16.67(0.00)*	*I (0)*
735	-2.99(0.04)**	-4.58(0.00)*	-4.82(0.00)*	-5.12(0.00)*	-2.51(0.12)	-4.61(0.00)*	-12.89(0.00)*	-14.84(0.00)*	*I (0)*
812	-3.29(0.02)**	-4.07(0.01)*	-7.56(0.00)*	-7.48(0.00)*	-3.16(0.03)	-4.10(0.01)*	-23.30(0.00)*	-26.25(0.00)*	*I (0)*
821	-1.90(0.33)	-1.36(0.86)	-11.17(0.00)*	-13.75(0.00)*	-1.94(0.31)	-0.94(0.94)	-10.00(0.00)*	-29.70(0.00)*	*I (1)*
841	-6.60(0.00)*	-3.67(0.04)**	-6.76(0.00)*	-7.63(0.00)*	-8.53(0.00)*	-6.56(0.00)*	-7.01(0.00)*	-8.21(0.00)*	*I (0)*
861	-3.58(0.01)*	-1.93(0.62)	-5.10(0.00)*	-5.36(0.00)*	-5.41(0.00)*	-2.34(0.40)	-5.04(0.00)*	-5.30(0.00)*	*I (1)*
862	-2.50(0.12)	-1.93(0.94)	-5.05(0.00)*	-5.36(0.00)*	-5.41(0.00)*	-2.34(0.40)	-5.05(0.00)*	-5.30(0.00)*	*I (1)*
864	-2.50(0.13)	-0.93(0.94)	-5.42(0.00)*	-6.06(0.00)*	-2.82(0.06)***	-0.37(0.99)	-5.42(0.00)*	-8.83(0.00)*	*I (1)*
891	-2.32(0.17)	-1.43(0.84)	-5.78(0.00)*	-6.16(0.00)*	-2.38(0.15)	-0.99(0.93)	-5.74(0.00)*	-8.54(0.00)*	*I (1)*
892	-1.45(0.55)	-1.79(0.69)	-5.46(0.00)*	-6.18(0.00)*	-1.53(0.51)	-1.37(0.86)	-5.46(0.00)*	-6.21(0.00)*	*I (1)*

894	-4.05(0.00)*	-3.30(0.08)***	-8.45(0.00)*	-10.18(0.00)*	-5.17(0.00)*	-3.62(0.04)**	-8.18(0.00)*	-10.27(0.00)*	*I (0)*
895	-3.13(0.03)**	-2.17(0.49)	-6.38(0.00)*	-7.06(0.00)*	-4.80(0.00)*	-2.32(0.42)	-6.38(0.00)*	-8.01(0.00)*	*I (1)*
897	-1.41(0.57)	-4.89(0.00)*	-8.92(0.00)*	-8.78(0.00)*	-1.16(0.68)	-4.95(0.00)*	-15.05(0.00)*	-14.20(0.00)*	*I (0)*
899	-3.45(0.01)*	-2.00(0.08)***	-4.57(0.00)*	-4.76(0.00)*	-10.12(0.00)*	-3.61(0.04)**	-4.44(0.00)*	-6.18(0.00)*	*I (0)*
lnY^{TR}	-0.21(0.93)	-2.84(0.19)	-7.02(0.00)*	-6.93(0.00)*	-0.12(0.94)	-2.88(0.18)	-7.53(0.00)*	-7.40(0.00)*	*I (1)*
$lnREX$	-1.92(0.32)	-1.13(0.91)	-8.26(0.00)*	-8.18(0.00)*	-1.87(0.34)	-1.81(0.68)	-8.25(0.00)*	-8.18(0.00)*	*I (1)*
$lnVOL^{TRUS}$	-0.12(0.37)	-2.32(0.43)	-5.66(0.01)*	-5.30(0.01)*	-1.44(0.33)	-1.43(0.46)	-5.56(0.01)*	-5.39(0.01)*	*I (1)*
$lnPOS^{TRUS}$	-1.11(0.41)	-1.53(0.53)	-6.18(0.00)*	-5.35(0.01)*	-0.13(0.22)	-0.63(0.13)	-8.04(0.00)*	-7.06(0.01)*	*I (1)*
$lnNEG^{TRUS}$	-1.13(0.14)	-0.24(0.13)	-8.04(0.01)*	-8.11(0.00)*	-0.13(0.52)	-0.56(0.44)	-9.21(0.00)*	-9.01(0.01)*	*I (1)*

Notes: This table adheres to the same notes as provided beneath Table 8.

Source: Author’s calculations (2023)

8.4 Symmetric Analysis of Third-Country Volatility and Trade Flows

8.4.1 Empirical Estimates of the Linear Export Demand Model

We commence our empirical analysis by examining the empirical estimates of Turkey's linear ARDL export demand model, as depicted in Equation (30). The short-term and long-term coefficient estimates of the explanatory variables under consideration are presented in Table 20, while the corresponding diagnostics are provided in Table 21. The short-term coefficients reveal that Germany's real income (lnY^{GR}) exhibits statistically significant short-term effects on the export volumes of 67 industries. This outcome underscores the pivotal role of income fluctuations in impacting real export quantities. Additionally, the short-term coefficients demonstrate that the bilateral real lira-euro rate ($lnREX$) significantly influences the exports of 65 industries. The corresponding diagnostic statistics indicate that most Turkish export industries have a small export share. Nevertheless, the analysis also encompasses a few large export sectors, e.g., industries coded 711 (power generation machinery with an export share of 5.32%), 719 (machinery and appliances with an export share of 6.55%), 732 (road motor vehicles with an export share of 15.94%), and 841 (clothing with an export share of 19.64%). Furthermore, the impact of third-economy risk, as captured by the lira-dollar rate ($lnVOL^{TRUS}$), has been found in 70 instances where at least one short-term coefficient attains statistical significance at either the 5% or 10% level. Based on these findings, it can be inferred that the short-run effect of third-economy volatility holds a dominant position in shaping Turkish exports to Germany. However, an essential inquiry emerges: are these short-term coefficients persist in the long-term? To delve into this inquiry, we turn our attention towards the normalized long-term coefficients highlighted in Table 20.

The long-term coefficients reveal that the bilateral real lira-euro rate ($lnREX$) has a significant impact on 37 export sectors. This coefficient has a positive sign for 30 export sectors coded 031, 046, 047, 051, 052, 053, 055, 061, 062, 099, 112, 221, 276, 292, 421, 513, 551, 553, 632, 652, 663, 664, 673, 697, 717, 725, 729, 841, 851, and 894. An increase in the real bilateral exchange rate ($lnREX$) shows a lira depreciation, so we expect a positive sign here (a depreciation will increase exports). On the other hand, this coefficient has a negative sign for 7 export sectors coded 121, 273, 541, 581, 661, 715, and 831. In this case, a negative sign implies that a depreciation of the lira will result in a reduction of Turkish exports.

The real GDP of Germany (lnY^{GR}) exhibits significant coefficients across 51 export sectors. In 39 export industries, specifically those coded as 031, 047, 048, 051, 053, 055, 061, 062, 073, 112, 121, 221, 263, 266, 421, 512, 551, 599, 632, 651, 652, 654, 662, 663, 673, 678, 684, 695, 696, 697, 698, 711, 722, 724, 729, 821, 841, 891, and 894, the anticipated positive long-run coefficient signifies that Germany's increasing economic strength corresponds to heightened imports of goods from Turkey. Conversely, the estimated coefficient adopts negative sign in the remaining 12 industries coded as 032, 283, 541, 599, 621, 653, 665, 691, 719, 725, 732, and 831. This phenomenon might be attributed to Germany's intensified domestic production of substitute products, leading to reduced imports from Turkey (Bahmani-Oskooee, 1986).

The variable *DM* holds significance across 55 export sectors. Out of these sectors, the effect is negative in only 4 industries and positive in 51 industries. This negative effect could be due to increased competition from foreign markets or other factors that have negatively affected the competitiveness of these industries. In contrast, the expected positive effect suggests that the trade liberalization reforms have benefited these industries/sectors. The reforms have likely opened up new trade opportunities, increasing exports and growth in these sectors.

Regarding the impact of third-country volatility, the long-term empirical estimates reveal that $lnVOL^{TRUS}$ has a significant negative coefficient across 9 small sectors. Notably, increased lira-dollar volatility leads Turkish exporters to prioritize the United States over Germany, suggesting risk aversion as they seek immediate export gains to offset potential future losses. Conversely, in 61 instances, a positive coefficient indicates that high lira-dollar volatility drives Turkish exporters to replace U.S. products with German ones. This finding supports the long-term substitution effect, where increased lira-dollar volatility prompts a shift from U.S. to German goods.

Table 20. Short-term and Long-term Coefficients of the Linear ARDL Export Demand Specification (30)

There is at Least One Short-Term Estimate Significant				Long-run Coefficients				
SITC-1	lnY^{GR}	$lnREX$	$lnVOL^{TRUS}$	C	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: ‘*’ (‘**’) represents statistical significance at the 10% and 5% levels, respectively.

Source: Author’s calculations (2023)

8.4.2 Diagnostic Tests

The validity and robustness of the long-term empirical findings hinge on cointegration. We compare Narayan's (2005) upper critical limits of the *F*-statistic with computed *F*-statistic values. The reported *F*-test validates cointegration across export specifications at 5% or 10% significance levels. Additionally, utilizing the ECM_{t-1} statistic and applying Banerjee's et al. (1998) critical values, we detect cointegration for all export specifications.

Furthermore, the high adjusted R^2 values demonstrate that all export models are well-fitted, indicating a strong explanatory power of each specification. We apply the Lagrange Multiplier (LM) test to examine residuals for serial correlation. The diagnostic is significant in merely 07 instances, indicating serial correlation in these functions. Applying the Ramsey *RESET* test for model misspecification, we find significance in only six cases. This affirms the appropriate specification of our linear export model across most industries. Additionally, *CUSUM* and *CUSUMSQ* tests establish short-term and long-term stability of each export function. These tests show stability in nearly all instances, affirming the robustness of the proposed linear *ARDL* export model results.

Table 21. Diagnostic Statistics Corresponding to Coefficients of the Linear ARDL Export Demand Specification (30)

SITC-1	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: This table adheres to the same notes as provided beneath Table 11.

Source: Author’s calculations (2023)

8.4.3 Empirical Estimates of the Linear Import Demand Model

We have estimated Turkey's linear ARDL import demand model (Equation (31)), and its short-term and long-term effects are presented in Table 22, while Table 23 provides corresponding diagnostics. In the short-term, Turkey's real income (lnY^{TR}) significantly affects 78 import industries, emphasizing the importance of the income effect on real import flows. In addition, short-term estimates indicate the significant impact of the real lira-euro exchange rate ($lnREX$) on imports in 72 sectors. The underlying diagnostics indicate that most Turkish import sectors have a small import share, although some large import sectors are also found. Furthermore, the short-run results reveal significant short-run lag estimates for the third-economy effect ($lnVOL^{TRUS}$) in 73 functions.

The long-term coefficients show that the impact of third-economy volatility ($lnVOL^{TRUS}$) significantly impacts 50 Turkish import industries. Out of these industries, 15 exhibit a positive sign for the volatility effect, while 35 exhibit a negative sign. Notably, two major Turkish import industries coded as 541 (medicinal and pharmaceutical products) with a 4.24% import share and 581 (plastic materials) with an 8.33% import share, are positively affected. These industries collectively import approximately 12.57 percent of their commodities from Germany. Conversely, the three largest sectors having codes 711 (power generating machinery, other than electric) with a 4.83% import share, 719 (machinery and appliances non-electrical parts) with a 13.24% import share, and 732 (road motor vehicles) with a 16.14% import share, importing about 34.21 percent of German commodities, are adversely influenced by third-economy effect. The empirical investigation indicates that Turkey’s growing economy and increasing local demand led to a greater reliance on imports, particularly from the United States. This shift in import patterns highlights the need to consider the external currency risk in the bilateral trade model to better understand Turkey's actual import trends from Germany.

The long-term effect of $lnREX$ is positive in 13 instances and negative in 60 instances. The negative coefficient implies that the depreciation of the TL in relation to the German euro negatively affects Turkish imports from Germany across most sectors. The anticipated negative estimate aligns with the common understanding that a depreciation of the Turkish lira makes imports more expensive. As the lira depreciates against the euro, it reduces the purchasing power of Turkish importers, making imported goods from Germany relatively more expensive. This increase in import costs can act as a deterrent for Turkish businesses and importers, leading to a decrease in imports from Germany.

In addition, enhanced Turkish economic activity (lnY_t^{TR}) favours German commodities in 49 notable instances. This indicates that as the Turkish economy experiences growth and increased economic activity, there is a corresponding increase in demand for German products.

The 1984 trade liberalization reforms (*DM*) in Turkey significantly affected 62 Turkish import sectors. These reforms in Turkey encouraged imports from Germany by creating a more favorable trade environment, fostering competition, increasing product variety, promoting efficiency gains, enabling specialization, and strengthening trade relations. These reforms played a vital role in shaping the import patterns between Turkey and Germany, highlighting the significance of trade policy in facilitating international trade and economic growth.

Table 22. Short-term and Long-term Coefficients of the Linear ARDL Import Demand Specification (31)

There is at Least One Short-Term Estimate Significant				Long-run Coefficients				
SITC-1	lnY^{TR}	$lnREX$	$lnVOL^{TRUS}$	C	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: ‘*’ (‘**’) represents statistical significance at the 10% (5%) levels, respectively.

Source: Author’s calculations (2023)

8.4.4 Diagnostic Tests

The validity and meaningfulness of the estimates corresponding to the import demand specification hinge on passing related diagnostic tests. These tests serve to assess various aspects of the model's performance. Cointegration detection, using the F or ECM_{t-1} test, reveals cointegration across all import sectors. High adjusted R^2 values signify strong fit of import specifications. *LM* and *RESET* tests show that our model is not a victim of autocorrelation and the model is correctly specified. Furthermore, the *CUSUM* and *CUSUMSQ* diagnostics demonstrate stable and consistent estimates over time. Overall, diagnostic tests endorse the validity and reliability of the linear import specification estimates.

Table 23. Diagnostic Statistics Corresponding to Coefficients of the Linear ARDL Import Demand Specification (31)

SITC-1	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: This table adheres to the same notes as provided beneath Table 13.

Source: Author's calculations (2023)

8.5 Asymmetric Analysis of Third-Country Volatility and Trade Flows

8.5.1 Empirical Estimates of the Non-Linear Export Demand Model

We conducted asymmetry tests to investigate whether the influence of third-economy volatility on bilateral trade volumes between Turkey and Germany exhibits asymmetric effects. For this purpose, we employed the *Wald-SR*^{TRUS} and *Wald-LR*^{TRUS} tests to assess short-term and long-term asymmetry hypotheses, respectively. The results indicate that there is an asymmetric adjustment in the short-run for most instances, primarily due to the difference in j linked to (ΔPOS^{TRUS}) and (ΔNEG^{TRUS}) uncertainty. Our analysis indicates statistically significant short-term asymmetric impacts of third-economy volatility. This was established by examining differences in magnitude or sign between ΔPOS^{TRUS} and ΔNEG^{TRUS} across all sectors. Additionally, our analysis identifies instances of third-economy short-run joint asymmetry. This particular form of asymmetry emerges when the cumulative coefficients linked to ΔPOS^{TRUS} differs from those linked to ΔNEG^{TRUS}.

