

EXCHANGE RATE FLUCTUATIONS
AND TURKEY'S EXPORT PERFORMANCE:
INSIGHTS ACROSS INDUSTRIES AND TRADE PARTNERS



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Exchange Rate Fluctuations and Turkey's Export Performance:
Insights Across Industries and Trade Partners

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ABSTRACT

Exchange Rate Fluctuations and Turkey's Export Performance: Insights Across Industries and Trade Partners

This study examines the impact of exchange rate volatility (ERvol) on Turkey's export performance over the period 2003–2023, highlighting heterogeneity across industries and trading partners. The analysis covers nine of Turkey's major export markets and six key product sectors. Using econometric techniques, particularly Ordinary Least Squares (OLS) regression, the study quantifies the relationship between ERvol and sectoral export values while controlling for GDP of Turkey, GDP of trade partner, inflation, the Real Effective Exchange Rate (REER), and average exchange rates. The OLS results confirm that heightened exchange rate volatility generally has a significant negative effect on export values, though the magnitude of this impact varies by sector and destination. Complementary correlation analysis reveals consistent patterns across trade partners: notably, maintaining a stable or competitive REER emerges as a stabilizing factor for export performance, and certain industries—especially machinery and chemicals—exhibit heightened sensitivity to currency fluctuations. The results also indicate that exports to advanced economies tend to be more resilient to volatility shocks, whereas those to less diversified or emerging markets experience more pronounced adverse effects. These findings expose distinct sector-specific and partner-specific vulnerabilities, underscoring the need for targeted strategies to manage exchange rate risk. Accordingly, policymakers and exporters are advised to implement tailored measures to mitigate the adverse impacts of currency fluctuations and bolster the stability of Turkey's export performance under volatile exchange rate conditions.

ÖZET

Döviz Kuru Dalgalanmaları ve Türkiye'nin İhracat Performansı:

Sektörler ve Ticaret Ortakları Üzerine Bulgular

Bu çalışma, 2003–2023 döneminde döviz kuru oynaklığının (ERvol) Türkiye'nin ihracat performansı üzerindeki etkisini incelemekte ve sektörler ile ticaret ortakları arasındaki farklılıkları vurgulamaktadır. Analiz, Türkiye'nin dokuz büyük ihracat pazarını ve altı temel ürün sektörünü kapsamaktadır. Ekonometrik tekniklerle, özellikle En Küçük Kareler (OLS) regresyonu kullanılarak yapılan analizde, ERvol ile sektörel ihracat değerleri arasındaki ilişki; Türkiye'nin GSYH'si, ticaret ortağının GSYH'si, enflasyon, Reel Efektif Döviz Kuru (REER) ve ortalama döviz kurları gibi değişkenler kontrol edilerek nicel olarak ortaya konmuştur. OLS sonuçları, artan döviz kuru oynaklığının genel olarak ihracat değerleri üzerinde anlamlı ve olumsuz bir etkisi olduğunu doğrulamaktadır; ancak bu etkinin büyüklüğü sektöre ve hedef pazara göre farklılık göstermektedir. Tamamlayıcı korelasyon analizi, ticaret ortakları arasında tutarlı desenleri ortaya koymaktadır. Sonuçlar ayrıca, gelişmiş ekonomilere yönelik ihracatın kur şoklarına karşı daha dayanıklı olduğunu, buna karşın daha az çeşitlenmiş veya gelişmekte olan pazarlara yapılan ihracatın daha belirgin olumsuz etkilerle karşılaştığını göstermektedir. Bu bulgular, sektöre ve ülkeye özgü kırılmalılıkları ortaya koymakta ve döviz kuru riskini yönetmeye yönelik hedefli stratejilere duyulan ihtiyacı vurgulamaktadır. Bu doğrultuda, politika yapıcılara ve ihracatçılara; döviz kuru dalgalanmalarının olumsuz etkilerini azaltmak ve Türkiye'nin ihracat performansını istikrara kavuşturmak amacıyla finansal korunma araçları, pazar çeşitlendirmesi ve destekleyici kamu politikaları gibi uyarlanmış önlemler uygulamaları önerilmektedir.

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CHAPTER 1

INTRODUCTION

1.1 General background

International trade serves as a foundation for Turkey's economy, significantly contributing to economic growth, employment, and external balance. Turkey's export-driven economy relies on maintaining competitive trade agreements with major international partners. Turkey's major trade partners include Germany, the United States, the United Kingdom, France, Poland, Netherlands, Spain, Italy, and Iraq. Collectively, these nations account for almost 50% of Turkey's total export volume, covering a wide range of product categories such as automotive and parts, textiles and apparel, machinery and equipment, chemicals and plastics, food and agricultural products, and electronics.

In recent years, the Turkish economy has experienced considerable exchange rate fluctuations, particularly in the value of the Turkish lira relative to major currencies such as the US Dollar (USD) and Euro (EUR). This volatility has been triggered by various factors, including domestic economic challenges, political uncertainty, and international market dynamics. For instance, the lira experienced severe depreciation, contributing to both opportunities and challenges for exporters, between 2003 and 2023. Furthermore, amid global uncertainty, the impact of international trade in shaping Turkey's economic landscape has become increasingly critical. Trade-related challenges, such as shifts in global demand, evolving geopolitical dynamics, and the COVID-19 pandemic, have added levels of complexity. These developments highlight the need for a more advanced and sector-specific analysis of the impact of exchange rate fluctuations on Turkish exports.

1.2 The importance of exchange rates for export competitiveness

Exchange rates have a significant role in determining a country's export competitiveness. They directly affect the pricing of goods in global markets and have a significant impact on the demand for exports and the profitability of exporters. A depreciation of the home currency usually increases export competitiveness by making goods cheaper for international customers. In contrast, an appreciation can reduce competitiveness by increasing prices in foreign markets. So, currency depreciation generally advantages exporters in labor-intensive industries, such as textiles and apparel, by increasing price competitiveness in international markets. In contrast, industries that rely on imported intermediate goods, such as machinery and chemicals, face higher production costs, reducing the potential advantages of a weaker Turkish lira.

In practice, the effects of exchange rate fluctuations reach beyond pricing dynamics. It has impacts on long-term business planning, investment decisions, and market expansion strategies. For Turkish exporters running in highly competitive global markets, managing currency risks is crucial to sustaining growth and profitability. Given the complexities, policymakers and businesses must understand how exchange rate fluctuations affect different industries and trade relationships.

1.3 Significance of the study and the research gaps

The relationship between exchange rate volatility and export performance is a complex and progressing challenge, especially for an open economy like Turkey's. While economic theory suggests that exchange rate fluctuations should have a direct impact on trade flows, the reality is influenced by various factors, including industry-specific characteristics, external market circumstances, and macroeconomic policy.

This intricacy makes analyzing exchange rate effects on exports both challenging and necessary.

Turkey's export performance is determined by specific structural factors. Key industries rely significantly on imported intermediate goods, resulting in a dual impact when exchange rates fluctuate. The frequent volatility of the Turkish lira, particularly against major currencies like the US Dollar (USD) and Euro (EUR), creates both opportunities and challenges for exporters. For example, a depreciation of the Turkish lira may increase price competitiveness in international markets, it simultaneously increases the cost of imported inputs, decreasing potential gains. Another aspect of this problem is the asymmetric nature of exchange rate impacts. Currency depreciation and appreciation usually result in unequal and sector-specific effects. For instance, Turkish exports to developed markets like Germany or the United States may react differently to exchange rate fluctuations than exports to less diversified markets like Iraq. Turkey's export relationships with key trade partners, including Germany, the United States, and Iraq, exhibit diverse responses to currency movements. However, existing research often aggregates data, overlooking the sector-specific and partner-specific dynamics that drive these effects. Additionally, limited attention is given to the asymmetric impacts of exchange rate changes or the moderating role of external factors such as global demand and geopolitical risks.

Existing macroeconomic research often overlooks the heterogeneity in how exchange rate fluctuations impact different sectors, treating exports as a uniform entity. However, industries such as automotive, textiles, machinery, and agriculture are uniquely influenced by factors like import dependency, labor intensity, and market competition. By adopting a sector-specific approach, this study provides a

granular understanding of these dynamics, shedding light on the nuanced ways in which exchange rate volatility affects Turkey's export performance.

1.4 Defining research objectives

This study investigates the complex relationship between exchange rate fluctuations and the export performance of Turkey, focusing on four primary dimensions. First, it examines how fluctuations in the Turkish lira relative to major currencies like the US Dollar (USD), Great Britain Pound (GBP), and Euro (EUR) affect export volumes across various industries. To address this, the study tests the following hypothesis:

- $H_{1,0}$: Fluctuations in the Turkish lira relative to the US Dollar (USD), Great Britain Pound (GBP), and Euro (EUR) do not differentially affect the volume of exports across different industries.
- $H_{1,1}$: Fluctuations in the Turkish lira relative to the US Dollar (USD), Great Britain Pound (GBP) and Euro (EUR) significantly and differentially affect the volume of exports across different industries.

Second, the study explores the short-term effects of exchange rate fluctuations on Turkey's export volumes. By analyzing trade with its nine major partners across six key product categories, the research aims to uncover temporal patterns and structural factors that influence export performance during periods of currency volatility.

- $H_{2,0}$: Exchange rate fluctuations do not have short-term effects on Turkey's export volumes to its major trade partners across key product categories.
- $H_{2,1}$: Exchange rate fluctuations have significant short-term effects on Turkey's export volumes to its major trade partners across key product categories.

Third, the aim is to identify asymmetric effects and sectoral vulnerabilities that inform strategies for mitigating risks and leveraging opportunities associated with currency movements.

- H_{3,0}: Exchange rate volatility does not significantly influence Turkey's export performance across different product categories and trade partners.
- H_{3,1}: Exchange rate volatility does significantly influence Turkey's export performance across different product categories and trade partners.

Finally, the study evaluates the role of external factors, such as global economic conditions and government policies, in moderating the relationship between exchange rate volatility and export performance. Factors like global demand shifts, geopolitical dynamics, and trade agreements are considered to understand their amplifying or mitigating effects on Turkey's trade outcomes.