The analysis using the *Wald-SR*^{TRUS} test indicates that there are asymmetric effects of real lira-dollar volatility across 63 small and large export sectors, as detailed in Table 25. Notably, major Turkish export sectors including 684, 711, 719, 732, and 841, collectively contributing to about 49.1 percent of the overall exports.

A significant third-country volatility is apparent in 41 sectors, where either *POS*^{TRUS} or *NEG*^{TRUS} holds statistical significance at levels of 5% or 10%. The examination of differences in size or sign between the *POS*^{TRUS} and *NEG*^{TRUS} estimates reveals enduring long-run asymmetric influences on all scales of export sectors linked to the third-country. However, as Table 25 illustrates, the *Wald-LR*^{TRUS} test underscores significant effects stemming from the third-country in a total of 49 sectors.

For the non-linear ARDL export demand model represented by Equation (56), we first analyze the short-term influences of third-economy volatility. The coefficients presented in Table 24 reveal that the short-term influence of third-country volatility is observed in 61 export industries either through ΔPOS^{TRUS} or ΔNEG^{TRUS}. However, this influence was evident in seventy sectors in the earlier linear ARDL export demand model depicted in Equation (30). This reduction in significance is attributed to the gradual non-linear adjustment of the third-country effect. Additionally, the study highlights notable asymmetric effects of third-economy risk on real export volumes.

The variable *lnREX* significantly affects 35 export sectors in the long-term. Among these sectors, 24 sectors experience a positive coefficient, implying that a weaker Turkish lira relative to the German euro benefits Turkish exports to Germany. Conversely, 11 Turkish export sectors display a negative coefficient.

German income (lnY^{GR}) has a notably positive and significant impact on 45 industries in the long-run, indicating increased imports from Turkey as the German economy expands. On the other hand, in 08 export industries, the coefficient of German income (lnY^{GR}) has a negative sign. This suggests a different pattern, where Germany's domestic production of substitute products may be relatively higher. In such cases, as Germany's income increases, it leads to a higher production of substitute goods domestically, reducing the demand for imported goods from Turkey. Consequently, Turkish exports to Germany in these industries might experience a decline (Bahmani-Oskooee, 1986).

Furthermore, *DM* exhibits significant coefficients in 55 sectors, with a positive effect on 53 both small and large sectors and a negative effect on 02 small sectors. The expected positive coefficients suggest that the reforms have opened up new opportunities, reduced trade barriers, and created a more conducive environment for exports. As a result, Turkish industries in these sectors have experienced an increase in export volumes and trade activities.

Concerning the impact of third-country volatility, the long-term estimates reveal interesting outcomes. The coefficient for negative volatility (NEG^{TRUS}) significantly affects 37 small and large export sectors. This suggests that increased lira-dollar volatility prompts Turkish exporters in these sectors to shift exports from Germany to the United States. This behavior indicates a risk-averse group of traders aiming to booster present export revenues to offset potential future losses from exchange rate volatility. By diversifying their export sources, they mitigate the risk associated with lira-dollar exchange rate uncertainties.

In contrast, the positive volatility (POS^{TRUS}) coefficient exhibits a significant positive impact in 33 export industries. This indicates that in the face of heightened uncertainty, Turkish exporters in these sectors prefer German products over those from the United States. This finding supports the notion of a long-run substitution effect in these industries, where Turkish exporters actively choose German goods as a substitute when the lira-dollar exchange rate exhibits significant volatility. By favoring German products in such circumstances, Turkish exporters aim to minimize the risk associated with the volatile lira-dollar exchange rate and maintain stable export patterns. Hence, these empirical findings provide valuable insights into the behavior of Turkish exporters in response to third-economy volatility. The estimation results suggest that risk aversion plays a role in export decisions, with exporters strategically diversifying their sources to mitigate exchange rate risks.

Table 24. Short-term and Long-term Coefficients of the Non-Linear ARDL Export Demand Specification (56)

There are at Least One Short-Run Coefficient Significant				Long-run Coefficient Estimates					
SITC-1	lnY^{GR}	$lnREX$	$lnVOL^{TRUS}$	C	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: ‘*’ (‘**’) denotes statistical significance at the 10% (5%) levels, respectively.

Source: Author’s calculations (2023)

8.5.2 Diagnostic Tests Associated with Estimates of the Non-Linear Export Demand Model

Conducting diagnostic tests is essential to validate the long-term findings of the *NARDL* export specification. These tests help assess the model's performance and ensure its reliability. Table 25 provides significant *F*-test results in 69 functions, confirming the presence of cointegration in these industries. In addition, all export models exhibit cointegration on the basis of ECM_{t-1} test, further supporting the validity of the proposed model. The high adjusted R^2 values suggest the suitability of the non-linear export specification for each sector. This indicates the model's ability to explain and predict export behavior in these industries. Ramsey's *RESET* test confirms the correct specification of the non-linear export function across most industries.

The absence of significant serial correlation, as indicated by the *LM* test, suggests that the residuals do not exhibit any significant pattern of autocorrelation. This is important as it ensures that the model's assumptions regarding the independence of residuals are not violated, enhancing the reliability of the estimates. The *CUSUM* and *CUSUMSQ* tests provide evidence of the stability of the short-term and long-term coefficients in all export industries. These tests indicate that the model estimates remain stable over time and do not suffer from any significant structural changes or instability.

In summary, the diagnostic tests conducted on the non-linear *ARDL* export model validate the robustness of the long-term findings. The results indicate that the model is well-specified, captures the cointegration relationships, provides a good fit to the data, exhibits no significant serial correlation, and maintains stability in its coefficient estimates. These findings enhance the confidence in the model's ability to analyze and understand export behavior in the examined industries.

Table 25. Diagnostic Statistics Corresponding to Coefficients of the Non-Linear ARDL Export Demand Specification (56)

SITC-1	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: This table adheres to the same notes as provided beneath Table 15.

Source: Author’s calculations (2023)

8.5.3 Empirical Estimates of the Non-Linear Import Demand Model

We conducted asymmetry tests using the $Wald\text{-}SR^{TRUS}$ and $Wald\text{-}LR^{TRUS}$ tests before interpreting the short-term and long-term empirical findings of the NARDL import specification presented in Equation (57). These tests assess whether there are asymmetric effects in variable relationships. The $Wald\text{-}SR^{TRUS}$ results reveal short-run nonlinear effects for the third-country influence in all instances, observed through the magnitude or sign differences b/w the ΔPOS & ΔNEG coefficients. Additionally, the j associated with ΔPOS^{TRUS} and ΔNEG^{TRUS} differ in most industries, confirming the short-term adjustment asymmetry. This implies that the effects of third-economy volatility on import industries exhibit asymmetric patterns in the short-run. The significant $Wald\text{-}SR^{TRUS}$ test detects third-economy effects asymmetry in 79 sectors. Hence, utilizing short-term modelling with nonlinear adjustment of external volatility, we deduce that the majority sectors carry nonlinear effects.

Likewise, the $Wald\text{-}LR^{TRUS}$ test indicates the presence of long-term asymmetry in lira-dollar volatility across 70 functions (refer to Table 27). This test examines the long-run effects and provides evidence of the asymmetry in the relationship between lira-dollar volatility and import industries. The presence of long-run asymmetry suggests that the effects of lira-dollar volatility on imports differ depending on the direction and magnitude of the volatility.

In summary, the findings from short-term and long-term asymmetry tests indicate that the majority of import sectors display asymmetric effects. The short-run analysis reveals the asymmetry of third-economy effects, while the long-run analysis highlights the asymmetry of lira-dollar volatility. These findings suggest that the impacts of these factors on import industries are not symmetric and vary depending on specific conditions and characteristics of the industries.

We'll now discuss coefficient estimates in both the short-term and long-term of the NARDL import demand model (Equation 57) in Table 26, with corresponding diagnostics in Table 27. Short-term asymmetry is evident for the external volatility in 68 instances associated with ΔPOS^{TRUS}or ΔNEG^{TRUS}. In comparison, the previous symmetric import demand specification had 69 significant instances. Hence, the *NARDL* import analysis suggests approximately a similar number of import industries affected by lira-dollar exchange rate volatility.

The long-term coefficients of the non-linear *ARDL* import specification (Table 26) show significance for the third-country effect (captured through POS^{TRUS} or NEG^{TRUS}) in 67 sectors. Positive values are observed in 49 import industries, including major sectors coded

541, 581, 711, and 729 (importing around 20.6% from Germany), while two industries (coded 719 and 722) importing approximately 17.6 percent from German's economy have been adversely impacted by external uncertainty. Notably, third-economy volatility predominantly affects small import sectors in the long-term. In contrast, the linear *ARDL* import analysis found 49 import sectors impacted by third-economy volatility. Consequently, asymmetric analysis enhances import specification estimation and underscores third-economy volatility's significance in predicting Turkey's import flows.

In the context of third-country volatility effects on imports, empirical analysis using an asymmetric approach sheds light on specific industries. For instance, the import sector having code 581, accounting for 8.33% of imports, the symmetric import model (Equation 31) showed a positive third-economy volatility coefficient. However, the asymmetric import specification confirms that this outcome is driven by POS^{TRUS}. A similar situation arises in the largest sector coded 541, representing 4.24% of imports. While the symmetric import specification indicated a positive third-economy effect, asymmetric import analysis attributes this outcome to increased exchange rate uncertainty (POS^{TRUS}). Comparable findings emerge in other small import sectors. Ultimately, third-economy volatility bolsters imports estimations, reaffirming its significance as a predictor for Turkey's import patterns.

The dummy variable (*DM*) exhibits a significant positive impact in 70 instances. This indicates that these reforms have contributed to increased imports from Germany across these sectors.

Furthermore, enhanced Turkish economic activity (lnY_t^{TR}) benefits German goods in Turkey in 67 out of 93 notable instances, reflecting a rising demand for German products as Turkey's economy expands, driving increased imports from Germany. Conversely, this variable carries a significant negative estimate in 5 instances, signifying that growth in the Turkish economy prompts a shift toward domestic production of import-substituting goods, causing a decline in imports.

In the long-term, the variable *lnREX* exhibits a positive impact on 40 sectors and a negative impact in 26 sectors. The negative coefficient indicates that lira depreciation adversely affects Turkish imports.

Table 26. Short-term and Long-term Coefficients of the Non-Linear ARDL Import Demand Specification (57)

There is at Least One Short-Term Estimate Significant				Long-run Coefficients					
SITC-1	lnY^{TR}	$lnREX$	$lnVOL^{TRUS}$	C	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: '*' ('**') represents statistical significance at the 10% (5%) levels, respectively.

Source: Author's calculations (2023)

8.5.4 Diagnostic Tests

The presence of cointegration is pivotal to validate the non-linear *ARDL* import model's long-run coefficient estimates. In Table 27, the *F*-test lacks significance in 14 instances, indicating possible absence of cointegration for specific sectors. However, ECM_{t-1} testing affirms cointegration in these instances. Thus, cointegration is confirmed for all import sectors through *F*-test or ECM_{t-1} analysis. Additional diagnostic tests reinforce the long-run findings: high adjusted R^2 values indicate robust model fit across all import sectors, the *LM* test detects the absence of autocorrelation in most instances, and the Ramsey *RESET* test affirms appropriate model specification for most import sectors. Moreover, the *CUSUM* and *CUSUMSQ* tests affirm coefficient stability in both short-term and long-term for all import specifications, indicating enduring consistency and reliability. Overall, diagnostic tests for the *NARDL* import specification consistently support the obtained long-run coefficient estimates.

Table 27. Diagnostic Statistics Corresponding to Coefficients of the Non-Linear ARDL Import Demand Specification (57)

SITC-1	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: This table adheres to the same notes as provided beneath Table 17.

Source: Author's calculations (2023)

8.6 Conclusion

Incorporating the third-economy effect into the modeling framework holds substantial implications for bilateral trade flows. Recent empirical research underscores the significance of accounting for third-country volatility, as excluding it may lead to bias assessment of exchange rate volatility in bilateral trade (Cushman, 1986). Cushman's argument highlights that bilateral trade considers not only direct risks from exchange rates but also indirect risks linked to third-country volatility. Bahmani-Oskooee et al. (2013) provide robust evidence for the third-country effect by comparing analyses with and without its consideration. Further empirical studies, including Bahmani-Oskooee et al. (2015), emphasize the pivotal role of third-country volatility in bilateral trade. Wang et al. (2016) note that increased third-country volatility coincides with increased exports from China to the U.S., Europe, or Japan. Tunc et al. (2018) discover that when external volatility surpasses bilateral exchange rate volatility, exporting countries tend to shift exports from third-countries to bilateral partners.

In the specific context of Turkey's bilateral trade flows, our empirical study uncovered that incorporating the third-country volatility effect not only enhances the empirical results concerning lira-euro exchange rate volatility but also establishes it as a crucial determinant of Turkey's bilateral trade flows. The empirical findings indicate that the influence of third-economy risk is more pronounced in Turkish exports than in Turkish imports. Specifically, incorporating third-economy volatility into the model affects over 50% of Turkey's export and import sectors in both the short-term and long-term. Furthermore, the empirical results demonstrate that nonlinear ARDL models yield more significant short-term and long-term effects. Additionally, the higher values of adjusted R^2 obtained from the third-economy volatility estimates, compared to the estimates of real bilateral exchange rate volatility, suggest that neglecting this crucial regressor/determinant may undermine the results' reliability.

CHAPTER IX

Exchange Rate Misalignment and Growth Dynamics

9.1 Definition of Variables and Data Sources

This empirical study examines the symmetric plus asymmetric influences of RER misalignment on Turkey's economic progress. The study considers quarterly data from 1987Q1 to 2021Q4 for empirical analysis. To achieve these objectives, the study adopts a three-step estimation procedure. In step 1, the study considers the key macroeconomic fundamentals to estimate Turkey's equilibrium real exchange rate following the PEER approach (see Model 3, Equation (15)). In this econometric specification, the RER is considered to be the dependent variable. However, the list of explanatory variables of the model includes the real GDP, government consumption expenditure, net foreign assets, private sector credit, terms-of-trade index, foreign exchange reserves, and labour productivity. In step 2, the analysis calculates the RER misalignment series (see Model 4, Equation (20)). In step 3, the study explores the symmetric plus asymmetric effects of currency misalignment on Turkey's economic growth. For this purpose, the study employs the economic growth specification in which the real economic growth rate is our variable of interest. While, the list of explanatory variables of the model includes the RER misalignment, the saving rate, the terms of trade index, credit to the private sector, foreign exchange reserves, the inflation rate, and the gross external debt (see Model 5, Equation (21)). A detailed description of each variable used in these econometric specifications can be described as follows:

$\boldsymbol{RER}$ (real exchange rate) = Taking 2015 = 100 as the reference/base year, the real exchange rate series is constructed using the nominal exchange rate (*NER*) expressed in units of U.S. dollars per unit of the Turkish lira and the CPI indices of Turkey and the U.S. Symbolically,

$$RER_t = NER_t * \left(\frac{CPI_t^{TUR}}{CPI_t^{USA}}\right) \tag{81}$$

In Equation (81), the variable RER_t represents the real exchange rate, NER_t represents the nominal bilateral exchange rate (i.e., U.S. dollar/1TL), CPI_t^{TUR} represents the consumer price index of Turkey and CPI_t^{USA} signifies the consumer price index of the United States. In this formulation, an increase in the RER signifies an appreciation of the Turkish lira against the U.S. dollar. Data on the NEX has been taken from the IFS (2023), while data on consumer price indices (index 2015 = 100) have been obtained from the Federal Reserve Economic Data (FRED) (2023) database.