- H_{4,0}: External factors, such as global economic conditions and government policies, do not impact the effect of exchange rate volatility on Turkish exports.
- H_{4,1}: External factors, such as global economic conditions and government policies, significantly impact the effect of exchange rate volatility on Turkish exports.

CHAPTER 2

LITERATURE REVIEW

Exchange rate fluctuations and their volatility play a crucial role in shaping economic outcomes in open economies like Turkey, influencing macroeconomic stability, trade competitiveness, and sectoral dynamics. The relationship between exchange rates and economic performance is complex and multifaceted, with effects that vary across industries, timeframes, and economic conditions. As an emerging market, Turkey's export-driven economy faces unique challenges, including reliance on imported inputs and sensitivity to global market dynamics. These factors amplify the impact of currency movements on trade flows, profitability, and overall growth. This literature review synthesizes existing research on the effects of exchange rate fluctuations, focusing on their implications for Turkey's economy. The review is organized into five sections, reflecting key dimensions of the subject: Theoretical Foundations and Macroeconomic Impacts, Exchange Rate Volatility and Trade Flows, Sectoral and Currency-Specific Effects, Methodological Insights, and Contextual Studies on Turkey. By integrating insights from global and Turkey-specific studies, this review provides a comprehensive understanding of the mechanisms through which exchange rate dynamics influence economic performance.

2.1 Theoretical foundations and macroeconomic impacts

Understanding the theoretical underpinnings of exchange rate fluctuations is critical for analyzing their macroeconomic implications. This section explores key studies on

the relationship between exchange rate volatility and economic growth, considering different economic theories and empirical findings.

Karahan (2020) examines how exchange rate fluctuations impact Turkey's economic growth from 2002 to 2019, contrasting the traditional and structuralist views. While the traditional view suggests currency depreciation boosts growth by increasing net exports, the structuralist view warns of rising production costs due to import dependency. Using Johansen Cointegration, Granger Causality, and Innovation Accounting techniques, the study finds a negative causal relationship between exchange rate volatility and growth. This underscores the need for policymakers to stabilize both exchange rates and inflation to ensure long-term economic growth.

Yilmazkuday (2024) extends this perspective globally, analyzing 62 countries. It finds that exchange rate volatility disproportionately harms developing economies, reducing growth by 0.4% over three years. In contrast, advanced economies remain resilient. The study emphasizes the role of fiscal discipline, inflation control, and structural reforms in mitigating adverse effects in emerging markets.

Audi (2024) explores the dynamics in Lebanon from 1980 to 2023, revealing a dichotomy between short- and long-term impacts. While volatility initially hampers growth due to uncertainty, a long-term positive adjustment emerges. Factors like industrial and agricultural contributions significantly influence growth, highlighting the importance of macroeconomic stabilization policies.

Morina et al. (2020) focus on Central and Eastern Europe (CEE) from 2002 to 2018, showing that exchange rate volatility negatively affects growth through reduced trade competitiveness and macroeconomic stability. Countries with open

economies and stable policies are less vulnerable, reinforcing the importance of maintaining stable exchange rates to foster development.

2.2 Exchange rate volatility and trade flows

exchange rate volatility has a direct impact on trade flows, as currency fluctuations affect the price competitiveness of exports and imports. This section examines studies that analyze how exchange rate movements impact trade volumes, trade balances, and industry-level trade dynamics.

Bahmani-Oskooee and Durmaz (2016) analyzed 61 Turkish industries from 1990 to 2012, finding that short-term exchange rate volatility significantly affects imports in 39 industries and exports in 23. Industries relying on imported inputs, like chemicals and machinery, face persistent long-term effects. The authors advocate for exchange rate stabilization to protect trade flows.

Kasman and Kasman (2005) highlight a paradoxical effect: long-term exchange rate volatility positively affects Turkey's export volumes, as firms seek external markets to offset domestic constraints. However, short-term volatility disrupts trade flows, emphasizing the need for stable exchange rate regimes.

Bahmani-Oskooee and Halicioğlu (2017) explore Turkey's bilateral trade balances with 11 major partners. They find that real depreciation of the Turkish lira positively impacts trade balances, particularly with European countries, while appreciation has no significant effect. The study also identifies a J-curve pattern, where depreciation initially worsens trade balances before long-term improvement.

Rahman et al. (2020) investigate Bangladesh's trade, revealing that volatility negatively affects exports and imports by introducing uncertainty. GARCH models

confirm these impacts, stressing the importance of macroeconomic stability to mitigate risks.

2.3 Sectoral and currency-specific effects

Fluctuations vary across industries, depending on their reliance on imported inputs, pricing strategies, and global market exposure. This section discusses sector-specific effects and the role of currency regimes in shaping trade competitiveness.

Thorbecke and Sengonul (2023) examine Turkish imports and exports from 1998 to 2021. They find that currency appreciation boosts trade across sectors, while depreciation has limited effects due to reliance on imported inputs. The study highlights the dominance of USD and EUR pricing in Turkish trade, emphasizing the need for exchange rate stabilization over competitive depreciation strategies.

Dincer and Kandil (2011) analyze 21 Turkish export sectors from 1996 to 2008, showing that anticipated appreciation reduces export growth due to price competitiveness loss. Conversely, unexpected fluctuations yield mixed outcomes, shifting from positive pre-2002 to negative post-2002 due to rising import dependency.

Akdoğan et al. (2023) investigate how labor-intensive firms respond to exchange rate changes. Firms in this category benefit more from currency depreciation due to their lower reliance on imported inputs and greater flexibility in workforce expansion, enhancing export volumes and market diversity.

Gül (2021) explores the substitutability between domestic sales and exports in Turkish manufacturing firms. During periods of low domestic demand, firms shift to export markets to offset losses, illustrating counter-cyclical trade behavior influenced by firm-specific characteristics.

Dinçer et al. (2019) highlight the contrasting impacts of exchange rate volatility on manufacturing and service firms. Service firms benefit from currency depreciation, while manufacturing firms face higher costs due to imported inputs, emphasizing the need for sector-specific strategies.

Bahmani-Oskooee and Mohammadian (2016) focus on Australia, revealing the asymmetric impacts of exchange rate changes. Depreciation has limited long-term effects, while appreciation significantly reduces GDP, underscoring the importance of accounting for nonlinearities in exchange rate analysis.

2.4 Methodological insights

The choice of methodology significantly influences the interpretation of exchange rate effects on trade and economic performance. This section highlights various econometric approaches, including ARDL models, GARCH models, and gravity models used in empirical research on exchange rate volatility.

Tarasenko (2021) benchmarks the methodological rigor of this review. Using a gravity model and instrumental variables, it evaluates Russia's trade across eight sectors. Findings reveal sector-specific sensitivities to volatility, with manufactured goods suffering reduced competitiveness and fuel imports increasing despite volatility. Financial development and price elasticity emerge as key moderators.

Turna and Özcan (2021) employ ARDL models to study exchange rates, interest rates, and inflation in Turkey. Findings reveal that exchange rate volatility significantly affects inflation, particularly in sectors like energy. The study underscores the importance of foreign reserves and export incentives in mitigating inflationary pressures.

Ozata (2020) calculates volatility using GARCH models, demonstrating that exchange rate fluctuations increase production costs and reduce investment in Turkey. The study calls for strengthened financial systems and reduced reliance on imported inputs to stabilize growth.

2.5 Contextual studies on Turkey

Turkey's unique economic structure and trade composition necessitate country-specific studies to understand how exchange rate fluctuations influence exports and macroeconomic stability. This section reviews research that directly examines Turkey's exchange rate policies, trade balances, and structural vulnerabilities.

Özen et al. (2020) analyze exchange rates, interest rates, and inflation using FMOLS and Granger causality tests. They find that Turkey's reliance on imported production inputs exacerbates the inflationary effects of exchange rate volatility, emphasizing the need for stabilization policies.

Yilmaz and Sensoy (2022) challenge the export-led growth hypothesis in Turkey, finding that economic growth reduces exports by redirecting resources to domestic demand. The study highlights the structural complexities of Turkey's trade dynamics.

Güncavdı and Kayam (2017) examine structural barriers in Turkish exports, showing that demand constraints in high-income markets and import dependency limit growth potential. Policy recommendations focus on reducing reliance on imported goods and improving product competitiveness.

Erduman et al. (2020) explore import content in Turkish production and exports, finding that high import dependency in sectors like motor vehicles

undermines benefits from currency depreciation. Policies should target reducing this dependency to enhance resilience to exchange rate fluctuations.

Kurt and Derekoy (2020) examine the profitability of Turkish manufacturing firms, finding that larger firms with higher foreign sales mitigate exchange rate risks through hedging strategies. The study underscores the role of firm-specific characteristics in managing volatility impacts.

Bahmani-Oskooee & Durmaz (2016) investigated the impact of exchange rate volatility on Turkish trade flows using monthly data from 61 different industries between 1990 and 2012. Their analysis reveals that industries reliant on imported inputs are more vulnerable to exchange rate fluctuations, reducing their competitiveness.

The reviewed literature highlights the multifaceted impacts of exchange rate fluctuations on economic growth, trade dynamics, and sectoral performance, particularly within Turkey's unique context. Theoretical foundations emphasize the dual nature of exchange rate changes, with implications ranging from growth stimulation to inflationary pressures. Empirical studies on trade flows and sectoral effects reveal the importance of disaggregated analyses to capture industry-specific sensitivities. Methodological insights demonstrate the value of advanced econometric techniques in unpacking these relationships, while contextual studies underscore the critical role of structural reforms and policy interventions in mitigating the adverse effects of exchange rate volatility.

Despite these contributions, significant gaps remain. Limited studies comprehensively analyze how Turkey's export performance varies across major trade partners and key product categories, leaving critical industry-specific dynamics underexplored. Additionally, while some works address bilateral trade balances, few

examine the role of external factors, such as global economic conditions or government policies, in moderating exchange rate impacts on exports. Furthermore, much of the literature relies on aggregate data, overlooking the heterogeneous effects across industries and product categories. Addressing these gaps through disaggregated analyses and incorporating contextual variables would provide actionable insights for improving Turkey's export resilience and policy effectiveness. Together, these findings and gaps provide a comprehensive framework for understanding and addressing the challenges posed by exchange rate fluctuations in Turkey and similar economies. By exploring these under-examined areas, future research can contribute to a more nuanced understanding of how exchange rate volatility interacts with trade dynamics, industry-specific outcomes, and external economic conditions.

CHAPTER 3

DATA

3.1 Sample

The sample design for this study has been carefully selected to align with the research objectives of analyzing the exchange rate fluctuations on export performance of Turkey. By focusing on nine major trade partners and six product categories between 2003-2023, this study ensures a comprehensive overview of Turkey's trade dynamics. These selections highlight the diverse significance of Turkey's export system, allowing an in-depth analysis of sectoral and partner-specific sensitivities to exchange rate changes.

A) Trade Partners: The selection of Germany, the United States, the United Kingdom, Italy, Iraq, France, Spain, Poland, and the Netherlands as Turkey's major trade partners based on their economic and strategic performance. Collectively, they account for almost 50 percent of Turkey's total export volume, highlighting their importance in shaping Turkey's trade system. Moreover, they also play a crucial role in the country's Imports. The sample balances advanced economies like the US, UK, and Germany with emerging markets like Iraq, resulting in a broad range of trade relationships for analysis. These countries also represent a diverse range of geopolitical ties, economic partnerships, and market sizes, allowing for a more nuanced investigation of how exchange rate fluctuations impact trade. Additionally, their inclusion ensures the availability and consistency of reliable trade data throughout the study period, supporting robust statistical analysis.

B) Product Categories: The six product categories were selected to reflect the breadth and diversity of Turkey's export system. These product categories represent

industries with distinct characteristics and responses to exchange rate fluctuations:

Category 1 - Automotive and Parts(HS Codes 87): Includes motor vehicles, passenger cars, trucks, buses, motorcycles, automotive engines, and various vehicle parts and accessories. The automotive sector is heavily reliant on imported intermediate goods and foreign direct investment, making it sensitive to exchange rate fluctuations. Category 2 - Textiles and Apparel(HS Codes 50-64): Encompasses natural and synthetic fibers, yarns, fabrics, clothing items, knitted and woven garments, footwear, and related textile accessories. The textile sector is characterized by labor-intensive production processes and strong global price competition, affecting its responsiveness to currency changes. Category 3 - Machinery and Equipment(HS Codes 84): Covers industrial machinery, mechanical appliances, engines, pumps, turbines, heating and cooling systems, and various specialized mechanical tools and equipment. This sector is capital-intensive, often with substantial imported technology components, creating significant exposure to exchange rate volatility. Category 4 - Chemicals and Plastics(HS Codes 28-40): Consists of inorganic and organic chemicals, pharmaceuticals, fertilizers, plastics, polymers, rubber products, and related chemical substances. This industry is impacted by fluctuations in both input costs and global pricing, with many inputs tied closely to international markets. Category 5 - Food and Agricultural Products (HS Codes 01-24): Includes live animals, meat and dairy products, seafood, cereals, fruits and vegetables, beverages, processed food items, tobacco products, and other agricultural commodities. Agricultural trade typically depends heavily on seasonal and supply-chain conditions and is often less flexible in responding to currency fluctuations due to product perishability and fixed production cycles. Category 6 - Electronics and Electrical Equipment(HS Codes 85): Comprises electrical

machinery, electronic equipment, consumer electronics, telecommunications devices, semiconductors, household appliances, and related electrical apparatus. Electronics production involves considerable global supply-chain integration, with significant reliance on imported components and global technology markets, amplifying the sensitivity to exchange rate movements.

These groups were also chosen because of their varied reliance on imported goods, labor intensity, capital intensity, and market competition, making them ideal for examining the heterogeneity of exchange rate impacts. Collectively, these six categories account for nearly 50% of Turkey's total exports, highlighting their significance as key drivers of trade and economic performance.

C) Time Period: The period 2003-2023 was chosen for both practical and analytical reasons. One of the key reasons for commencing in 2003 is availability and reliability of trade data for some designated trading partners, including Iraq. Before 2003, reliable and complete export data for Iraq were mostly unavailable due to political instabilities and conflicts in the region. The analysis strength relies heavily on ensuring data completeness and accuracy. This period also provides a comprehensive view of examining the impact of major global and domestic financial events on Turkey's export performance. It covers key economic crisis, including: The Global Financial Crisis (2008–2009), The European Sovereign Debt Crisis (2010–2012), The Turkish Currency Crisis (2018), The COVID-19 Pandemic (2020–2021). By recording these events, the research period reflects a wide range of economic conditions, from periods of growth and stability to crises and recovery. Thus, the period 2003-2023 provides both the breadth and depth needed to properly address the research topics, ensuring that the analysis takes into account structural

developments in the economy, the influence of global and internal crises, and the evolution of Turkey's export policies.



Table 1. Trade Partners Share from Turkey's Trade 2003-2012

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Germany's total Imp	13.63	12.83	11.67	10.58	10.31	9.25	10.00	9.46	9.54	9.05
Germany's total Exp	15.84	13.84	12.87	11.32	11.18	9.81	9.59	10.08	10.34	8.61
I+E	14.53	13.23	12.14	10.86	10.65	9.47	9.83	9.69	9.83	8.88
U.S.A's total Imp	5.04	4.87	4.60	4.49	4.80	5.93	6.09	6.64	6.66	5.97
U.S.A's total Exp	7.94	7.69	6.68	5.92	3.89	3.27	3.18	3.31	3.40	3.68
I+E	6.22	5.98	5.41	5.03	4.45	4.88	4.87	5.37	5.49	5.07
U.K's total Imp	5.05	4.43	4.02	3.68	3.22	2.60	2.46	2.52	2.42	2.38
U.K's total Exp	7.77	8.78	8.05	7.97	8.04	6.18	5.81	6.35	6.04	5.70
I+E	6.15	6.14	5.58	5.31	5.09	4.02	3.87	3.98	3.72	3.68
Italy's total Imp	7.89	7.03	6.48	6.20	5.73	5.29	5.39	5.47	5.59	5.64
Italy's total Exp	6.76	7.36	7.65	7.90	6.97	5.92	5.77	5.71	5.82	4.18
I+E	7.43	7.16	6.93	6.84	6.21	5.54	5.55	5.56	5.67	5.07
Iraq's total Imp	0.06	0.15	0.06	0.09	0.07	0.07	0.09	0.08	0.04	0.06
Iraq's total Exp	1.75	2.88	3.74	3.03	2.65	2.97	5.02	5.30	6.16	7.10
I+E	0.75	1.22	1.48	1.20	1.07	1.21	2.16	2.07	2.23	2.82
France's total Imp	6.01	6.36	5.04	5.19	4.62	4.47	5.03	4.41	3.83	3.63
France's total Exp	5.98	5.81	5.18	5.38	5.57	5.01	6.08	5.32	5.04	4.07
I+E	6.00	6.14	5.10	5.26	4.98	4.68	5.47	4.75	4.27	3.80
Netherlands's total Imp	2.39	1.96	1.84	1.55	1.56	1.51	1.80	1.70	1.66	1.55
Netherlands's total Exp	3.23	3.38	3.36	2.97	2.81	2.38	2.08	2.16	2.40	2.13
I+E	2.73	2.52	2.43	2.09	2.05	1.86	1.92	1.88	1.93	1.78
Spain's total Imp	2.89	3.34	3.04	2.75	2.55	2.25	2.68	2.61	2.57	2.55
Spain's total Exp	3.79	4.15	4.10	4.35	4.27	3.07	2.76	3.11	2.90	2.44
I+E	3.25	3.65	3.45	3.35	3.22	2.57	2.71	2.80	2.69	2.50
Poland's total Imp	0.60	1.02	1.07	1.03	0.97	0.98	1.29	1.41	1.45	1.29
Poland's total Exp	1.03	1.10	1.13	1.24	1.34	1.20	1.29	1.32	1.30	1.22
I+E	0.35	1.05	1.09	1.11	1.11	1.07	1.29	1.38	1.40	1.26
TOTAL IMP SUM	43.56	41.97	37.83	35.54	33.84	32.35	34.83	34.30	33.77	32.12
TOTAL EXP SUM	54.09	55.00	52.76	50.07	46.73	39.81	41.58	42.66	43.42	39.11
IMP + EXP SUM	47.40	47.09	43.60	41.06	38.83	35.30	37.67	37.48	37.24	34.86