$\boldsymbol{Y}$ $(real\ income)$ = It is a measure of Turkey's real economic activity (million TL), proxied by Turkey's real GDP (the base year 2009). We have used Turkey's real GDP to adjust for inflation. Notably, output levels in Turkey exhibit a clear seasonality pattern; therefore, we utilize seasonally adjusted real GDP using the Tramo/Seats technique[109]. The data on the real GDP of Turkey has been compiled from the IFS (2023).

$\boldsymbol{G}$ $(Government\ expenditures)$[110] = It includes the total consumption expenditures (in billion U.S. dollars) of the central government of Turkey over time. It refers to the government spending allocated towards purchasing goods and services for current use by Turkish government entities. This category includes various types of expenditures, such as salaries and wages of government employees, purchases of goods and services for government operations, and expenditures on programs and services provided by the government. Data on the total government consumption expenditure has been obtained from the FRED (2023) database.

$\boldsymbol{NFA}$ (net foreign assets) = It refers to the difference between the total foreign assets of the central bank of Turkey and its total foreign liabilities to non-residents (in thousand TL). In other words, it represents the net position of Turkey's assets held abroad minus its liabilities owned by foreign entities. We have calculated this series using the following formula:

NFA[111] = central bank's foreign assets – central bank's foreign liabilities (82)

Foreign assets typically include foreign currency reserves, foreign financial instruments (e.g., stocks, bonds), direct investments in foreign businesses, and other claims on foreign entities. These assets are owned by Turkey's residents or entities, including the government, corporations, and individuals. On the other hand, foreign liabilities include obligations owed to foreign entities, such as foreign debts, loans from international financial institutions, and other liabilities owed to foreign creditors. Data on the net foreign assets of Turkey has been collected from the CBRT (2023).

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[109] This method is based on a regression-based time series decomposition technique that separates the seasonal, trend, and irregular components of the data. It utilizes an iterative process to estimate and remove the seasonal component. However, other methods such as *Census X-12*, *Census X-13*, and *X-12-ARIMA*, which are commonly used to remove the seasonal pattern from data, do not comparatively perform better in our case.

[110] We have considered seasonally adjusted data for empirical analysis.

[111] A positive net foreign assets value indicates that Turkey's foreign assets exceed its foreign liabilities, reflecting a net creditor position. Conversely, a negative net foreign assets value suggests that Turkey's foreign liabilities surpass its foreign assets, indicating a net debtor position.

$\boldsymbol{CRP}$ (private sector credit) = It refers to the ratio of private sector credit to the nominal GDP of Turkey (expressed as a percentage). It includes loans, advances, and other forms of credit extended to private individuals, households, and businesses by banks and other financial institutions. The private sector uses this credit for various purposes: investment, consumption, and working capital. We have calculated this indicator using the following expression:

$$CRP\ (\%age\ of\ GDP) = \frac{Private\ sector\ credit}{GDP} * 100 \quad (83)$$

In Equation (83), *CRP* represents the total amount of credit extended to the private sector by banks and financial institutions, which includes loans, advances, and other forms of credit provided to individuals, households, and businesses. GDP refers to the total domestic production of the final goods and services produced in Turkey during a specific period. This calculation indicates the proportion of credit concerning the overall economic output of Turkey. Data on credit to the private sector have been extracted from the CBRT (2023).

$\boldsymbol{TOT}$ (terms of trade) = It refers to the ratio between the prices of Turkey's exports and its imports (2010 = 100 index). It is a measure that indicates the relative value of Turkey's exports in terms of the goods and services it can import. We have calculated the terms of the trade index using the following formula:

$$TOT = \frac{Export\ price\ index\ (P_X)}{Import\ price\ index\ (P_M)} * 100 \quad (84)$$[112]

In Equation (84), P_X represents the average price index of Turkey's exports (reflecting the changes in the prices of its exported goods and services over time), and P_M represents the average price index of Turkey's imports (showing the changes in the prices of the goods and services it imports). An improvement in the *TOT* (where export prices rise relative to import prices) can lead to increased income and purchasing power for the country. Conversely, a deterioration in the *TOT* (where import prices rise relative to export prices) can put pressure on the economy by reducing purchasing power and potentially impacting the trade balance. Data on the terms of trade index (in U.S. dollars) has been compiled from the Turkish Statistical Institute (TurkStat) (2023).

$\boldsymbol{FER}$ (foreign exchange reserves) = Foreign exchange reserves of the CBRT refer to the total amount of foreign currencies and other internationally accepted reserve assets held by the central bank (in a million U.S. dollars). These reserves serve as a buffer to stabilize the country's currency and maintain confidence in the financial system. However, these foreign

[112] Export price index and export unit value index are synonyms. Same is the case with the import price index.

exchange reserves exclude the holdings of gold. Gold is often separated from the total reserves calculation as its value can be subject to significant fluctuations in the global market. Data on the foreign exchange reserves of Turkey has been taken from the IFS (2023).

$\boldsymbol{LP}$ (labor productivity) = Labour productivity, proxied as GDP per hour worked (in U.S. dollars), refers to the economic output generated per hour of labor input. It is a measure that reflects the efficiency and productivity of Turkey's labor force in producing goods and services. We have calculated labor productivity using the formula as follows:

$$Labor\ productivity\ (GDP\ per\ hour\ worked) = \frac{GDP}{Total\ hours\ worked} \tag{85}$$

In Equation (85), *GDP* represents the gross domestic product, and ‘total hours worked’ refers to the aggregate number of hours worked by all individuals in the economy during the same period. This includes hours worked by employees in various sectors, including full-time and part-time workers. The result indicates the value of economic output generated per hour of labor input[113]. Data on labor productivity has been taken from the FRED (2023) database.

$\boldsymbol{Y_g}$ (economic growth) = The economic growth rate of Turkey is proxied by the real GDP growth rate (index 2009 = 100), which represents the percentage change in the value of real GDP over a specific quarter, typically compared to the preceding quarter. It measures the expansion or contraction rate in Turkey's overall economic output. We have used Turkey’s real GDP growth rate to remove the effect of inflation. We have calculated this series using the following formula:

$$Real\ GDP\ growth\ rate = \frac{GDP\ in\ current\ period}{GDP\ in\ previous\ period} * 100 \tag{86}$$

The real GDP growth rate data has been extracted from TurkStat (2023).

$\boldsymbol{RERMIS}$ (real exchange rate misalignment) = This variable refers to a situation where the actual ER between two currencies deviates from its equilibrium level. It indicates a discrepancy between the market-determined ER and the rate reflecting long-term macroeconomic fundamentals. We have calculated the extent of *RERMIS* using the H-P filter technique.

$\boldsymbol{SAV}$ (saving rate) = The savings rate (or savings-to-income ratio) refers to the proportion of disposable income that individuals or households save rather than spend on consumption. It represents the portion of income that is not immediately consumed and is

[113] Higher labour productivity indicates that a country is able to produce more output with the same amount of labor input, indicating increased efficiency and economic growth. It is an important determinant of a country's overall economic performance and competitiveness.

instead set aside for future use or investment. We have calculated the saving rate (%age of GDP) using the following formula:

$$Saving\ rate = \frac{Total\ savings}{Total\ disposable\ income} * 100 \tag{87}$$

The gross national saving rate data has been collected from the World Economic Outlook (WEO) (2023) database.

$\boldsymbol{INF}$ (inflation rate) = The inflation rate, expressed as a percentage change, can be calculated quarterly by comparing the current quarter's average price level to the previous quarter's average price level. The formula for calculating the quarterly inflation rate is as follows:

$$INF = \frac{Current\ price\ level - Previous\ price\ level}{Previous\ price\ level} * 100 \tag{88}$$

Data on the inflation rate (%age change) has been taken from the IFS (2023) database.

$\boldsymbol{GED}$ (gross external debt) = It refers to the total amount of debt (in a million U.S. dollars) owed by Turkey to foreign creditors or entities outside its borders. It includes both public and private sector debt, encompassing loans, bonds, and other financial instruments borrowed by Turkey from foreign governments, international organizations, commercial banks, and other lenders. The gross external debt data have been collected from the CBRT (2023).

9.2 Unit Root Properties of the Variables

To investigate the symmetric and asymmetric effects of real exchange rate misalignment on Turkey's economic growth, we conducted an empirical analysis by examining the conventional unit root properties of the respective time-series variables under consideration. As mentioned earlier, the *ARDL* approach to cointegration requires a pretest of the unit root properties of the variables to confirm that there are no integrated variables of order two, i.e., *I(2)* or higher. To this end, we performed two standard unit root tests: the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. In Table 28, the results of the two conventional unit root tests[114] show a mixture of *I(0)* stationary and *I(1)* non-stationary variables at the 1%, 5%, and 10% significance levels for the two specifications: *"intercept"* and *"trend and intercept."*

[114] Both unit root tests confirm that none of the variables are *I(2)*.

Table 28. ADF and PP Unit Root Test Results

Variables	*ADF* Test				*PP* Test				
	Level		First Difference		Level		First Difference		Order of Integration
	I	*T & I*	*I*	*T & I*	*I*	*T & I*	*I*	*T & I*	
$lnRER$	-0.97(0.76)	-0.53(0.98)	-11.69(0.00)*	-11.90(0.00)*	-0.80(0.82)	-0.05(1.00)	-11.68(0.00)*	-12.03(0.00)*	*I (1)*
lnY	-0.26(0.98)	-2.07(0.56)	-12.23(0.00)*	-12.24(0.00)*	0.44(0.98)	-2.06(0.56)	-12.30(0.00)*	-12.38(0.00)*	*I (1)*
lnG	-0.59(0.87)	-2.21(0.48)	-5.62(0.00)*	-5.54(0.00)*	-0.85(0.80)	-4.21(0.01)*	-18.35(0.00)*	-18.29(0.00)*	*I (1)*
$lnNFA$	-3.28(0.02)**	-1.46(0.84)	-3.29(0.02)**	-7.96(0.00)*	-3.07(0.03)**	-1.23(0.90)	-7.94(0.00)*	-8.43(0.00)*	*I (1)*
CRP	0.68(0.99)	-1.94(0.63)	-10.58(0.00)*	-10.71(0.00)*	0.77(0.99)	-1.99(0.65)	-10.54(0.00)*	-10.57(0.00)*	*I (1)*
TOT	-2.17(0.28)	-2.18(0.50)	-14.60(0.00)*	-14.64(0.00)*	-1.91(0.33)	-2.65(0.26)	-14.81(0.00)*	-15.00(0.00)*	*I (1)*
$lnFER$	-0.97(0.76)	-0.53(0.98)	-11.69(0.00)*	-11.90(0.00)*	-2.62(0.09)***	-1.50(0.83)	-11.14(0.00)*	-11.52(0.00)*	*I (1)*
$lnLP$	0.39(0.98)	-2.95(0.15)	-3.11(0.03)*	-3.21(0.09)***	1.30(1.00)	-2.13(0.53)	-3.12(0.00)*	-3.72(0.02)*	*I (1)*
Y_g	-13.19(0.00)*	-13.18(0.00)*	-9.45(0.00)*	-9.40(0.00)*	-13.54(0.00)*	-13.59(0.00)*	-90.99(0.00)*	-92.03(0.00)*	*I (0)*
$lnRERMIS$	-5.75(0.00)*	-5.72(0.00)*	-12.48(0.00)*	-12.43(0.00)*	-4.96(0.00)*	-4.93(0.00)*	-22.90(0.00)*	-23.28(0.00)*	*I (0)*
SAV	0.80(0.99)	-0.87(0.96)	-6.35(0.00)*	-11.18(0.00)*	0.80(0.99)	-0.97(0.94)	-10.85(0.00)*	-11.22(0.00)*	*I (1)*
INF	-1.42(0.57)	-2.17(0.50)	-12.92(0.00)*	-12.87(0.00)*	-1.20(0.11)	-1.25(0.19)	-26.17(0.00)*	-27.32(0.00)*	*I (1)*
$lnGED$	-1.58(0.49)	0.01(0.97)	-9.53(0.00)*	-9.63(0.00)*	-1.47(0.54)	-0.26(0.99)	-9.48(0.00)*	-9.65(0.00)*	*I (1)*
$lnOVER_{VAL}$	0.49(0.99)	-2.57(0.29)	-11.84(0.00)*	-11.83(0.00)*	0.64(0.99)	-2.48(0.34)	-11.91(0.00)*	-11.96(0.00)*	*I (1)*
$lnUNDER_{VAL}$	0.72(0.99)	-2.63(0.27)	-11.39(0.00)*	-11.43(0.00)*	1.06(0.99)	-2.61(0.28)	-11.34(0.00)*	-11.42(0.00)*	*I (1)*

Notes: This table adheres to the same notes as provided beneath Table 8. Source: Author's calculations (2023)

9.3 The Structural Breakpoint Unit Root Test

Although traditional unit root tests demonstrate the stationary nature of a given time series, such tests do not account for possible structural breaks in the data. Perron (1989) and Akram and Rath (2017) highlighted that failing to consider structural breaks can introduce bias and reduce the ability to reject a false unit root null hypothesis. To address this issue, Perron (1997) and Zivot and Andrews (2002) proposed a breakpoint unit root test that endogenously determines the presence of a structural break in the data. In this study, we utilize the unit root test of Zivot and Andrews (2002) to identify the structural breakpoints in the examined time series data.

Table 29 presents the results of the null hypothesis of a unit root with a structural breakpoint. The findings indicate that the unit root null hypothesis cannot be rejected for model 3 (Equation 15) and model 5 (Equation 21), except for variables such as real *GDP* (*lnY*), net foreign assets ($lnNFA$), exchange rate misalignment (*lnRERMIS*), and inflation rate (*INF*). However, it should be noted that the suggested breakpoint is only valid for model 5. In line with the dependent variable (Y_g), a dummy variable (*D94*) is incorporated into model 5.

Table 29. The Zivot and Andrews Breakpoint Unit Root Test Results

Model 3 (Equation 15)			
Variables	*t-statistic (p-value)*	*Break date*	*Lag*
$lnRER$	-1.92 (0.99)	2002Q3	4
lnY	-6.17 (0.01)*	1997Q3	0
lnG	-4.36 (0.19)	1988Q3	0
$lnNFA$	-4.74 (0.07)**	1993Q4	1
CRP	-3.25 (0.82)	1998Q2	3
TOT	-3.23 (0.83)	1988Q2	0
$lnFER$	-3.35 (0.78)	2014Q2	2
$lnLP$	-4.48 (0.14)	1993Q1	5
Model 5 (Equation 21)			
Y_g	-14.39 (0.01)*	1994Q3	0
$lnRERMIS$	-6.06 (0.01)*	2000Q4	8
SAV	-3.45 (0.72)	2020Q4	6
INF	-7.09 (0.01)*	1990Q3	0
$lnGED$	-2.90(0.94)	2018Q1	1

Exact critical values	
1%	-5.35
10%	-4.61

Notes: Numbers in parentheses are the asymptotic one-sided *p*-values from Vogelsang (1993). '*' ('**') indicates the 1% (10%) significance levels.
Source: Author's calculations (2023)

9.4 Cointegration Estimates

Before estimating Equation (34) using the linear *ARDL* cointegration approach, it is essential to ascertain the appropriate lag order for the *ARDL* model. The appropriate lag length is crucial as the *F*-bound tests are sensitive to the chosen lags, and a cointegrating relationship can be identified between the variables. Pesaran et al. (2001) and Khalid et al. (2021) emphasized the importance of finding a balance between selecting a lag order that effectively addresses residual serial correlation and avoiding overparameterization of the conditional *ECM*, especially when dealing with limited time series data in empirical analysis.

Equation (15) is estimated employing a maximum of seven (7) lags for the examined quarterly data to determine the proper lag length. The *AIC* and *SIC* tests are utilized to identify the appropriate lag order. Nevertheless, in small samples, it is advisable to prioritize the *SIC* criterion (Pesaran and Shin, 1999; Fatai et al., 2003). The optimal *ARDL* specification is determined as (1, 0, 7, 2, 3, 3, 5 ,1).

Table 29 presents the outcomes of the *ARDL F*-bounds test for the chosen optimal *ARDL* specification. The computed *F*-statistic for Equation (21) is 9.73, exceeding the upper critical bounds of the *F*-test provided by Pesaran et al. (2001) and Narayan (2005) at the 1% level of significance. Thus, the null hypothesis of no long-run cointegration is rejected, indicating a cointegrating relationship between real exchange rates and macroeconomic fundamentals.

Table 30. F-Bounds Cointegration Test Results

Significance level	Pesaran et al. (2001)[y]		Narayan (2005)[z]	
	I(0)	*I(1)*	*I(0)*	*I(1)*
1%	2.96	4.26	3.23	4.76
5%	2.32	3.50	2.48	3.75
10%	2.03	3.13	2.13	3.29
Calculated	9.73***		9.73***	

F-statistic		

Notes:' y' represents the *F*-bounds test critical limits from Pesaran et al. (2001, Table CI (iii), Case III, page 300). '*z*' indicates the *F*-bounds test critical limits from Narayan (2005, Case III, page 1988) for the case with 80 observations. '*', '**', and '***' denote significance at the 10%, 5%, and 1% levels, respectively.
Source: Author's calculations (2023)

9.5 The Equilibrium Real Exchange Rate Estimates

Having found a cointegrating association between the *RER* and its macroeconomic fundamentals, the *ARDL* model's results and associated residual and stability diagnostic tests are reported in Table 31. The short-term empirical estimates (coefficients associated with the first-differenced variables) have at least one significant coefficient at different significance levels, indicating that all macroeconomic fundamentals have a significant short-term impact on the real exchange rate (refer to Panel A).

The long-term coefficients of the *ARDL* specification demonstrate that all explanatory macroeconomic variables tend to have the anticipated signs consistent with macroeconomic theory and in line with prior expectations, except for foreign exchange reserves (refer to Panel B). The variable foreign exchange reserves have the wrong expected sign but are statistically significant at the 1% significance level.

A robust and significant Balassa-Samuelson effect is evident in the Turkish economy, where a 1% rise in real *GDP* triggers a notable 0.43% appreciation in the *RER*. Additionally, increased government consumption expenditure also drives *RER* appreciation, with a 1% increase leading to a 0.18% appreciation. This aligns with macroeconomic theory, highlighting Turkey's inclination for non-tradable goods spending in government consumption.

Similarly, a rise in net foreign assets contributes to *RER* appreciation. More precisely, a 1% growth in net foreign assets results in a 0.04% appreciation in the real exchange rate. As anticipated, lending to the private sector exerts a positive influence on the real exchange rate due to enhanced local demand. This implies that a 1% increase in private sector credit leads to a 0.13% appreciation in the *RER*.

The terms of trade coefficient is negative, indicating the prevalence of the *I.E* over the *S.E* as improved terms-of-trade lead to *RER* appreciation; however, this relationship lacks statistical significance[115]. Finally, labor productivity is another fundamental factor behind real

[115] Conrad and Jagessar (2018) examined the real oil price as a proxy variable for the terms of trade and found a positive and significant association between the real oil price and the *REER*. The authors concluded that the real

exchange rate appreciation in Turkey. More precisely, a 1% increase in labor productivity causes Turkey's real exchange rate to appreciate by 0.31%. Our derived empirical estimates support the empirical results of Conrad and Jagessar (2018), Abbasi (2021), Abbasi and Iqbal (2021), Ayele (2022), and Iqbal et al. (2023).

In Table 31, the real exchange rate adjustment parameter (i.e., the error correction term's coefficient) is negative and significant at the 1% significance level. This indicates a stable long-term connection between the real exchange rate and the macroeconomic fundamentals, as outlined in Equation (21)[116]. The coefficient denotes the speed at which the *RER* adjusts to close disequilibrium gaps following shocks in the system. The results show that the percentage of the total adjustment offset in each successive quarter is 31% for the real exchange rate.

A series of residual and stability diagnostic tests measure the adequacy of the proposed *ARDL* specification. To test for the absence of serial correlation, heteroskedasticity, and nonnormality in the residuals of the proposed econometric model, the Breusch-Godfrey *LM* test (Breusch, 1978; Godfrey, 1978), the White heteroskedasticity test (White, 1980) without cross terms, and the Jarque-Bera normality test (Jarque & Bera, 1980) are applied. The results in Table 31 show that the residuals have no serial correlation, are homoscedastic, and are normally distributed (refer to Panel C).

In addition, the stability of the parameters in Equation (21) was assessed through the cumulative sum of recursive residuals (*CUSUM*) and cumulative sum of squares of recursive residuals (*CUSUMSQ*) tests, introduced by Brown et al. (1975). The graphical plots of these stability tests are illustrated in Figures 21 and 22 in Appendix A, respectively. The results of the *CUSUM* and *CUSUMSQ* tests affirm the dynamic and structural stability of the estimated equilibrium model for the real exchange rate, significant at the 5% level. The specification maintains stability throughout the end of the period, which is a desirable outcome.

In summary, diagnostic tests for residuals and stability provide strong support for the robustness of the long-run normalized equations. Ramsey's *RESET* test identifies no model misspecification, confirming the adequacy of the proposed econometric specification. Finally,

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oil price has a positive influence on the *REER*, i.e., a 1% increase in oil prices leads to a 0.22% appreciation in the *REER* in the Trinidad and Tobago economy. A study by Hasanov et al. (2017) reached similar conclusions. They found that a 1% increase in the real oil price leads to an appreciation of the *REER* by 0.26%, 0.28%, and 0.56% for Azerbaijan, Kazakhstan, and Russia, respectively.

[116] Kremers et al. (1992) found that a significant error correction term is comparatively more efficient in detecting cointegration.

the adjusted R^2 is used to evaluate the model's fit, and the result indicates that the estimated econometric model is well-fitted.

Table 31. ARDL Estimation Results (The ERER Specification)

Panel A: Short-run Coefficient Estimates								
Lag	0	1	2	3	4	5	6	7
$\Delta lnRER$	---	---	---	---	---	---	---	---
ΔlnY	---	---	---	---	---	---	---	---
ΔlnG	0.028 (0.243)	-0.343 (2.196)**	-0.312 (1.986)**	-0.554 (3.787)***	-0.426 (2.840)***	-0.432 (2.656)***	-0.241 (1.367)	---
$\Delta lnNFA$	-0.625 (12.486)***	-0.112 (1.900)*	---	---	---	---	---	---
ΔCRP	-0.010 (4.913)***	-0.004 (1.761)*	-0.061 (2.613)**	---	---	---	---	---
ΔTOT	-0.02 (2.039)**	0.033 (3.188)***	0.001 (1.276)	---	---	---	---	---
$\Delta lnFER$	0.539 (9.730)***	-0.032 (0.052)	0.063 (1.093)	0.103 (2.012)**	0.235 (4.429)***	---	---	---
$\Delta lnLP$	0.335 (1.134)	---	---	---	---	---	---	---
Panel B: Long-run Coefficient Estimates								
Variables	Constant	lnY	lnG	$lnNFA$	CRP	TOT	$lnFER$	$lnLP$

	-1.921 (2.196)**	0.431 (0.035)**	0.187 (2.165)**	0.039 (5.186)***	-0.130 (3.872)***	-0.002 (0.363)	0.189 (5.267)***	0.310 (2.066)**
Panel C: Diagnostics								
F-stat.	*Adj* R^2	ECM_{t-1}	*CUSUM*	*CUSUMSQ*	*LM*	*RESET*	JB_N	*WHITE*
9.732	0.981	-0.311 (9.118)***	Stable	Stable	0.477 [0.622]	3.195 [0.077]	0.640 [0.726]	1.114 [0.337]

Notes: Numerical values in parentheses denote absolute *t*-statistics. '*', '**', and '***' indicate significance at 10%, 5%, and 1% levels, respectively. For the *F*-bounds test, upper critical bounds by Pesaran et al. (2001, Table CI (v), Case V, page 301) are 3.45 (3.83) at 10% (5%) significance with $K=7$. $ECM_{(t-1)}$ has an absolute *t*-statistic, with critical value -4.23 (-4.57) at 10% (5%) significance with $K=7$, derived from Pesaran et al. (2001, Table CII (iii), Case III, page 303). *LM* and *RESET* are Langrange multiplier and Ramsey tests distributed as χ^2 with one degree of freedom, having critical values 2.70 (3.84) at 10% (5%) significance levels. *CUSUM* and *CUSUMSQ* assess coefficient stability. JB_N shows the Jarque-Bera normality test to check the H_0 of normal distribution. *WHITE* shows the χ^2 statistics for testing the H_0 of no heteroskedasticity. The number in brackets represents the corresponding *p*-values.

Source: Author's calculations (2023)

9.6 Estimation of the Real Exchange Rate Misalignment

After confirming a long-run cointegrating relationship between the *RER* and macroeconomic fundamentals, we estimate the *ERER* and currency misalignment. The permanent values of these fundamental determinants, derived via the *H-P* filter technique, serve as inputs for calculating equilibrium real exchange rates using the long-run cointegrating equation from Table 32. Figure 19 depicts the actual and estimated equilibrium real exchange rates, highlighting deviations between the observed and equilibrium rates in Turkey from 1987Q1 to 2021Q4.

Additionally, Figure 20 shows the pattern of the corresponding *RER* misalignment of the TL in percentage terms. The misalignment of the *RER* may have different effects on the economic growth of Turkey, depending on whether it reflects overvaluation or undervaluation. We decompose the series of *RER* misalignments to test this hypothesis into two components. Observations where the exchange rate misalignment is positive indicate overvaluation[117] (i.e., depreciation pressures), while observations where the exchange rate misalignment is negative indicate undervaluation[118] (i.e., appreciation pressures).

In Figure 19, the observed real exchange rate follows more or less the same path as its equilibrium level. The long-term *ERER* of Turkey can be analyzed in four sub-periods: (i) an appreciation from 1987Q1 to 1992Q2, (ii) a depreciation from 1993Q3 to 2000Q4, (iii) an appreciation from 2001Q1 to 2009Q4, and (iv) a continuous depreciation from 2010Q1 to 2021Q4. It is worth noting that macroeconomic fundamentals account for most long-term equilibrium real exchange rates. The appreciation at the beginning and depreciation at the end of the sample period seems to be related to an upward trend in output, government spending, net foreign assets, private sector credit, foreign exchange reserves, and labor productivity. At the same time, an increase in terms of trade could be partly responsible for the depreciation of the Turkish lira.

Figure 20 shows that Turkey's real exchange rate was undervalued by about 3% in the third quarter of 1987. However, this initial episode of undervaluation lasted, on average, until 1989Q3, reaching around 9%, due to unsuccessful disinflation efforts and debt financing policies. Following the start of capital account liberalization in August 1989, overvaluation began in 1989Q4 and persisted until 1993Q4. Significantly, the monetization of budget deficits in the last months of 1993, resulting from the rapid increase in public sector borrowing needs

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[117] Observations above zero in the vertical line scale (values above the red zero line in Figure 20).
[118] Observations below zero in the vertical line scale (values below the red zero line in Figure 20).

in 1992-1993, eventually led to the 1994 currency crisis. Consequently, the TL experienced a severe depreciation of over 80% against the U.S. dollar in 1994Q2, rendering it severely undervalued.

In the second quarter of 1995, the *RER* gradually converged to its equilibrium level and was slightly overvalued by about 1% in the fourth quarter of 1995. However, due to political uncertainties resulting from early elections in December 1995 and the contagion effects of the Asian crisis that erupted in 1997, the currency was slightly undervalued in real terms by approximately 1% in 1996Q4 and about 3% in 1997Q3.

The disinflation and stabilization programs implemented in 1998 and 2000, under *IMF* supervision and technical assistance, alleviated concerns about the Turkish economy and resulted in an average overvaluation of 8% between the second quarter of 1998 and the fourth quarter of 2000. Despite the short-term duration of the *IMF* disinflation programs, Turkey faced a significant capital outflow following the 1998 Russian crisis. In the lead-up to the two-tier crisis in December 2000 and February 2001, the real exchange rate was overvalued by 10% in 1999 and 6% in 2000.

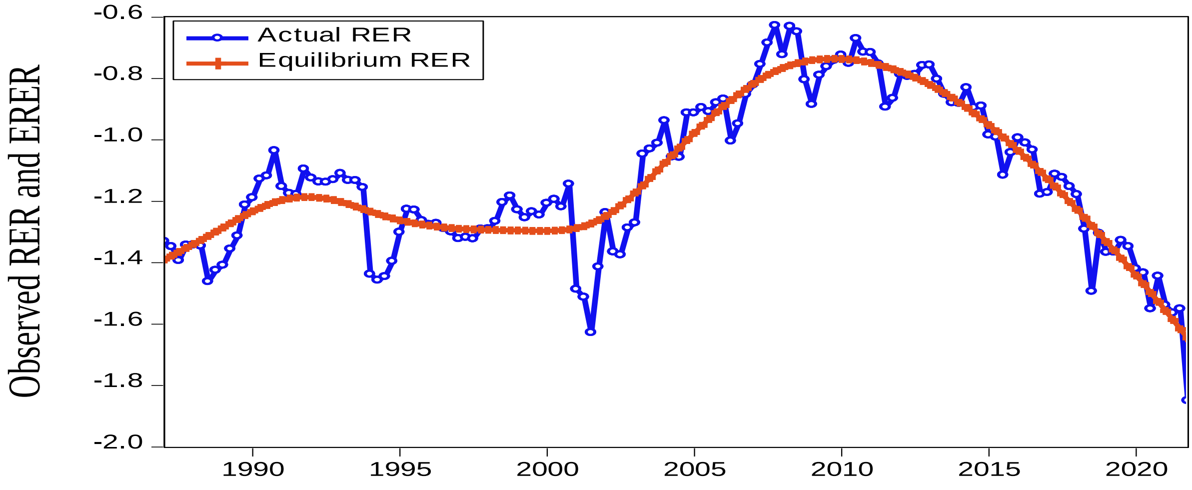
Following the two-tier crises, the real exchange rate of Turkey was undervalued from 2001Q1 to 2003Q1. Özlale and Yeldan (2004), Atasoy and Saxena (2006), and Söylemez (2013) confirmed the remarkable overvaluation of the TL during the fixed exchange rate regime that lasted until 2000, except for a short period after the 1994-1997 currency crisis. Kibritçioğlu and Kibritçioğlu (2004) and Gerek and Karabacak (2017) also found that Turkey's real exchange rate was significantly overvalued before the switch from a fixed to a flexible exchange rate system.