Table 2. Trade Partners Share from Turkey's Trade 2013-2023

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Germany's total Imp	9,81	9,35	10,30	10,81	9,11	9,15	9,17	9,90	8,02	6,61	7,93
Germany's total Exp	9,19	9,77	9,33	9,82	9,63	9,61	9,19	9,42	8,58	8,32	8,25
I+E	9,57	9,52	9,90	10,40	9,32	9,35	9,18	9,69	8,27	7,31	8,06
U.S.A's total Imp	5,12	5,36	5,38	5,47	5,11	5,55	5,63	5,25	4,84	4,19	4,36
U.S.A's total Exp	4,12	4,16	4,45	4,65	5,51	4,95	4,96	6,00	6,53	6,64	5,80
I+E	4,74	4,88	5,00	5,13	5,27	5,29	5,32	5,58	5,61	5,20	4,96
U.K's total Imp	2,52	2,47	2,67	2,68	2,80	3,34	2,68	2,54	2,05	1,62	1,80
U.K's total Exp	5,65	6,14	7,34	8,20	6,12	6,61	6,24	6,62	6,94	6,94	6,94
I+E	3,72	3,93	4,59	4,99	4,13	4,75	4,32	4,32	3,88	3,06	3,08
Italy's total Imp	5,19	5,16	5,14	5,15	4,84	4,55	4,45	4,19	4,26	3,87	4,15
Italy's total Exp	4,63	4,50	4,79	5,32	5,40	5,69	5,39	4,76	5,09	4,86	4,84
I+E	4,97	4,89	4,99	5,22	5,06	5,04	4,88	4,44	4,64	4,28	4,43
Iraq's total Imp	0,06	0,11	0,14	0,42	0,65	0,64	1,27	3,74	0,61	0,39	0,41
Iraq's total Exp	8,02	7,90	5,94	5,36	5,77	4,97	5,65	5,39	4,94	5,41	4,99
I+E	3,10	3,22	2,52	2,48	2,71	2,50	3,30	4,46	2,58	2,46	2,31
France's total Imp	3,32	3,42	3,67	3,71	3,45	3,32	3,21	3,18	2,92	2,59	3,19
France's total Exp	4,12	4,12	4,07	4,23	4,20	4,34	4,40	4,25	4,05	3,76	4,03
I+E	3,62	3,70	3,83	3,93	3,75	3,76	3,76	3,65	3,44	3,07	3,54
Netherlands's total Imp	1,35	1,44	1,41	1,51	1,60	1,48	1,52	1,65	1,66	1,24	1,22
Netherlands's total Exp	2,34	2,19	2,19	2,52	2,46	2,84	3,19	3,06	3,00	3,16	3,08
I+E	1,73	1,74	1,73	1,93	1,95	2,06	2,29	2,27	2,27	2,03	1,99
Spain's total Imp	2,54	2,51	2,70	2,86	2,73	2,46	2,11	2,30	2,33	1,93	2,62
Spain's total Exp	2,82	2,99	3,30	3,50	4,01	4,59	4,50	3,94	4,27	3,80	3,83
I+E	2,65	2,70	2,94	3,13	3,24	3,38	3,22	3,01	3,21	2,70	3,12
Poland's total Imp	1,30	1,30	1,44	1,63	1,47	1,39	1,24	1,37	1,34	1,18	1,40
Poland's total Exp	1,32	1,49	1,62	1,86	1,96	1,99	1,91	2,05	2,07	2,16	2,33
I+E	1,31	1,37	1,51	1,73	1,67	1,65	1,55	1,67	1,67	1,58	1,79
TOTAL IMP SUM	31,21	31,11	32,84	34,24	31,77	31,89	31,28	34,12	28,03	23,62	27,09
TOTAL EXP SUM	42,21	43,26	43,02	45,45	45,05	45,60	45,43	45,49	45,49	45,05	44,10
IMP + EXP SUM	35,42	35,95	37,01	38,93	37,11	37,77	37,82	39,08	35,56	31,68	33,28

(all data in percent)

3.2 Variables

The variables used in this study are carefully chosen to align with the research aims.

Dependent Variable: The export volumes from Turkey to the nine selected trade partners across six product categories. Export volumes are measured in USD, aggregated annually for each country and product category. Data is obtained from official Turkish trade statistics and international trade databases, ensuring accuracy and reliability.

Main Explanatory Variable: The main explanatory variable is the exchange rate volatility (*ERvol*). *ERvol* was calculated employing the following formula using daily bilateral exchange rate (TRY/USD, TRY/EUR, TRY/GBP). Exchange rate data is sourced from the Central Bank of Turkey and international financial institutions.

$$ERvol_{it} = std.dev. [\ln(ER_{it}) - \ln(ER_{i(t-1)})]$$

Where *ER_{it}* indicates the daily exchange rate, currency *i*, at time *t*, where *t* denotes days. The standard deviation is then calculated over a one-year period.

(Dell’Araccia, 1999; Rose, 2000; Tenreyro, 2003; Nicita, 2013)

Control Variables:

GDP of trade partner: The current GDP of each of the nine trade partners was used to ensure consistency with other economic indicators and to reflect real-time economic conditions. GDP serves as a measure of the economic capability and import demand potential of trade partners. Data was obtained from the World Bank and cross-verified with the IMF.

GDP of Turkey: Added to control for the overall domestic economic performance, providing a measure of the country’s export supply capacity. The

current GDP was used in the calculations to ensure consistency with other economic indicators and to reflect real-time economic conditions. Data was obtained from the World Bank and cross-verified with the IMF.

Turkey's Inflation rate: Annual Consumer Price Index (CPI) change in Turkey. Inflation impacts production costs and competitiveness, influencing export dynamics. Data obtained from Statista.

Real Effective Exchange Rate (REER): A trade-weighted index that adjusts the nominal exchange rate to reflect relative pricing levels between Turkey and its trading partners. Adds a broad measure of Turkey's overall price competitiveness. Data was obtained from the Central Bank of Turkey.

Average FX rate: The average annual bilateral exchange rates (TRY/USD, TRY/EUR, TRY/GBP) are included as control variables to capture the general trends in exchange rate levels, complementing the volatility measure. These rates provide additional insights into the baseline effects of exchange rate changes on trade. Data was obtained from the Central Bank of Turkey. Indicator (dummy) Variables:

- GFC - The Global Financial Crisis (2008–2009): Dummy = 1 for crisis years, 0 for non-crisis year
- EDC - The European Sovereign Debt Crisis (2010–2012): Dummy = 1 for crisis years, 0 for non-crisis year
- TLC - The Turkish Currency Crisis (2018): Dummy = 1 for crisis years, 0 for non-crisis year
- COVID-19 Pandemic (2020–2021): Dummy = 1 for pandemic years, 0 for non-pandemic years

Trade Agreements: FTAs are an important part of Turkey's trade relationships, allowing for tariff reductions, improved market access, and more

efficient trade procedures. Turkey has established free trade agreements (FTA) with some of its major partners.

1. European Union (Germany, Italy, France, Netherlands, Poland, Spain):

Turkey has been part of a Customs Union with the EU since 1996. This agreement eliminates tariffs on industrial commodities and processed agricultural products, thereby improving the integration with EU countries.

2. United Kingdom: Following Brexit, Turkey and the UK agreed on an FTA in December 2020 to provide trade continuity and build on the previous EU Customs Union Framework. This agreement ensures tariff-free trade for most industrial goods, preserving the stability of Turkey-UK trade relations.

However, there are no FTAs between Turkey and the other trade partners examined in this study. Furthermore, given the limited number of FTAs established during the 2003–2023 study period and the absence of new agreements that significantly alter trade dynamics with these partners, FTAs are not included as a variable in this analysis. For agreements established before 2003, such as the EU Customs Union, their effects are assumed to have already been incorporated into the baseline trade relationships and do not directly impact the results within this timeframe.

Table 3. Summary Statistics Table

Variable	Obs	Mean	Std. Dev.	Min	Max
Total Import	189	7404.888	5895.793	41.656	28683.48
Total Export	189	7117.4	4199.254	486.046	21144.91
Category 1 Exp	189	1223.029	975.1057	5.64	4110.556
Category 2 Exp	189	1632.774	1102.466	57.592	4833.958
Category 3 Exp	189	650.4967	591.9071	35.993	3215.965
Category 4 Exp	189	514.0365	372.1433	39.898	1752.974
Category 5 Exp	189	786.7227	862.9143	37.057	5258.733
Category 6 Exp	189	468.0519	364.4392	24.461	1601.863
ERvol	189	0.0089408	0.0044955	0.0038513	0.025067
GDP TR	189	760928.2	186445.9	314595.6	1118253.0
GDP partner	189	3513369.0	5355549.0	21921.57	27400000.0
Inflation TR	189	15.88571	16.27735	6.25	72.31
REER TR	189	94.14476	22.94102	47.61	127.71
Avg FX Rate	189	5.144838	5.968226	1.292908	29.51198
GFC	189	0.0952381	0.2943232	0.0	1.0
EDC	189	0.1111111	0.3151044	0.0	1.0
TLC	189	0.047619	0.2135245	0.0	1.0
Covid-19	189	0.0952381	0.2943232	0.0	1.0

CHAPTER 4

METHODOLOGY

This study employs a multi-step approach to analyze the impact of exchange rate fluctuations on Turkey's export performance. While initial exploratory analyses provided insights into basic trends and relationships, they were insufficient to fully capture the complexities of the subject. To ensure robust findings, an Ordinary Least Squares (OLS) regression model was implemented as the primary analytical tool.

A) Descriptive Analysis: The first step of the analysis involved descriptive statistics and graphical exploration of key variables to understand trends and patterns. Several visualizations were constructed, including:

- Time series plots of exchange rate volatility (ERvol) and foreign exchange (FX) rates.
- Time series plots of total imports, total exports, and exports for each of the six product categories.
- Scatter plots examining the relationships between total imports, total exports, and exports in the six product categories across the nine trade partners.

While these graphical analyses provided an initial understanding of trade and exchange rate trends, they were insufficient for drawing definitive conclusions on causal relationships.

B) Pearson Correlation Analysis: To further explore the relationships between key variables, Pearson correlation coefficients were calculated. This statistical measure quantifies the strength and direction of a linear relationship between two continuous variables, ranging from -1 to 1. A positive coefficient indicates a direct relationship (both variables increase together), while a negative coefficient suggests

an inverse relationship (one variable increases while the other decreases). A value close to 0 implies little to no correlation. The Pearson correlation coefficient (r) is computed using the following formula:

$$r = \frac{\sum (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum (X_i - \bar{X})^2} \sqrt{\sum (Y_i - \bar{Y})^2}}$$

Where:

- X_i and Y_i are individual sample points,
- $\bar{X}$ ($\bar{X}$ bar) and $\bar{Y}$ ($\bar{Y}$ bar) are the mean values of X and Y .

In this study, Pearson correlation analysis was applied to examine the linear relationships between exchange rate fluctuations and export performance across different product categories and trade partners. While this approach helped identify associations, it does not account for confounding factors or imply causation.

Therefore, a more advanced econometric approach was required.

C) Ordinary Least Squares (OLS) Regression Model: Given the limitations of descriptive and correlation analyses, the Ordinary Least Squares (OLS) regression model was employed as the main analytical framework. OLS is a widely used econometric method that estimates the relationship between a dependent variable and one or more independent variables by minimizing the sum of squared residuals. The general form of an OLS regression model is given by:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_n X_{ni} + \varepsilon_i$$

Where:

- Y_i is the dependent variable (export volume),
- $X_{1i}, X_{2i}, \dots, X_{ni}$ are independent variables (exchange rate fluctuations, GDP, REER, etc.),
- β_0 is the intercept,
- $\beta_1, \beta_2, \dots, \beta_n$ are coefficients estimating the impact of each independent variable,
- ε_i is the error term.

In this study, OLS regression was used to quantify the impact of exchange rate fluctuations on Turkey's export performance while controlling for additional economic factors such as GDP (both domestic and trade partner), Turkey's Real Effective Exchange Rate (REER), and interest rates. The model allows for a more precise estimation of how exchange rate volatility influences trade, accounting for potential confounding variables.

By employing this structured methodology, the study moves beyond simple associations and provides a more rigorous econometric evaluation of exchange rate impacts on Turkish exports.

CHAPTER 5

RESULTS

5.1 Time series

5.1.1 Time series ERvol – FX rates

This section presents the time series trends of Exchange Rate Volatility (ERvol) and Average FX Rates across three major currencies: USD (TRY/USD), Euro (TRY/EUR), and British Pound (TRY/GBP), over the period 2003–2023. These charts highlight the relationship between volatility and currency value fluctuations, identifying key trends, spikes, and stabilization phases.

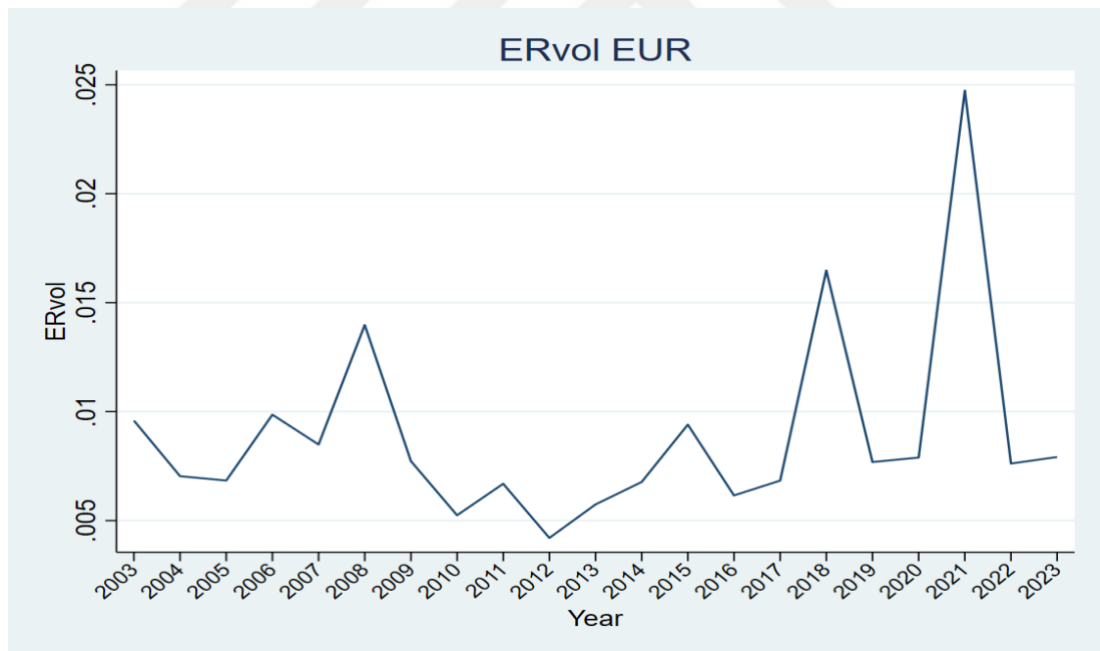


Figure 1. ERvol (EUR) by year

Figure 1 presents the time series trends of ERvol and TRY/EUR exchange rates between 2003 and 2023. The analysis highlights volatility spikes during major

financial crises and periods of domestic uncertainty. Volatility Trends: Noticeable peaks in ERvol align with the Global Financial Crisis (2008–2009), the Turkish Currency Crisis (2018), and the COVID-19 Pandemic (2020–2021). The TRY/EUR rate shows a consistent upward trajectory, reflecting ongoing depreciation trends. ERvol reacts sharply to periods of global economic instability.

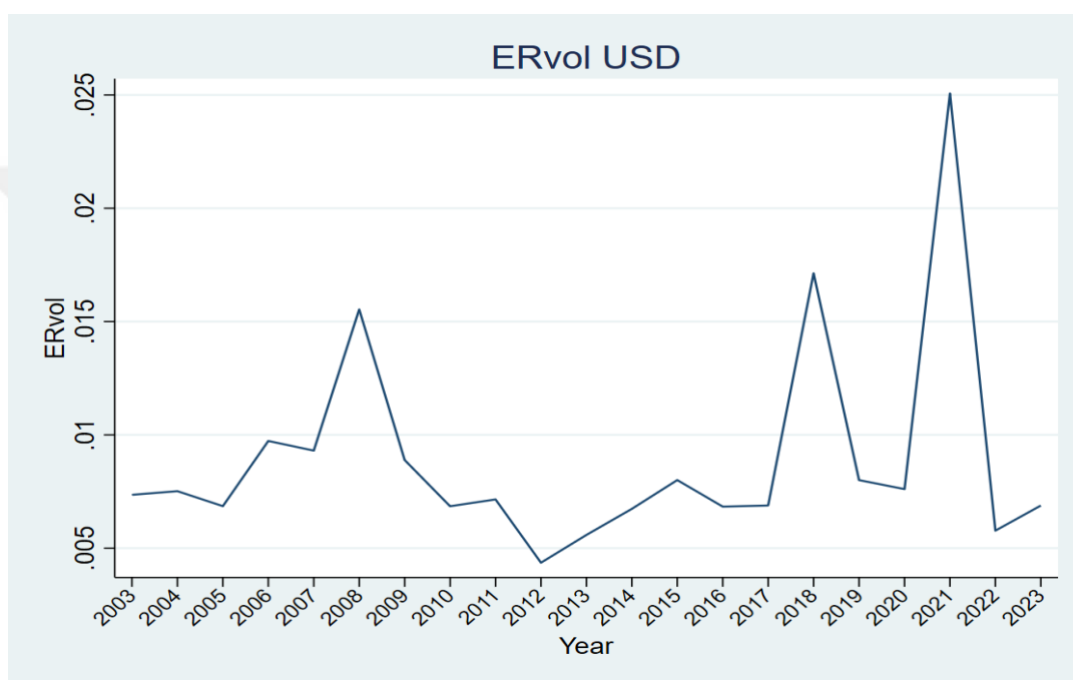


Figure 2. ERvol (USD) by year

Figure 2 displays the time series trends of ERvol and TRY/USD exchange rates from 2003 to 2023. The chart illustrates periods of sharp increases in volatility, coinciding with significant macroeconomic and geopolitical events. Volatility Peaks: Significant spikes in ERvol are observed during the same crises. The TRY/USD exchange rate exhibits a steady upward trend, reflecting the persistent depreciation of the Turkish lira. Increased volatility often follows sharp changes in FX rates, indicating potential lagged effects. The TRY/USD exchange rate demonstrates a

consistent long-term depreciation pattern, with ERvol reacting sharply during global and domestic economic disruptions.

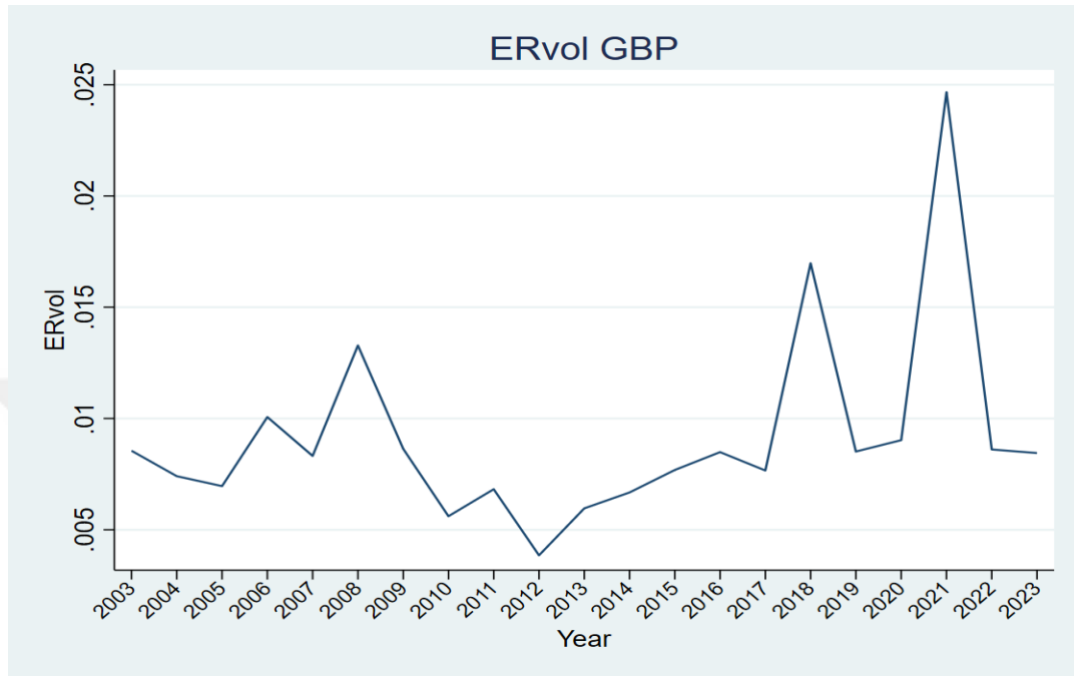


Figure 3. ERvol (GBP) by year

Figure 3 illustrates the time series trends of ERvol and TRY/GBP exchange rates from 2003 to 2023. The analysis captures key volatility spikes and gradual depreciation patterns in the exchange rate. Volatility Peaks: ERvol shows distinct peaks during the same crises. The TRY/GBP exchange rate follows an upward trajectory, with occasional periods of stabilization. Like TRY/USD and TRY/EUR, ERvol shows delayed reactions to significant currency shifts.

All three currency pairs (TRY/USD, TRY/EUR, TRY/GBP) exhibit long-term upward trends, indicating persistent lira depreciation. Volatility spikes align closely with significant macroeconomic and geopolitical crises. ERvol often reacts

with a delay to sharp changes in FX rates, indicating complex market adjustment mechanisms.