When Turkey switched from a fixed exchange rate system to a floating one in February 2001, the TL experienced a significant depreciation[119]. Given the favorable economic environment created by political stability after the November 2002 parliamentary elections, an overvaluation of about 10% began in 2003Q2 and lasted until 2006Q1, reaching approximately 2%. However, long-term misalignment estimates also indicate an increase in undervaluation from 13% in 2006Q2 to 2% in 2006Q4, which can be attributed to the deterioration in global risk perceptions. Since this shock was short-lived, the real exchange rate was overvalued by 5% in the second quarter of 2007 and remained overvalued by 10% until the third quarter of 2008. Nevertheless, the period from the fourth quarter of 2008 (6%) to the fourth quarter of

[119] The overvalued TL depreciates when it transitions to the floating exchange rate regime after the 2001 crisis and remains undervalued throughout the regime, supporting the findings of Dağdeviren et al. (2012).

2009 (1%) witnessed another phase of undervaluation as the global financial crisis also impacted Turkey. In summary, the TL has experienced various episodes of undervaluation and overvaluation in the post-2010 period.

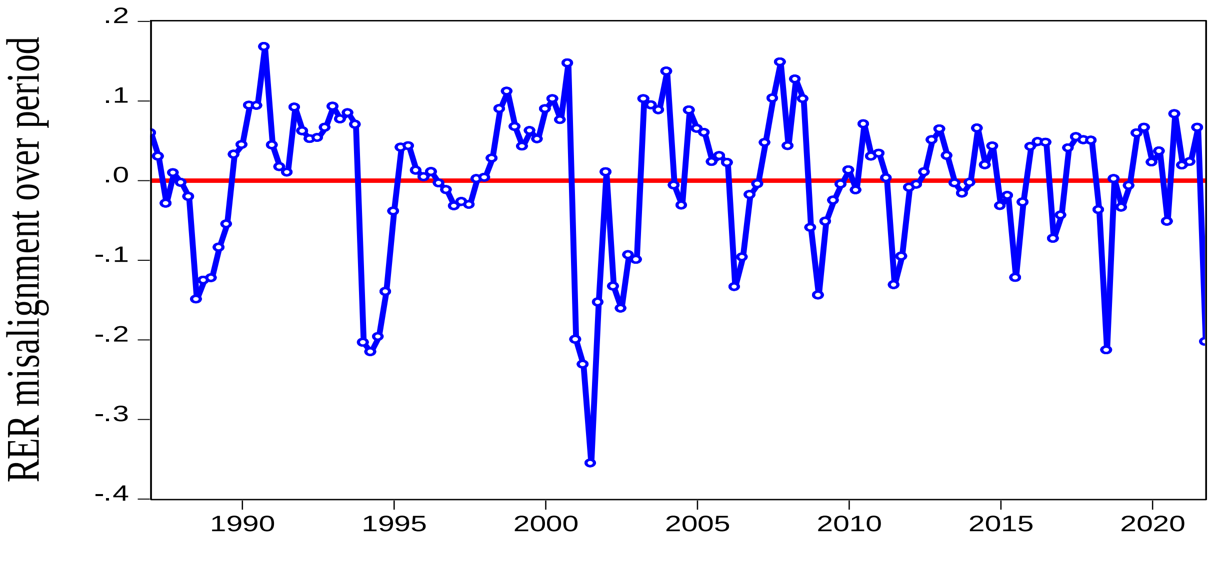
Figure 19. Actual RER and ERER over the Sample Period, 1987Q1-2021Q4



Years (t)

Source: Data processed by the author using EViews (2023)

Figure 20. RER Misalignment Calculated Using the H-P Filter Method, 1987Q1-2021Q4



Years (t)

Source: Data processed by the author using EViews (2023)

9.7 Symmetric Effects of Real Exchange Rate Misalignment on Economic Growth

After estimating the *RER* misalignment, we estimate the linear *ARDL* growth model to assess the association between the *RER* misalignment and Turkey's economic growth. Before estimating the symmetric economic growth model, we applied the *ARDL F*-bounds test to examine whether there is a long-term cointegrating association between the selected growth determinants. The outcomes of the *F*-bounds test depend crucially on the comparisons of the calculated *F*-statistics with the critical values derived from Pesaran et al. (2001) and Narayan (2005). The findings of the *ARDL* bounds test are shown in Table 32 (refer to Panel C).

Since the computed value of the *F*-statistic (13.57) is above the critical upper bound (3.50) at the 5% significance level[120], there is a long-term cointegrating association between the explanatory variables. The outcome suggests rejecting the null hypothesis of no cointegration, providing compelling evidence of a cointegrating relationship between economic growth and its determinants. A long-run cointegrating relationship allows us to estimate the short-run dynamics and the adjustment toward equilibrium. Based on the *AIC* and *SIC* criteria[121], an optimal *ARDL* model (4, 2, 4, 0, 8, 1, 1, 1) with the misalignment series is appropriate.

Regarding the long-term association (Equation 21) between economic growth and its determinants, as shown in Table 32, it is observed that *RER* misalignment inhibits *EG*, which is theoretically expected and statistically significant. Specifically, the findings indicate that *RER* misalignment impedes *EG*, indicating that a 1% rise in *RER* misalignment leads to a 1.84% quarterly reduction in Turkey's real economic growth rate. Thus, our empirical results establish that *RER* misalignment does not foster increased economic growth in Turkey.

Our empirical estimates are consistent with other empirical studies conducted by Sallenave (2010), Abida (2011), Dubas (2012), Wong (2013), Akram and Rath (2017), Conrad and Jagessar (2018), Mamun et al. (2020), Abbasi (20210, Abbasi and Iqbal (2021), and Iqbal et al. (2022). The estimation results confirm the crucial role of the *RER* in determining *EG*. *RER* misalignment is the main problem in Turkey's economic growth process. For example, Sekkat and Varoudakis (2000) and Bouoiyour and Rey (2005) demonstrate that mismanagement of economic strategies, inconsistency between monetary and fiscal policy, and exchange rate design can lead to the existence of *RER* misalignment, which has a significant influence on economic growth, particularly in emerging economies like Turkey.

Importantly, all signs of the long-term coefficients in the economic growth model are consistent with the prior expectations of economic theory. For instance, the long-term coefficient estimates of the inflation rate and external debt in the growth equation confirm that

[120] Refer to Table 29 for details

[121] Equation (37) is empirically estimated using a maximum of 8 lags.

they discourage Turkey's economic growth, which is theoretically expected and statistically significant at the 1% significance level. The negative influence of external debt on *EG* could be explained by several factors, such as channeling debt funds into unproductive activities, ineffective debt management and handling, and crowding out of private investment (De Vita et al., 2018). However, as expected, savings, private sector credit, the terms of trade, and foreign exchange reserves support Turkey's long-term economic growth (refer to Panel B).

To check the robustness of the estimation results, we performed some residual diagnostic checks: the Breusch-Godfrey *LM* test (Breusch, 1978; Godfrey, 1978), the White heteroskedasticity test (White, 1980) without cross terms, and the Jarque-Bera normality test (Jarque and Bera, 1980). The results in Table 32 indicate that the residuals exhibit no serial correlation, are homoscedastic, and follow a normal distribution (refer to Panel C).

To assess the stability of the long-term connection between economic growth and *RER* misalignment, we conducted *CUSUM* and *CUSUMSQ* tests. The plots of these stability statistics remain within the critical bounds, indicating that the estimated growth equation is stable at the 5% significance level (refer to Figures 23 and 24 in Appendix A). The result confirms the importance of *RER* misalignment in the growth model, as excluding it could lead to instability. Therefore, the growth model is deemed stable.

Moreover, the error correction term (ECM_{t-1}) coefficient in the growth equation is statistically significant at the 1% significance level, demonstrating the anticipated negative direction. This confirms the non-explosiveness of the series and the attainability of long-run equilibrium. The high adjusted R^2 value reflects a strong fit of the growth model to the data. Lastly, validation comes from Ramsey’s *RESET* test, affirming the correctness of our proposed growth model.

Table 32. Empirical Results of the Symmetric ARDL Growth Model

Panel A: Short-run Coefficient Estimates								
Lag	0	1	2	3	4	5	6	7
ΔYg	---	0.389 (2.531)**	0.366 (3.009)***	0.172 (2.044)**	---	---	---	---
$\Delta RERMIS$	-2.167 (0.550)	-1.178 (4.530)***	---	---	---	---	---	---
ΔSAV	1.089 (2.602)**	0.634 (1.470)	1.182 (2.635)***	1.136 (2.401)**	---	---	---	---
ΔCRP	0.087 (0.665)	0.141 (1.196)	-0.081 (0.805)	-0.070 (0.702)	-0.290 (2.968)***	-0.086 (0.824)	0.255 (2.475)**	-0.636 (5.588)***
ΔTOT	---	---	---	---	---	---	---	---
$\Delta lnFER$	0.278 (0.087)	---	---	---	---	---	---	---
ΔINF	-0.132 (2.211)**	---	---	---	---	---	---	---
$\Delta lnGED$	13.754 (1.745)*	---	---	---	---	---	---	---
Panel B: Long-run Coefficient Estimates								
Constant	$DUM94$[122]	$RERMIS$	SAV	CRP	TOT	$lnFER$	INF	$lnGED$

[122] The expected significant negative sign of the dummy variable confirms that the currency crisis in 1994 negatively affected the economic performance of Turkey.

85.095 (3.683)***	-7.978 (2.722)***	-1.842 (2.099)**	0.534 (3.001)***	0.139 (3.832)***	0.051 (1.347)	5.672 (2.618)**	-0.421 (5.226)***	-11.714 (3.285)***
Panel C: Diagnostics								
F-statistics	*Adj* R^2	ECM_{t-1}	*CUSUM*	*CUSUMSQ*	*LM*	*RESET*	JB_N	*WHITE*
13.568	0.912	-1.672 (10.770)***	Stable	Stable	0.553 [0.557]	3.195 [0.077]	0.672 [0.726]	0.780 [0.775]

Notes: This table adheres to the same notes as provided beneath Table 31.

Source: Author’s calculations (2023)

9.8 Asymmetric Effects of Real Exchange Rate Misalignment on Economic Growth

We now investigate whether *RER* misalignments have asymmetric effects on economic growth. Specifically, we are primarily interested in exploring the individual effects of overvaluation and undervaluation on Turkey's economic growth while keeping the control variables of the growth equation the same. To do this, we determine the appropriate lag length using the *AIC* and *SIC* criteria before estimating the *NARDL* growth model presented in Equation (74). Selecting 8 lags, an optimal *NARDL* model (3, 3, 3, 1, 1, 1, 7, 5) with cumulative sums of the positive and negative misalignment series is found to be suitable.

The *NARDL F*-bounds test is utilized to evaluate the existence of a long-term cointegrating relationship among the growth determinants. Table 33, Panel C, demonstrates that the calculated *F*-statistic (12.46) exceeds the critical upper bound (4.26) at the 1% significance level, as established by Narayan (2005) and Pesaran et al. (2001). Consequently, the cointegration test establishes a cointegrating relationship among the growth determinants. Supplementary diagnostic tests also support the empirical results of the non-linear *ARDL* growth specification. The *LM* test confirms the absence of autocorrelation in the residuals. Ramsey's *RESET* test confirms the correct specification of the proposed model. Similarly, the *CUSUM* and *CUSUMSQ* tests affirm both short-term and long-term stability of the estimates (refer to Figures 25 and 26 in Appendix A).

We conducted the *Wald-SR* & *Wald-LR* asymmetry tests to examine the short-term and long-term asymmetry hypotheses. Short-term adjustment asymmetry is apparent due to differing lag numbers in $OVER_{VAL}$ and $UNDER_{VAL}$. As depicted in Table 33, Panel C, the short-run asymmetry test (*Wald-SR*) provides significant evidence of the asymmetric effects of $OVER_{VAL}$ and $UNDER_{VAL}$ on economic growth. In addition, we observe short-run cumulative asymmetry, with the sum of $OVER_{VAL}$-related estimates differing significantly from the sum of $UNDER_{VAL}$-related estimates. Lastly, the *Wald-LR* test reveals a long-run asymmetric impact, as the normalized estimates linked to $OVER_{VAL}$ and $UNDER_{VAL}$ exhibit statistical differences in the growth model.

The results of the *NARDL* model, presented in Table 33, Panel A, indicate that the short-run coefficients suggest significant impacts of all growth determinants on Turkey's economic performance. However, the long-term coefficients indicate that, except for the terms of trade, all the short-term effects persist in the long-term. Furthermore, all control variables in the nonlinear growth equation exhibit theoretically expected signs, and these growth determinants are statistically significant.

The long-term coefficients of the *NARDL* growth specification demonstrate that savings, private sector credit, terms of trade, and foreign exchange reserves contribute to sustained economic growth in Turkey. In contrast, the long-run empirical estimates reveal that high inflation and enormous external debt harm Turkey's economic growth. In this context, De Vita et al. (2018) have argued that the negative influence of external debt on economic growth in Turkey can be attributed to allocating debt resources to unproductive activities, ineffective management of debt, external debt handling, and crowding out private investment.

More importantly, the empirical results are inconsistent with theoretical expectations regarding the impact of overvaluation and undervaluation on economic growth. The empirical estimates of the *NARDL* growth model indicate that overvaluation and undervaluation negatively affect economic growth in the long-term, and this outcome is statistically significant at the 1% and 10% levels. Specifically, the *NARDL* growth model results show that a 1% overvaluation of the Turkish lira is associated with a -0.55% decline in economic growth. Similarly, a 1% undervaluation of the Turkish lira is associated with a -0.85% decline in economic growth in Turkey. The results indicate that undervaluation negatively impacts Turkey's economic growth more than overvaluation.

Thus, a decrease in the *RER*, representing the real depreciation of the domestic currency, increases input costs for imports, such as machinery, equipment, raw materials, and other intermediate goods used in the production process. Consequently, increased production costs due to the TL depreciation against the U.S. dollar can fuel cost-push inflation, which impedes Turkey’s economic growth. Hence, the empirical results reveal that undervaluation and overvaluation are detrimental to Turkish economic performance. Our empirical estimates are consistent with other empirical studies such as Dubas (2012), Conrad and Jagessar (2018), Mamun (2019), and Mamun et al. (2020, 2021).

In contrast to the controversial view on the association between currency misalignment and economic growth, Krugman and Taylor (1978) examine the consequences of undervaluation on national output. They argue that undervaluation could hinder economic growth by transferring income from the poor to the rich, a notion that has been empirically supported by Lima and Porcile (2013), Mamun (2019), and Mamun et al. (2020, 2021) for various emerging economies, including Turkey. Therefore, analyzing the impact of undervaluation on output and aggregate consumption patterns can provide insights into whether undervaluation in Turkey affects output and income distribution.