5.1.2 Time series total import

This section examines the import volume trends from Turkey's nine major trade partners (Germany, United States, United Kingdom, Italy, Iraq, France, Netherlands, Spain, and Poland) over the period 2003–2023. The analysis focuses on identifying key patterns, disruptions, and trends in import activities, highlighting the impact of significant global and domestic economic events.

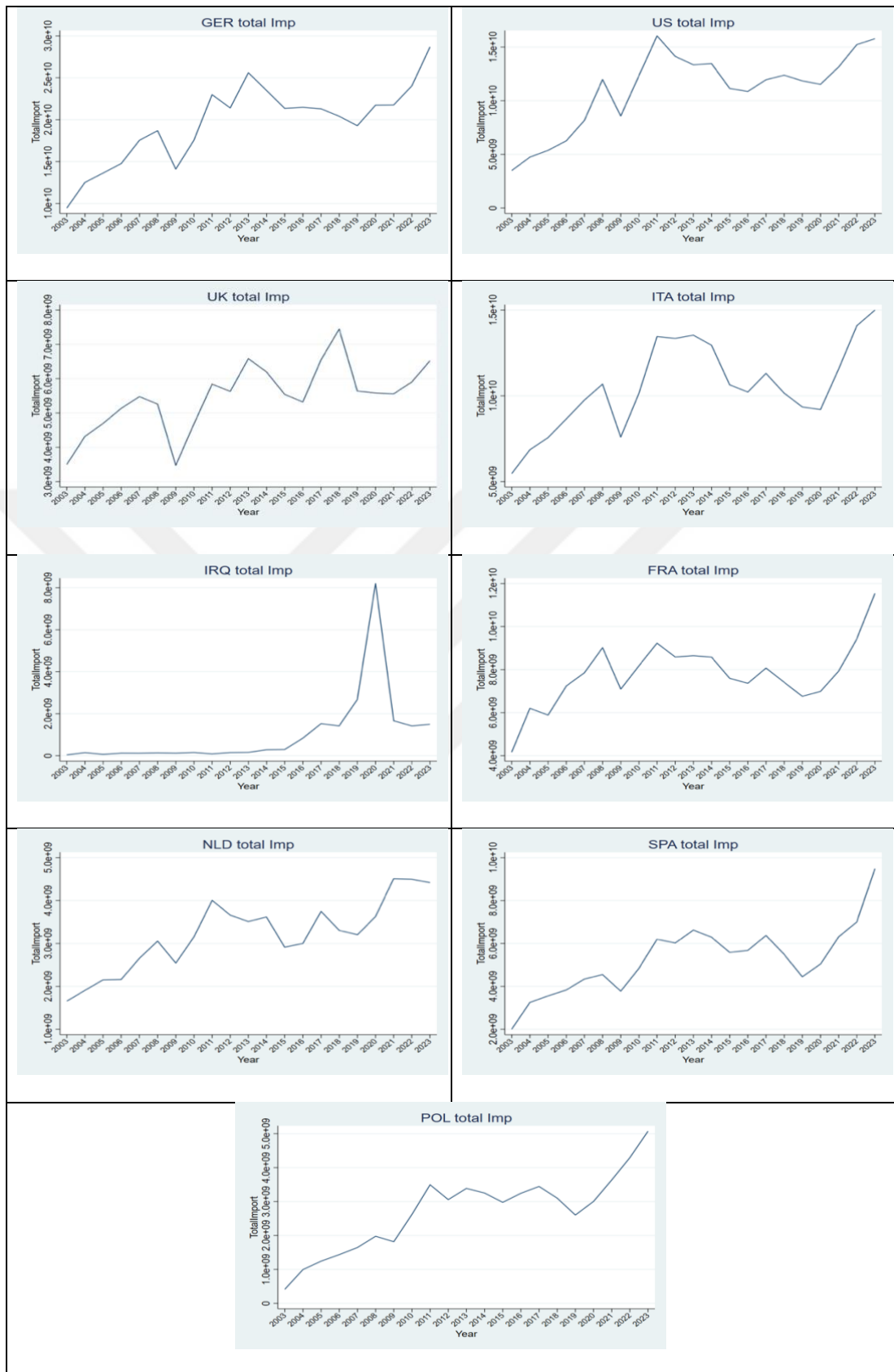


Figure 4. Total import volume by year

Most trading partners show a gradual increase in import volumes over the two decades, reflecting growing trade ties and economic integration. Noticeable dips in import volumes align with significant events, mentioned earlier. Some partners (e.g., Germany and USA) demonstrate faster recoveries post-crisis, while others (e.g., Iraq) show prolonged stagnation. The overall trend highlights Turkey's increasing reliance on imports from its key partners, despite periodic disruptions caused by exchange rate volatility, economic crises, and geopolitical factors. These patterns suggest a structural dependence on external markets for raw materials, intermediate goods, and industrial supplies.

5.1.3 Time series total export

This section examines the export volume trends from Turkey to its nine major trade partners (Germany, United States, United Kingdom, Italy, Iraq, France, Netherlands, Spain, and Poland) over the period 2003–2023. The analysis highlights key patterns, disruptions, and trends in export activities, focusing on the impact of global economic crises, domestic economic challenges, and geopolitical factors on Turkey's export performance.

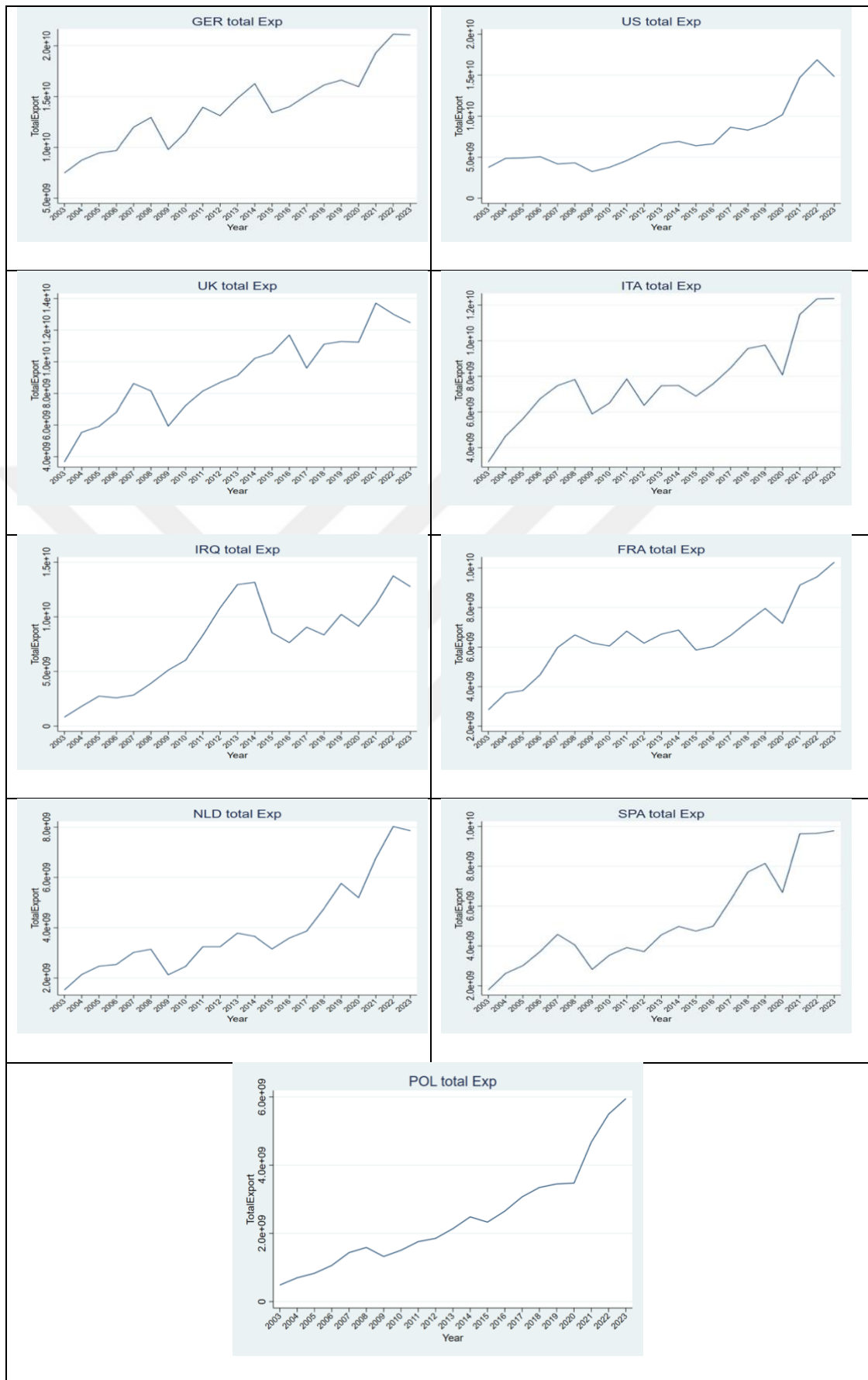


Figure 5. Total export volume by year

Most trading partners exhibit a gradual increase in export volumes over the two decades, reflecting Turkey's expanding global trade integration and sectoral diversification. While some partners (e.g., Germany, United States, and United Kingdom) show resilient and rapid recoveries after periods of crisis, others (e.g., Iraq and Italy) display slower rebounds and prolonged disruptions.

5.1.4 Time series category 1

This section examines the export volume trends of Turkey's Automotive and Parts sector over the period 2003–2023. The analysis focuses on identifying key patterns and notable fluctuations in automotive exports, emphasizing the impact of major economic crises and exchange rate volatility, as well as the recovery trajectories and structural factors influencing this sector's export performance.