Table 33. Empirical Results of the Asymmetric ARDL Growth Model

Panel A: Short-run Coefficient Estimates								
Lag	0	1	2	3	4	5	6	7
ΔYg	---	0.817 (4.254)***	0.726 (4.692)***	0.329 (3.174)***	---	---	---	---
ΔSAV	0.809 (1.653)	0.279 (0.618)	1.359 (2.876)***	1.735 (3.677)***	---	---	---	---
ΔTOT	0.272 (0.909)	-0.393 (1.051)	0.404 (7.060)***	0.508 (1.528)	---	---	---	---
$\Delta lnFER$	3.790 (2.060)***	---	---	---	---	---	---	---
ΔINF	-0.084 (5.332)***	---	---	---	---	---	---	---
$\Delta lnGED$	-10.268 (6.138)***	---	---	---	---	---	---	---
$\Delta OVER_{VAL}$	3.153 (0.439)	-5.439 (5.815)***	9.892 (1.611)	-9.111 (8.612)***	2.456 (0.441)	0.986 (0.173)	-4.590 (2.676)***	-1.854 (1.961)*
$\Delta UNDER_{VAL}$	-0.705 (0.158)	-3.573 (5.858)***	1.477 (2.240)**	-1.022 (2.612)**	-1.563 (3.198)***	8.523 (1.609)	---	---
Panel B: Long-run Coefficient Estimates								
Variables	Constant	SAV	TOT	$lnFER$	INF	$lnGED$	$OVER_{VAL}$	$UNDER_{VAL}$

	12.132 (3.859)***	0.518 (2.039)**	0.109 (1.535)	1.662 (2.897)***	-0.241 (3.079)***	-10.849 (2.871)***	-0.547 (1.964)*	-0.849 (3.197)***
Panel C: Diagnostics								
F-statistic	*Adj R^2*	*ECM_{t-1}*	*CUSUM* *(CUSUMSQ)*	*LM*	*RESET*	*WHITE*	*Wald-SR*	*Wald-LR*
12.455	0.935	-2.308 (10.347)***	Stable (Stable)	0.893 [0.413]	4.739 [0.122]	0.822 [0.567]	[6.223]***	[4.091]***

Notes: (i) This table adheres to the same notes provided beneath Table 32. (ii) *Wald-SR* and *Wald-LR* denote the short-term and long-term Wald asymmetry tests, respectively. The *Wald* tests follow a χ^2 distribution with one degree of freedom. The critical values for these tests are 2.70 at the 10% significance level and 3.84 at the 5% significance level, respectively.

Source: Author's calculations (2023)

CHAPTER X

Conclusion And Policy Recommendations

10.1 Conclusion

The influence of exchange rate volatility on international trade flows has been debated among economists, policymakers, and academics since the breakdown of fixed exchange rates in the 1970s. Advocates and critics have put forth differing viewpoints on the consequences of exchange rate volatility on trade volumes. Some empirical studies suggest that increased exchange rate uncertainty inhibits the growth of foreign trade (Ozturk, 2006). However, other empirical studies have found that exchange rate uncertainty exhibits a positive influence on international trade flows (Asteriou et al., 2016). However, the precise influence of exchange rate uncertainty on trade flows is a complex and multifaceted issue that requires further research (Abbasi, 2021).

Earlier empirical studies that examined aggregate trade flows between a single country and the rest of the world were heavily criticized by researchers for suffering from the so-called "aggregation bias." This bias arises because the overall effect of exchange rate volatility may be diluted when analyzing aggregate data. To address this concern and obtain more significant effects, researchers started focusing on bilateral trade data between the two countries (Dell'Ariccia, 1999; Clark et al., 2004). However, even empirical studies using bilateral trade data were heavily criticized by researchers for potentially suffering from another aggregation bias. This bias arises because exchange rate uncertainty may have an insignificant effect on bilateral trade between two countries. In response to this criticism, researchers shifted their focus toward industry-level analysis. Recent empirical studies have attempted to examine the influence of exchange rate volatility on trade volumes at the commodity level by analyzing disaggregated trade flows between two countries. These empirical studies have revealed significant effects of exchange rate uncertainty on trade volumes at the industry level. However, it is noteworthy that these empirical studies provide industry-specific results.

More importantly, earlier empirical studies presumed symmetric effects of exchange rate uncertainty on trade volumes, meaning that increased and decreased volatility would affect trade volumes in the same way. Nevertheless, recent empirical studies have challenged this strict assumption and provided significant evidence of asymmetric effects. These empirical studies have shown that increased volatility tends to depress trade flows, while decreased volatility enhances them (Akhtar et al., 2022; Rasaki & Oyedepo, 2023).

It is also worth noting that many studies have explored the influence of ER uncertainty on trade volumes between two trading partners. However, in the global trade scenario, a country engages in trade simultaneously with multiple other countries. Therefore, the impacts of exchange rate uncertainty on trade volumes are influenced by bilateral factors and the overall global trade environment, including the exchange rate dynamics with other trading partners. Hence, the third-country volatility effect is also supposed to significantly affect the trade flows between the two bilateral trade partners (Tunc et al., 2018; Khalid et al., 2023).

In the current empirical study, three essays are conducted to examine the effects of various factors on trade flows between Turkey and Germany, as well as the economic growth of Turkey. The first essay investigates the symmetric and asymmetric effects of bilateral exchange rate uncertainty on commodity trade volumes between Turkey and Germany. The study aims to determine whether the volatility of the exchange rate affects trade flows between Turkey and Germany symmetrically or asymmetrically. This analysis helps understand the specific dynamics of the trade relationship between the two countries and provides insights into how exchange rate uncertainty impacts their commodity flows.

The second essay delves into the symmetric and asymmetric consequences of third-economy uncertainty on commodity trade flows connecting Turkey and Germany. This essay examines how exchange rate volatility in the United States affects bilateral trade flows between Turkey and Germany. By incorporating the impact of third-economy uncertainty, the study captures the broader global trade context and the spillover effects from the U.S. on the bilateral trade relationship.

The last essay of the study focuses on the symmetric and asymmetric consequences of *RER* misalignment on Turkey's economic growth. *RER* misalignment occurs when the actual exchange rate deviates from its equilibrium level. The essay aims to determine whether RER misalignment affects Turkey's economic growth symmetrically or asymmetrically. By analyzing the effects of misalignment, the study provides insights into the connection between exchange rates and economic growth and sheds light on the potential challenges or opportunities arising from exchange rate fluctuations.

To analyze the symmetric and asymmetric consequences of real bilateral *ER* uncertainty on commodity volumes between Turkey and Germany, the study considers annual time-series data from 1980 to 2022. The sample includes 90 industries exporting from Turkey to Germany and 114 industries importing from Germany to Turkey to obtain industry-specific estimates. In this study, the real lira-euro exchange rate (VOL_t^{TRGR}) volatility is measured employing the *GARCH (1,1)* method. The empirical results of the symmetric *ARDL* model, developed by

Pesaran et al. (2001), show that real lira-euro volatility had short-run effects on 40 Turkish export and 77 Turkish import industries, which persisted in the long-term for 28 Turkish export and 39 Turkish import industries. In contrast, the empirical results of the nonlinear *ARDL* model, developed by Shin et al. (2014), demonstrate that the real lira-euro exchange rate volatility had short-term asymmetric effects on trade flows for 69 Turkish export and 86 Turkish import industries, which persisted for 49 Turkish export and 52 Turkish import industries in the long-term. The industry-specific findings indicate that an increase or decrease in real bilateral lira-euro volatility increases Turkish exports to Germany and Turkish imports from Germany for small and large industries.

To analyze the symmetric and asymmetric effects of third-economy uncertainty on commodity trade flows between Turkey and Germany, the current study considers annual time-series data between 1980 and 2022. The sample includes 79 industries exporting from Turkey to Germany and 93 industries importing from Germany to Turkey to obtain industry-specific results. In this study, real lira-dollar volatility (VOL_t^{TRUS}) is measured through the *GARCH (1,1)* framework. The empirical outcomes from the symmetric *ARDL* model reveal significant short-run symmetric impacts across 59 (67) export (import) sectors, persisting long-term for 70 Turkish export and 50 Turkish import industries. Conversely, the empirical findings of the asymmetric ARDL model demonstrate short-term asymmetric effects on real trade flows within 61 (68) export (import) sectors. Remarkably, these effects transform into long-term asymmetric effects for 70 Turkish export and 67 Turkish import industries. The empirical results underscore the increased significance of nonlinear *ARDL* models for both short-term and long-term effects. Notably, the empirical estimates emphasize that relying solely on asymmetric analysis is inadequate, stressing the importance of incorporating third-economy volatility effects in export and import demand models to gain a comprehensive insight into the actual trade pattern between two trading partners.

To examine the symmetric and asymmetric effects of real exchange rate misalignment on Turkey's economic growth, the current research considers quarterly data covering 1987Q1-2021Q4. The study utilizes the permanent equilibrium exchange rate (*PEER*) model and measures the *RER* misalignment using the *H-P* filter method. Considering the single-equation approach, the empirical findings of the symmetric *ARDL* model demonstrate that real *GDP*, government expenditures, net foreign assets, private sector credit, foreign exchange reserves, and labour productivity are the major factors determining Turkey's equilibrium real exchange rate, and a significant degree of currency misalignment is observed throughout the sample data. Furthermore, empirical estimates of the symmetric *ARDL* model suggest that higher currency misalignment reduces economic growth. In contrast, empirical estimates of the asymmetric *ARDL* model show that overvaluation and undervaluation impede economic growth in Turkey. Specifically, the results of the *NARDL* model show that a 1% overvaluation of the Turkish lira is associated with a -0.55% decline in economic growth. The results also show that a 1% undervaluation of the Turkish lira is associated with a -0.85% decline in economic growth in Turkey. The results indicate that undervaluation negatively affects Turkey's economic growth more than overvaluation. The long-term estimates of the asymmetric *ARDL* specification demonstrate that savings, private sector credit, terms of trade, and foreign exchange reserves stimulate sustained economic growth in Turkey. In contrast, the long-run estimates show that high inflation and high external debt harm Turkey's economic growth.

10.2 Policy Implications

One of the critical policy implications of this empirical study is that since real lira-euro volatility significantly affects fluctuations in Turkey's trade with Germany, particularly in the short-run, the Turkish government would need to take into account movements in real lira-euro volatility as one of the primary determinants in the short-term dynamics of the trade balance. This policy implication is essential for economic policymakers and practitioners seeking to promote a more stable and prosperous trade relationship between Turkey and Germany.

Another critical policy implication of this empirical study is that given the asymmetric influence of real lira-euro uncertainty on real trade volumes is an industry-specific phenomenon, affected industries or sectors can rely on the asymmetric results to inform how their sales or exports are affected in the presence of lira-euro volatility. For instance, export industries that benefit from real lira-euro volatility may expand their production and exports. In contrast, industries that suffer from real lira-euro volatility may seek alternative strategies to earn the expected profit. These policy implications are critical for industry stakeholders, traders, market participants, and economic policymakers seeking to develop effective trade policies and promote sustainable economic growth.

In addition, the short-run estimates indicate that real lira-euro volatility significantly affects Turkish imports. To minimize the negative impact of real lira-euro volatility on Turkey’s import industries, the Central Bank of the Republic of Turkey (*CBRT*) could take adequate measures to stabilize the exchange rate through prudent management of foreign exchange reserves and interest rates. Furthermore, ineffective monetary policy could endanger Turkey's import industry and trade balance. Hence, a robust and transparent monetary and fiscal policy focusing on exchange rate stability would enhance the import industry’s resilience against increased lira-euro volatility.

The empirical estimates of the third-country volatility carry significant policy implications, specifically for investors and traders aiming to handle potential risks as well as leverage return prospects linked to trading endeavors. The empirical results can specifically assist potential traders and investors engaged in export-oriented plus import-substituting sectors, guiding them to make well-informed investment decisions in those economic segments that gain from uncertainties in a floating exchange rate scenario. Additionally, incorporating a third-economy effect underscores the necessity for all stakeholders, traders, and market participants to acknowledge that alterations in trade policy tools in a third-economy can exert substantial influence on cross-border trade.

Lastly, incorporating asymmetric effects into the empirical investigation generates robust outcomes, offering economic policymakers’ clear insights into traders' behavior amidst varying volatility levels. The study recommends prioritizing export-oriented trade policies by policymakers to stimulate foreign trade collaborations, emphasizing a departure from short-run local currency manipulation. The crux of policymaking should center on value addition within the current production framework, fostering export growth to satisfy burgeoning internal demand for locally crafted products. Likewise, import-substituting strategies should channel efforts into capital goods and luxury item production. Furthermore, heightened emphasis should be directed towards enhancing the quality of internal products to augment the competitive edge of domestically installed industries at the global scale, thereby making substantial contributions to international trade and ultimately elevating the economic welfare of its citizens.

The empirical results of the exchange rate misalignment and economic growth reveal that overvalued and undervalued exchange rates harm Turkey's economic growth. These empirical findings highlight the importance of implementing appropriate policy options to address the challenges associated with Turkey's exchange rate misalignments. To address this issue effectively, economic policymakers should prioritize policies to mitigate exchange rate misalignments and promote long-term economic growth. They should use the exchange rate as a policy tool to avoid currency misalignment and create a favorable economic growth and development environment.

Given the impact of currency misalignment on resource allocation and the economy's debt burden, policymakers should actively manage signals sent to investors, market participants, and traders. Maintaining adequate foreign exchange reserves becomes critical to withstand potential financial shocks and maintain fiscal and current account stability. As a result, policymakers should emphasize the accumulation and prudent management of foreign exchange reserves to boost market confidence and enhance the economy's resilience. Furthermore, the *CBRT* should manage exchange rate fluctuations actively. While interventions in the foreign exchange market are required to reduce distortions in the real exchange rate, caution should be exercised to avoid excessive and unnecessary interventions that may lead to currency overvaluation and impede economic growth.

Finally, the study emphasizes the importance of coherent policy measures to address the adverse effects of overvalued and undervalued exchange rates on Turkey's economic growth. Policymakers can foster a stable and conducive environment for sustainable economic growth in Turkey by using the exchange rate as a policy tool, effectively managing foreign exchange reserves, and taking a balanced approach to foreign exchange market interventions.

10.3 Research Limitations

This empirical study assessing the impact of real bilateral exchange rate volatility on commodity trade volumes under the presence of third-country volatility effects has some limitations that need to be acknowledged. First, the association between exchange rate uncertainty and trade volumes is multifaceted and influenced by various factors such as economic policies, political events, market expectations, changes in global demand, and external shocks. Isolating the influence of bilateral and third-economy uncertainty from other factors can be challenging.

Second, empirical findings from bilateral-level studies may have limited generalizability to other country pairs or regions. The impact of exchange rate volatility on trade flows can vary depending on specific country characteristics, market structures, and economic conditions.

Third, the study only selects Germany as a trading counterpart, which may not be representative enough to capture the full range of exchange rate volatility and third-country variability effects. Increasing the sample size and including more trading zones could provide more robust and generalizable results.

Fourth, the study focused on specific product/industry classifications using the *SITC-1* (3-digit) classification system. Future research could explore other revisions and digit levels, such as *SITC*-Revision 4, which provides a more comprehensive and updated framework for classifying traded goods.

Fifth, the current study exclusively computed real exchange rate misalignment using the *H-P* filter technique to extract the long-run component. For this purpose, other detrending filters, such as the Beveridge Nelson decomposition or the Band Pass filter, have been utilized in the empirical literature. Further research is needed to explore these alternative detrending filters and their implications for the empirical analysis.