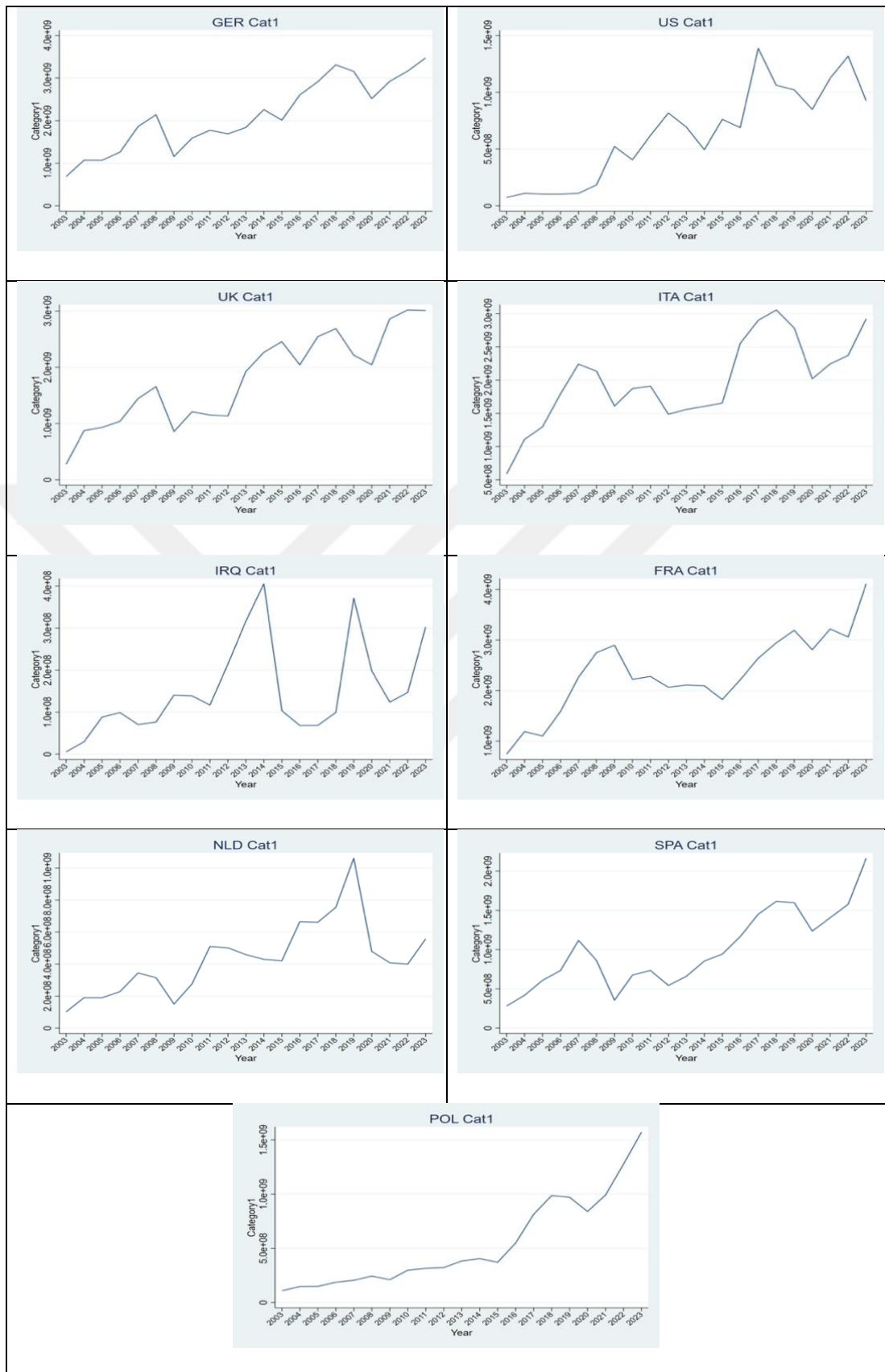


Figure 6. Category 1 export volume by year

Exports of automotive products generally show a strong upward trend from 2003 to 2023, reflecting the expansion of Turkey's automotive industry and deepening integration into global supply chains. Noticeable declines in export volume occurred during periods of global economic stress: the 2008–2009 Global Financial Crisis led to a sharp drop in automotive exports as international demand for vehicles plummeted, though a robust rebound followed in 2010–2011 as global markets recovered. A mild slowdown was also observable in the early 2010s, coinciding with the European debt crisis, which tempered demand in key European markets for a short period. By the mid-2010s, automotive exports resumed growth, reaching new highs, but the sector faced another disruption around the 2018 Turkish Lira crisis. During that episode, extreme exchange rate volatility and a domestic economic downturn temporarily constrained automotive export growth – local manufacturers grappled with higher costs for imported components even as the weaker lira made Turkish vehicles more price-competitive abroad. The COVID-19 pandemic in 2020 caused a brief yet significant contraction in automotive exports when global production lines and trade were temporarily halted; however, this downturn was short-lived, and exports bounced back quickly by 2021 as factories reopened and international car demand surged once more. Overall, recovery patterns in the automotive sector have been relatively rapid after global shocks (e.g. post-2009 and post-2020), highlighting the industry's resilience when external conditions normalize.

Structurally, the automotive export sector remains vulnerable to external fluctuations despite its long-term growth. It is heavily reliant on European markets (which constitute the largest buyers of Turkish vehicles and parts) and on imported intermediate inputs (like specialized components and raw materials). This reliance

means that economic downturns or weak demand in Europe directly translate into export slowdowns, and sharp currency depreciations, while boosting price competitiveness, and also increase production costs for manufacturers. The patterns from 2003–2023 suggest that Turkey’s automotive sector is cyclically sensitive – booming during global growth periods but exposed to shocks such as financial crises and supply-chain disruptions. Nonetheless, sustained investment in this industry and its integration with global automotive networks have enabled a generally upward trajectory, with each post-crisis recovery lifting automotive exports to new levels. The sector’s performance underlines a structural dependence on stable global demand and macroeconomic stability, as well as the need to manage exchange rate risks given its import-intensive production process.

5.1.5 Time series category 2

This section examines the export volume trends of Turkey’s textiles and Apparel sector over the period 2003–2023. The analysis identifies key trends in clothing and textile exports and highlights how major economic crises or exchange rate fluctuations have disrupted these trends. It also discusses the recovery patterns post-crisis and the sector-specific vulnerabilities and structural factors that shape the performance of textile and apparel exports.

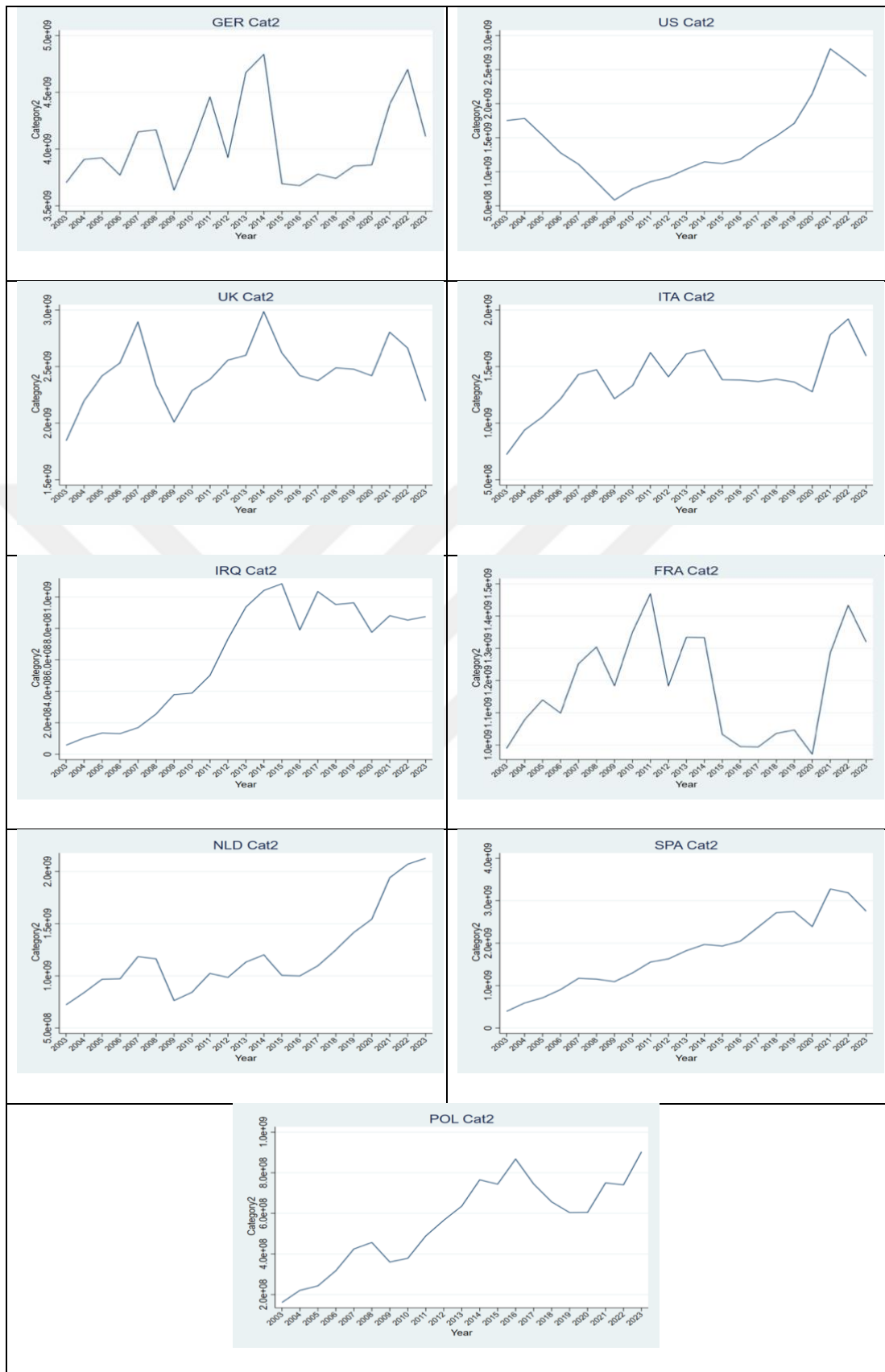


Figure 7. Category 2 export volume by year

Textile and apparel exports display a steady overall increase from 2003 to 2023, underpinned by Turkey's large, competitive clothing industry and its strong ties to international retailers. There was a moderate dip in export volumes during the 2008–2009 Global Financial Crisis when consumer spending on apparel in key markets declined – however, this downturn was less severe and shorter-lived than in heavy industrial sectors. By 2010, textiles and apparel exports had largely recovered, reflecting resilient demand and Turkey's agility in the fast-fashion supply chain. Export growth continued through the 2010s, with only a slight lull in the early 2010s (around the time of Europe's sovereign debt troubles) as retail demand in Europe softened briefly. Notably, during the 2018 Turkish Lira crisis, textile and apparel exports were less negatively affected and gained a boost – the sharp depreciation of the lira improved Turkey's price competitiveness abroad, leading to higher export orders even amidst domestic economic turmoil. This contrasts with many other sectors and highlights the apparel industry's ability to capitalize on a weaker currency (as production is labor-intensive with a significant local input share). In 2020, the COVID-19 pandemic caused a significant but temporary drop in apparel exports, as global retail stores shuttered and orders were canceled during lockdowns. This contraction, though noticeable, was quickly reversed by 2021: pent-up consumer demand, the global shift to online retail, and buyers diversifying suppliers (often favoring nearer producers like Turkey to mitigate supply chain risks) all contributed to a robust rebound in Turkey's textile and clothing exports following the pandemic shock.