Lastly, future research should consider using trade models incorporating the simultaneous effects of real bilateral exchange rate uncertainty and third-economy uncertainty on commodity trade flows. Such models could provide a more comprehensive understanding of the impact of exchange rate volatility on trade flows and help policymakers design appropriate trade policies to mitigate the adverse effects of exchange rate volatility on trade flows.

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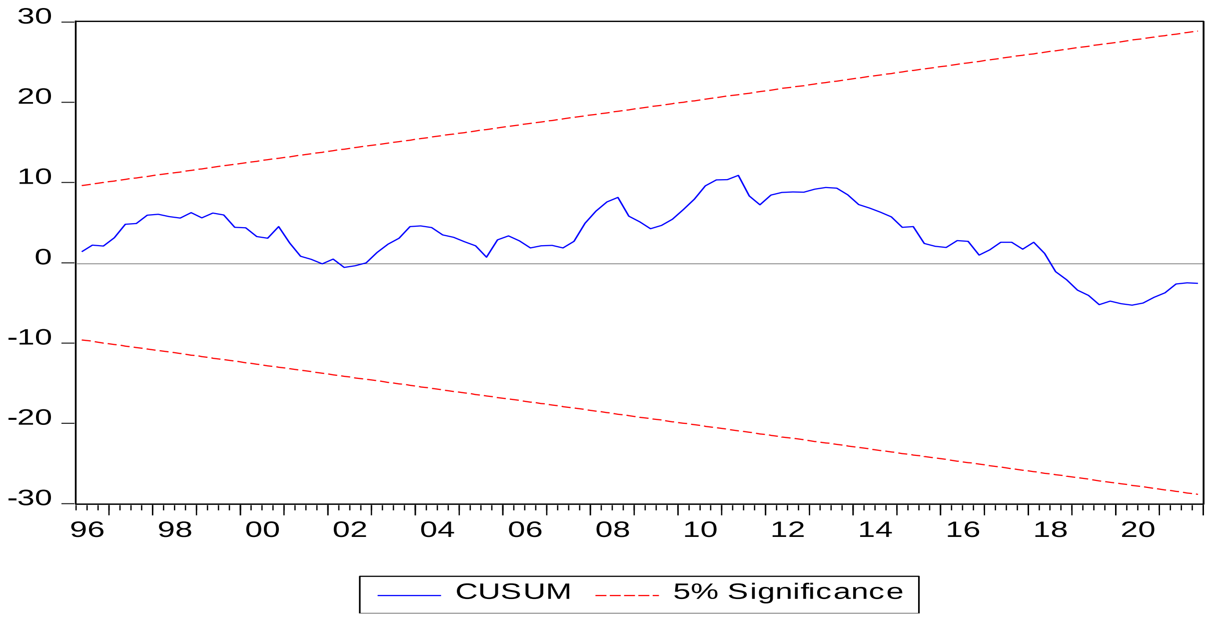
APPENDICES

Appendix A

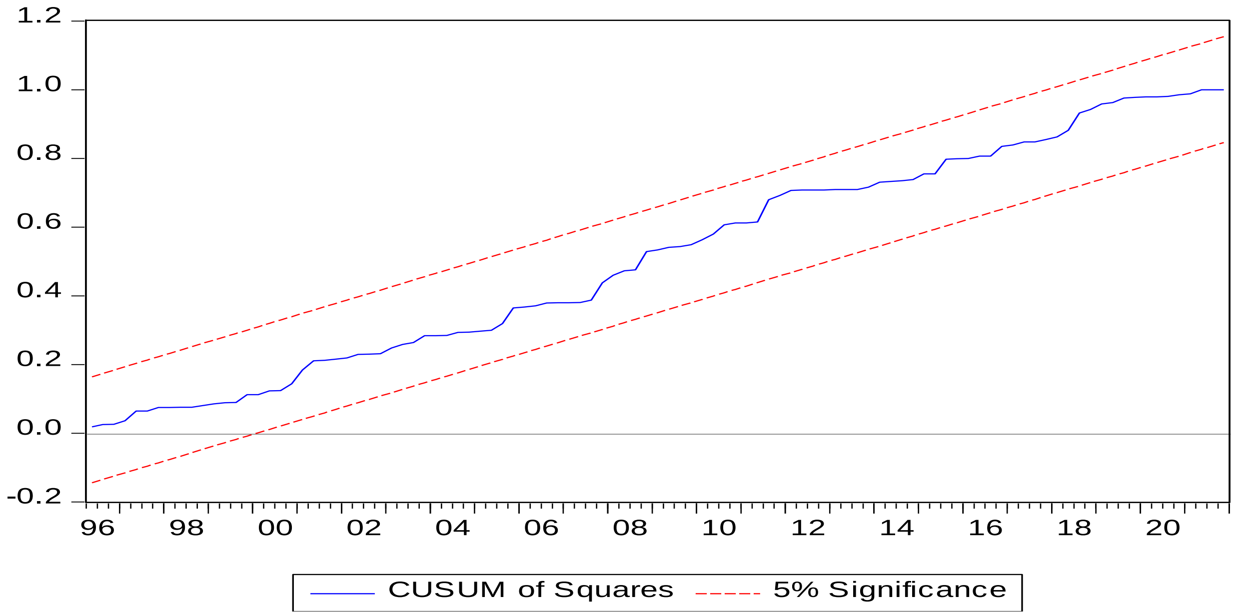
Graphical Representations of the CUSUM and CUSUMSQ Stability Tests

Figure 21. CUSUM Test Results (the ERER Model)



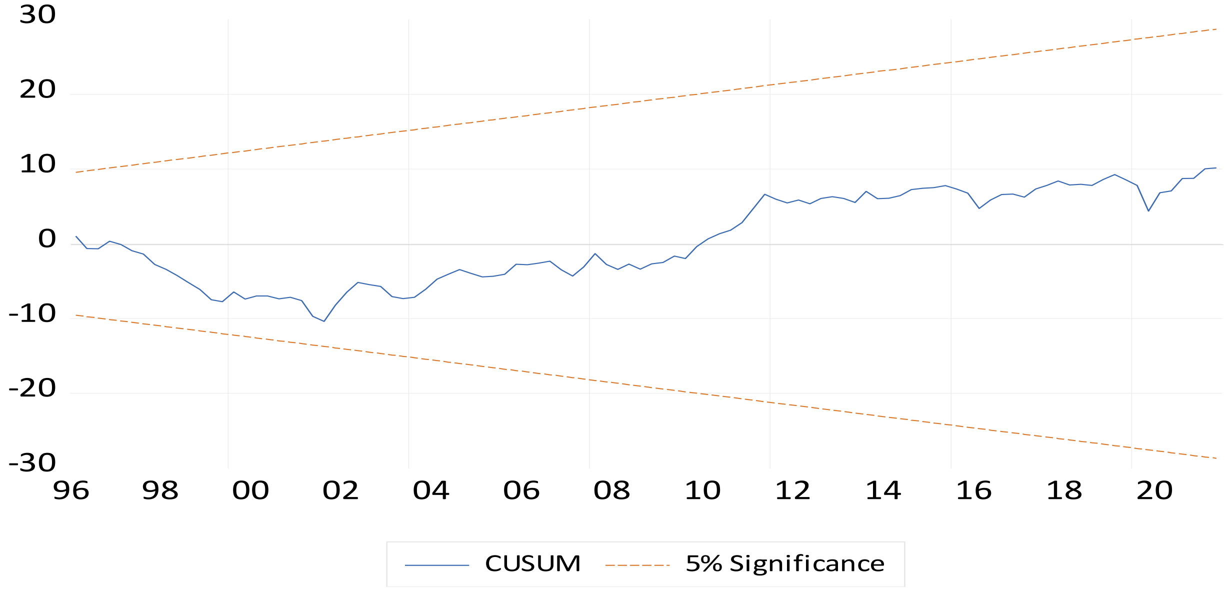
Source: Author's construction (2023)

Figure 22. CUSUMSQ Test Results (the ERER Model)



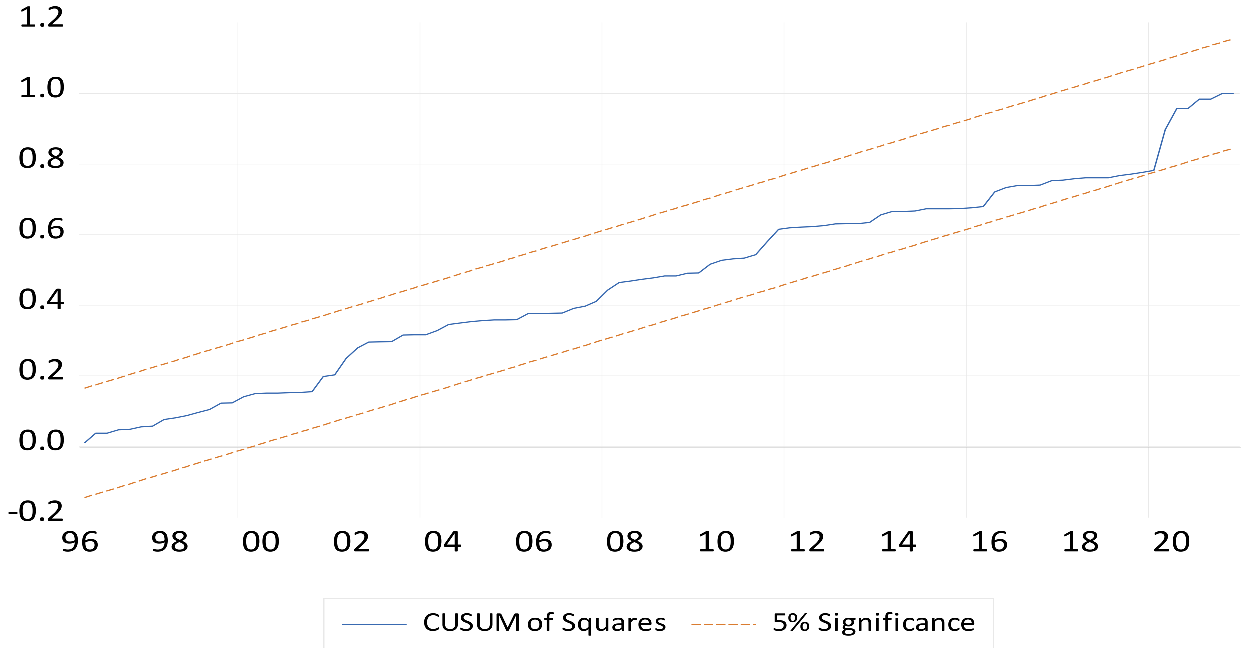
Source: Author's construction (2023)

Figure 23. CUSUM Test Results (the Linear Economic Growth Model)



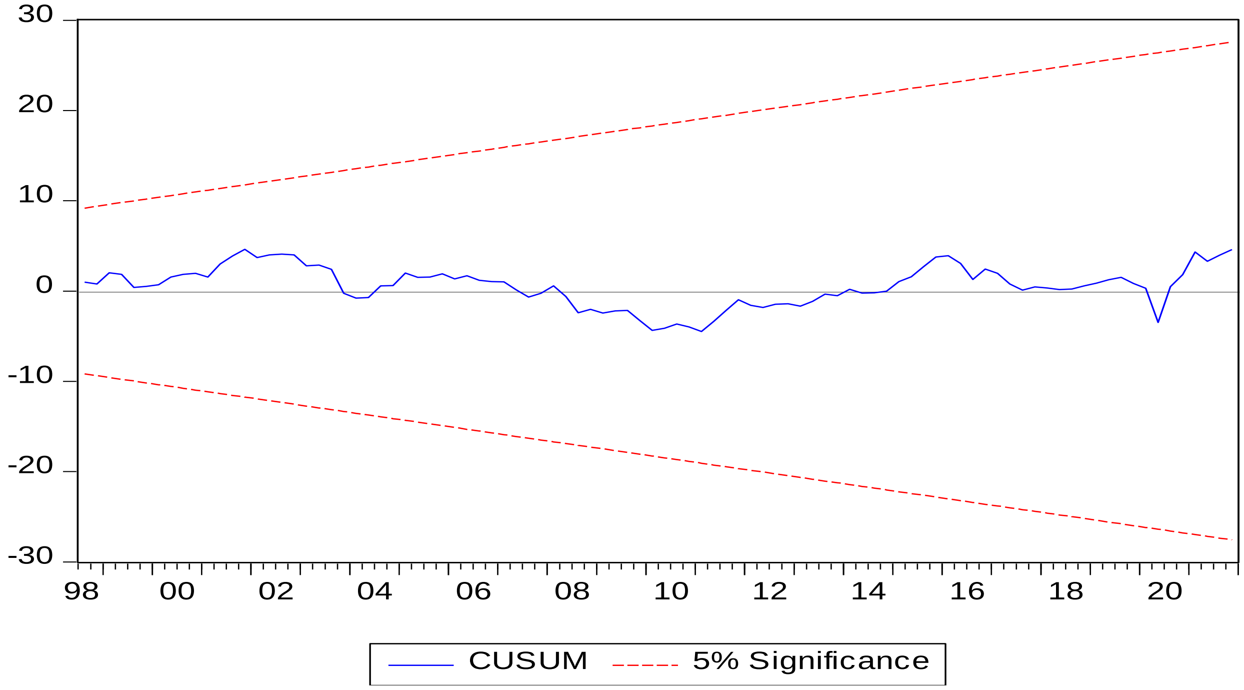
Source: Author’s construction (2023)

Figure 24. CUSUMSQ Test Results (the Linear Economic Growth Model)



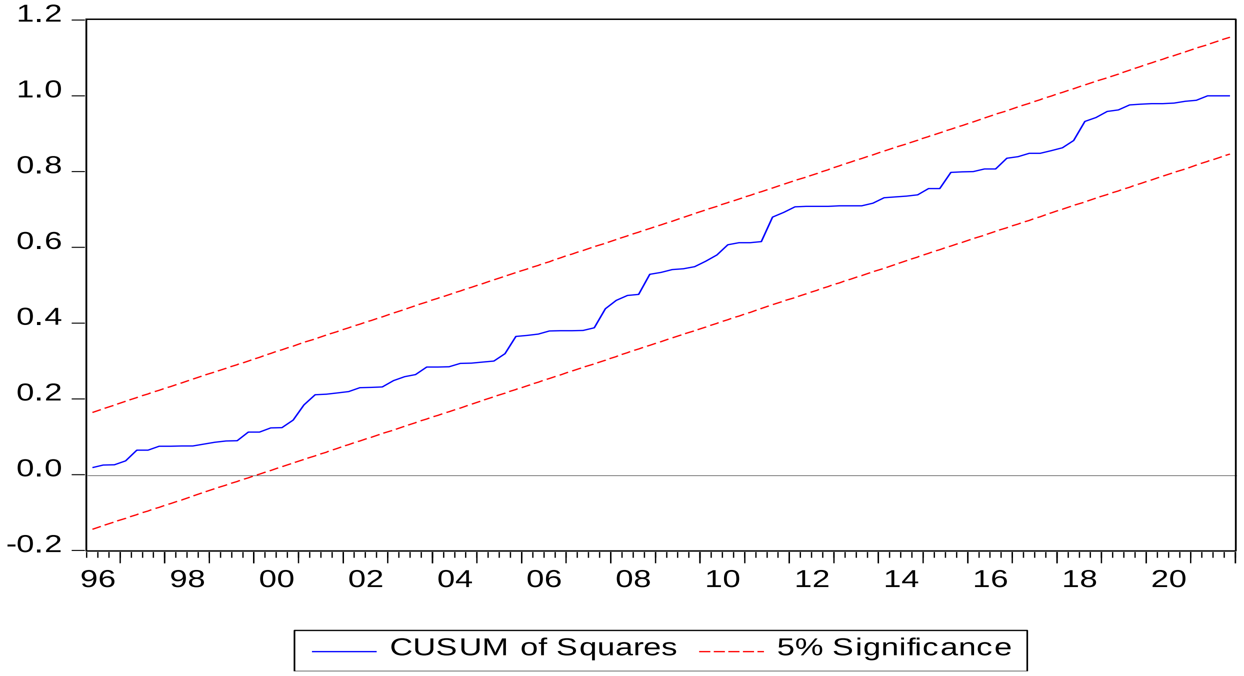
Source: Author’s construction (2023)

Figure 25. CUSUM Test Results (the Non-linear Economic Growth Model)



Source: Author’s construction (2023)

Figure 26. CUSUMSQ Test Results (the Non-linear Economic Growth Model)



Source: Author’s construction (2023)

Appendix B

Empirical Results of the GARCH (1,1) Specification

Table 34. Results of the GARCH (1, 1) Specification for the Real Lira-Euro Exchange Rate Volatility

Dependent Variable: *RER*				
Variable	Coefficient	Standard Error	z-statistic	Probability
C	0.787125	0.315036	2.498524	0.0125
RER (-1)	0.754391	0.094621	7.972759	0.0000
Variance Equation				
C	0.018093	0.058399	0.309826	0.0189
RESID (-1)^2	-0.175417	0.093110	-1.883983	0.0596
GARCH (-1)	1.161047	0.233229	4.978140	0.0000
R^2 = 0.590424			Adjusted R^2 = 0.580184	
S.E. of Regression = 0.620412			*D-W* Statistic = 2.048297	
AIC = 1.773692			*SIC* = 1.980557	
H-Q Criterion = 1.849516				

Source: Author’s Calculations (2023)

Table 35. Results of the GARCH (1, 1) Specification for the Real Lira-Dollar Exchange Rate Volatility

Dependent Variable: *RER*				
Variable	Coefficient	Standard Error	z-Statistic	Probability
C	0.6646	0.1990	3.2024	0.0150
RER (-1)	0.7595	0.2053	10.9183	0.0000
Variance Equation				
C	0.016015	0.028904	0.664658	0.0189
RESID (-1)^2	0.103758	0.088440	-1.111805	0.0442
GARCH (-1)	1.036535	0.172256	5.890315	0.0000
R^2 = 0.663712			Adjusted R^2 = 0.655305	
S.E. of Regression = 0.483628			*D-W* Statistic = 1.995371	
AIC = 1.353615			*SIC* = 1.560480	
H-Q Criterion = 1.429439				

Source: Author’s Calculations (2023)

Appendix C

Turnitin Similarity Report

Waqar Khalid

ORIGINALITY REPORT

13%	7%	7%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.panoeconomicus.org Internet Source	5%
2	Ahmet Murat Alper, İrfan Civcir. "Can overvaluation prelude to crisis and harm growth in Turkey", Journal of Policy Modeling, 2012 Publication	1%
3	Abdulla Hil Mamun, Harun Bal, Shahanara Basher. "Does currency misalignment matter for economic growth? – Evidence from Turkey", EuroMed Journal of Business, 2020 Publication	<1%
4	Javed Iqbal, Fatima Mahmood, Misbah Nosheen, Mark Wohar. "The asymmetric impact of exchange rate misalignment on economic growth of India: An application of Hodrick–Prescott filter technique", Economic Analysis and Policy, 2022 Publication	<1%
5	"The Princeton Encyclopedia of the World Economy. (Two volume set)", Walter de	<1%

Appendix D
RESEARCH ETHICS COMMITTEE APPROVAL

NEAR EAST UNIVERSITY

SCIENTIFIC RESEARCH ETHICS COMMITTEE

25.07.2023

Dear Waqar Khalid

Your project **"Essays on Exchange Rate Dynamics, Trade, and Growth Nexus in Turkey"** has been evaluated. Since only secondary data will be used the project does not need to go through the ethics committee. You can start your research on the condition that you will use only secondary data.

Prof. Dr. Aşkın KİRAZ

The Coordinator of the Scientific Research Ethics Committee

Appendix E

Curriculum Vitae (CV)

WAQAR KHALID

Email Address (s): waqarkhalidicp@gmail.com/waqar.khalid@neu.edu.tr

ORCID ID: https://orcid.org/0000-0002-5275-6665

Publons/Web of Science Researcher ID: AAA-1008-2022

Google Scholar Profile: https://scholar.google.com/citations?user=SKDM4NkAAAAJ&hl=en

ResearchGate Profile: https://www.researchgate.net/profile/Waqar-Khalid

Contact Number: +90 542 884 95 60

Personal Summary:

As a dedicated Ph.D. holder in Economics, I aim to continue my academic journey by pursuing impactful research, fostering intellectual growth, and contributing to the scholarly community. I am committed to advancing knowledge, mentoring students, and engaging in collaborative research endeavors that drive innovation and make a meaningful impact within my field.

Academic Qualifications:

Certificate/Degree: Secondary School Certificate (SSC) (2003-2005)
Field of Study: Science Group
Institute: Government High School, Lahor, Swabi, Pakistan

Certificate/Degree: Higher Secondary School Certificate (HSSC) (2005-2007)
Field of Study: Pre–Medical
Institute: Government Post Graduate College, Swabi, Pakistan

Degree: Bachelor of Arts (BA) (2007-2009)
Field of Study: Economics
Institute: Islamia College, Peshawar, Pakistan

Degree: Master of Science (M.Sc.) in Economics (2009-2011)
Thesis Title: "Illiteracy", A Cause of Socio-Economic Problems of District Swabi (A Case Study of Village Yar Hussain)
Supervisor: Dr. Fazl – e – Wahid, Lecturer, Islamia College University, Peshawar, Pakistan
Institute: Department of Economics, Islamia College University, Peshawar, KPK, Pakistan

Degree: Master of Philosophy (M.Phil.) in Economics (2014-2016)
Thesis Title: "An Econometric Analysis of Inter-fuel and Inter-factor Substitution in the Energy Sector of Pakistan"
Supervisor: Prof: Dr. Abdul Jalil, Associate Professor, School of Economics, QAU, Islamabad
Institute: School of Economics, Quaid-I-Azam University, Islamabad, Pakistan

Degree: Doctor of Philosophy (PhD) in Economics (2018-2023)
Thesis Title: "Essays on Exchange Rate Dynamics, Trade and the Growth Nexus in Turkey"
Supervisor (s): Prof. Dr. Hüseyin Özdeşer (Supervisor), Chairperson, Department of Economics, Near East University, Northern Cyprus
Prof. Dr. Irfan Civcir (Co-Supervisor), Faculty of Political Sciences, Department of Economics, University of Ankara, Ankara, Turkey
Institute: Graduate School of Social Sciences, Department of Economics, Near East University, Nicosia, Northern Cyprus

Computer & Research Skills:

- STATA
- EViews
- SPSS
- Dext
- Xero
- NCSS Statistical Software Package
- Microsoft Office
- Emailing
- Internet Browsing

Achievements and Awards:

- Received the Pride of Performance Award on Pakistan Day from the Anjuman Samaji Behbood, Yar Hussain, Swabi, Pakistan.
- Secured a laptop awarded to talented students by the Government of Pakistan under the Prime Minister's Laptop Scheme, Islamabad, Pakistan.
- Secured a Gold Medal in Master of Science (M.Sc.) Economics from Islamia College University, Peshawar, Pakistan.
- Secured the Highest Marks in Master of Science (M.Sc.) Economics at Islamia College University, Peshawar, Pakistan.

- Secured the Umeed-e-Pakistan Talent Award from the Study and Foundation for Excellence, Islamia College Peshawar, Khyber Pakhtunkhwa, Pakistan.
- Secured 1st position in 9th Class at Government High School Lahor, Swabi, Pakistan.
- Secured 1st position Hafiz-e-Quran Sanad from the Wafaq-ul-Madaris Al-Arabia, Multan, Pakistan.
- Secured 1st position Hafiz-e-Quran Award at Islamia College Peshawar, Pakistan.
- Member of the Winning Scout Team, Government High School Lahor, Swabi, Pakistan.
- Coordinator at the School of Economics, Quaid-I-Azam University, Islamabad, Pakistan.

List of Publications (SSCI, ESCI & Scopus Indexed):

- Khalid, W., & Khan, S. (2017). Impact of Operating and Financial Expenses on Sales Revenue: The Case of Fauji Fertilizer Company Limited. *International Journal of Business and Economics Research*, *6*(3), 40-47. 10.11648/j.ijber.20170603.12
- Khalid, W. (2017). Empirical Evidence on the J-Curve Between Pakistan and Selected South Asian Trade Partners. *European Business & Management, 3*(4), 57-64. 10.11648/j.ebm.20170304.11
- Khalid, W. (2017). Effects of Interest Rate and Exchange Rate on the Stock Market Performance of Pakistan: A Cointegration Approach. *Journal of Finance and Economics*, *5* (5), 219-232. http://doi.org/10.12691/jfe-5-5-4
- Khalid, W., & Khan, S. (2017). Effects of Macroeconomic Variables on the Stock Market Volatility: The Pakistan Experience. *International Journal of Econometrics and Financial Management*, *5*(2), 42-59. http://doi.org/10.12691/ijefm-5-2-4
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- Shah, N. H., Khalid, W., Khan, S., Arif, M., & Khan, M. A. (2020). An Empirical Analysis of Financial Risk Tolerance and Demographic Factors of Business Graduates in Pakistan. *International Journal of Economics and Financial Issues, 10*(4), 220-234. https://www.econjournals.com/index.php/ijefi/article/view/9365
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- Khalid, W., Akalpler, E., Khan, S., Shah, N. H., & Khan, S. (2021). The Relationship between Unemployment and Economic Growth in South Africa: VAR Analysis. *Forman Journal of Economic Studies, 17*(1), 1-32. http://doi.org/10.32368/FJES.20211701
- Khalid, W., & Özdeşer, H. (2021). Estimation of Substitution Possibilities between Hydroelectricity and Classical Factor Inputs for Pakistan's Economy. *Forman Journal of Economic Studies, 17*(2), 69-101. http://doi.org/10.32368/FJES.20211712
- Khan, S., Zahra, A., Khalid, W., Shah, N. H. (2021). Impact of Bank Profitability on Default Risk: Empirical Evidence from Pakistan. *Journal of Quantitative Methods (JQM), 5*(2), 1-33. https://doi.org/10.29145/2021/jqm/52/01
- Shah, N. H., Khan, M. A., Khalid, W., Jahangir, M., & Rahman, S. (2021). Does Mimicry Isomorphism Play a Role in Sustainable Development Operationalization: A Case of SMEs in Khyber Pakhtunkhwa. *Indian Journal of Economics and Business*, *20*(4), 2025-2040. http://www.ashwinanokha.com/IJEB.php
- Shah, N, H., Khalid, W., & Ahmad, A., Ghaffar, J. A., & Tahir, M. (2023). The Effect of Customer Relationship Management on Customer Retention: The Mediating Role of Customer Satisfaction and Effective Commitment. *Journal of Xi'an Shiyou University, Natural Science Edition, 19*(20), 1345-1368. http://xisdxjxsu.asia
- Khalid, W., Civcir, I., & Özdeşer, H. (2023). The Asymmetric Effects of Third-Country Exchange Rate Volatility on Turkish-German Commodity Trade. *Panoeconomicus (forthcoming)*. https://doi.org/10.2298/PAN220624015K

Submitted Articles:

- Khalid, W., Civcir, I., Özdeşer, H., & Iqbal, J. (2023). "The Asymmetric Impact of Real Exchange Rate Misalignment on Growth Dynamics in Turkey" in the ***Journal of Policy Modeling.***
- Khan, S., Fraz, A., Khalid, W., Zahra. A. (2023). "Bank-specific and Macroeconomic Determinants of Distance-to-Default: Evidence from listed Banks of Pakistan" in the ***Journal of Economics and Finance.***
- Sheheryar, K., Khalid, W., Zahra, A., & Shah, N. H. (2023). "Unveiling the Dynamics of Bank Liquidity: Exploring the Impact of Bank-specific and Macroeconomic

Determinants of Pakistani Banks" in the ***Journal of Economics, Finance and Administrative Science.***

- Khalid, W., Civcir, I., & Özdeşer, H. (2023). "Asymmetric Effects of Exchange Rate Volatility on Turkish-German Commodity Trade" in ***The Journal of International Trade & Economic Development.***
- Khalid, W., Civcir, I., & Özdeşer, H. (2023). "Revisiting the Asymmetric Effects of Third-Country Risk on Turkish-German Commodity Trade Flows" in ***Economic Change and Restructuring.***
- Ahmad, H., Shah, N. H., Khalid, W., Zahra, A., & Rehman, S. (2023). "Unveiling Pakistani Retailers' Attitudes towards Islamic Methods of Finance" in the ***Journal of Xi'an Shiyou University, Natural Science Edition.***

Conference Publication:

- Zahra, A., Khan, S., Khalid, W., & Shah, N. H. "Bank Profitability and Default Risk". *The 2021 Virtual Conference on FinTech, Business Ecosystem and Economic Development.* July 06, 2021.

Teaching Experience:

- Part-time lecturer in Economics at the Graduate School of Social Sciences, Department of Economics, Near East University, Nicosia, Northern Cyprus (Spring Semester 2022-2023)
- Part-time lecturer in Economics at the Faculty of Open and Distance Education, Near East University, Nicosia, North Cyprus, from the Fall Semester 2019-2020 to the Fall Semester 2020-2021
- Lecturer of Economics at the Raees-ul-Ahrar College of Commerce, Rawalpindi, Pakistan
- Visiting lecturer in Economics at the Department of Economics, University of Swabi, Khyber Pakhtunkhwa, Pakistan, from October 21, 2016, up to March 09, 2017
- Mathematics and English Instructor at Government Primary School No. 04, Yar Hussain, Swabi, Pakistan, from September 02, 2013 up to January 31, 2014
- Mathematics instructor at Hira International Model School (HIMS), Peshawar, Pakistan, from April 1st, 2010 up to May 30th, 2012

Refereeing Services:

- Referee for "***Cogent Economics & Finance"***, Taylor & Francis Online, the UK
- Referee for "***Cogent Business & Management"***, Taylor & Francis Online, the UK
- Referee for "***Cogent Social Sciences"***, Taylor & Francis Online, the UK
- Referee for "***Journal of Economics Management and Trade***", India
- Referee for "***Energy Economics"***, Elsevier, the Netherlands

Membership:

- Office Secretary, ***Sultana Nisar Welfare Organization (SNWO)***, Taj Abad Yar Hussain, Swabi, KPK, Pakistan since September 19th, 2016 up-to-date.

Personal Skills:

- Focused & result-oriented personality
- Competent & Hard worker
- Self-Driven
- Analytical
- Problem Solver

Hobbies:

- Reading Economics Literature
- Writing Academic Articles
- Multi-disciplinary Discussions
- Social noble activities

References:

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