From a structural perspective, the textiles and apparel sector demonstrates both strengths and vulnerabilities in its export performance. On one hand, it is labor-intensive and flexible, which allows producers to ramp up production or adapt

products quickly when demand returns (as seen after economic shocks). The sector benefits from a skilled workforce, domestic raw material production (e.g. Turkish cotton and textiles), and proximity to Europe, making it a go-to source for fast turnaround orders. These factors helped limit the damage from crises and enabled quick recoveries. On the other hand, textile and apparel exports remain vulnerable to global demand swings and intense international competition. During global downturns, discretionary spending on apparel falls, directly impacting export orders. Additionally, while currency depreciation has historically boosted apparel exports by lowering relative costs, it also squeezes margins when inflation catches up (through higher costs for imported dyes, machinery, or luxury fabrics). The period 2003–2023 also underscores how dependent this sector is on the European market and consumer trends – changes in EU economic conditions or fashion demand can significantly influence export volumes. In sum, Turkey’s textile and apparel exports have trended upward with remarkable resilience, but sustaining this growth will require navigating competitive pressures and mitigating the impact of economic fluctuations on this crucial, labor-intensive industry.

5.1.6 Time series category 3

This section analyzes the export volume trends of Turkey’s Machinery and Equipment sector from 2003 to 2023. The analysis highlights key patterns in machinery exports over the two decades and focuses on disruptions linked to economic crises and exchange rate fluctuations. It further examines how the sector’s export volumes recovered after these shocks and discusses the structural vulnerabilities that influence machinery and equipment export performance.

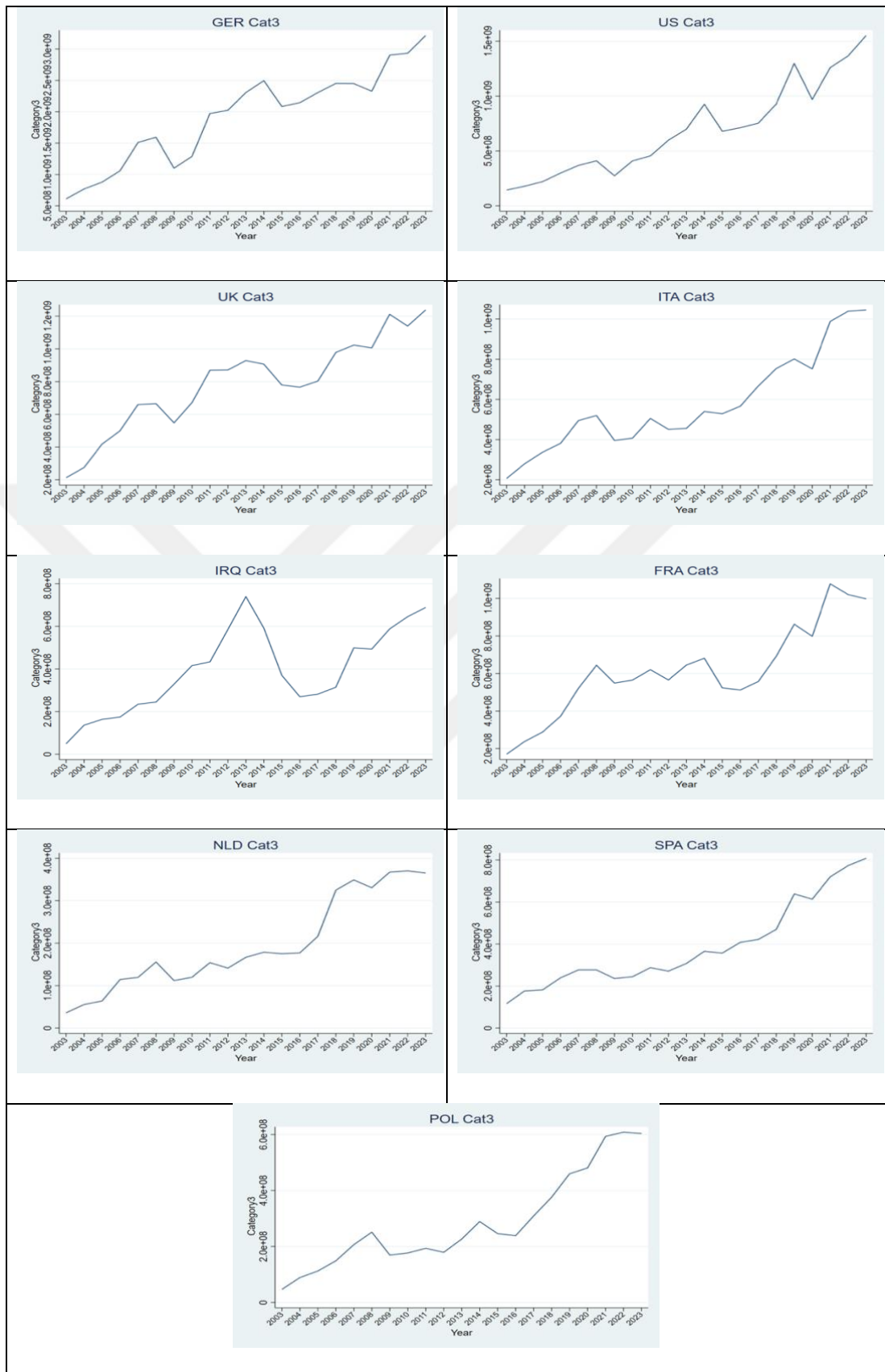


Figure 8. Category 3 export volume by year

Exports of machinery and equipment show an overall upward trajectory between 2003 and 2023, albeit from a lower base and at a more moderate pace compared to Turkey's leading sectors. The growth reflects gradual industrial diversification and Turkey's entry into global markets for mechanical appliances and equipment. However, this sector's export trend was punctuated by downturns during major crises. In 2009, amid the Global Financial Crisis, machinery exports fell noticeably as global industrial investment and demand for capital goods contracted sharply. The recovery for machinery exports after 2009 was present but somewhat slower and more incremental than the rebound in consumer-oriented sectors – it took a couple of years for export volumes to regain pre-crisis levels, mirroring the cautious rebound in global equipment demand. A minor stagnation can also be observed in the early 2010s, corresponding to the European debt crisis, when economic uncertainty in Europe (a key destination for Turkish machinery) caused some hesitation in new investments and purchases, tempering export growth for a short period. During the 2018 Turkish Lira crisis, machinery export volumes experienced some disruption as well: the domestic turbulence and a sharply weaker lira initially posed challenges, since machinery production relies heavily on imported components and capital goods (whose costs surged with the depreciating currency). Consequently, 2018 saw either a plateau or a slight dip in machinery exports as firms struggled with higher input costs and tighter financing, even though the weaker lira potentially made Turkish machinery more attractive price-wise to foreign buyers. By 2019–2020, machinery exports were growing again, until the onset of the COVID-19 pandemic. In 2020, global factory shutdowns and deferred business investments led to another drop in Turkish machinery exports; many international projects were paused, reducing demand for equipment. This decline, however, was relatively short-lived. As global

manufacturing and infrastructure projects resumed, Turkey's machinery exports recovered – by 2021, volumes were climbing again, supported by both renewed foreign demand and the push for alternative supply sources when global supply chains were under strain.

Structurally, the machinery and equipment sector's export performance reveals significant vulnerabilities to economic cycles and exchange rate movements. Being a capital- and technology-intensive industry, it is strongly dependent on imported inputs (from precision parts to advanced electronics), which makes production costs very sensitive to exchange rate volatility. A depreciating lira can erode profit margins or limit manufacturers' ability to produce, even as it makes the end products cheaper internationally – this dynamic was evident in 2018 when currency turmoil muted the gains from improved export price competitiveness. Moreover, machinery exports are closely tied to global investment trends: when major trading partners increase infrastructure or industrial spending, Turkish machinery exports benefit, but during downturns (financial crises or uncertainty periods), this category faces diminished demand. The sector's gradual growth also points to structural challenges such as the need for continued technological upgrading and competitiveness against global producers. Despite these challenges, the long-run increase in machinery exports suggests improving capabilities and diversification in Turkey's industrial base. The future resilience of this sector will depend on reducing import dependence for inputs (to mitigate exchange rate risk) and targeting a broader range of markets to buffer against regional economic slumps. Overall, the 2003–2023 period shows the machinery and equipment sector steadily growing but with clear sensitivity to external economic shocks and structural constraints.

5.1.7 Time series category 4

This section explores the export volume trends of Turkey's Chemicals and Plastics sector over 2003–2023. The analysis identifies the main trends in chemical exports and highlights disruptions linked to global economic crises and exchange rate fluctuations. It also discusses how the sector's exports recovered from these shocks and the structural factors and vulnerabilities that characterize the chemicals and plastics export performance.



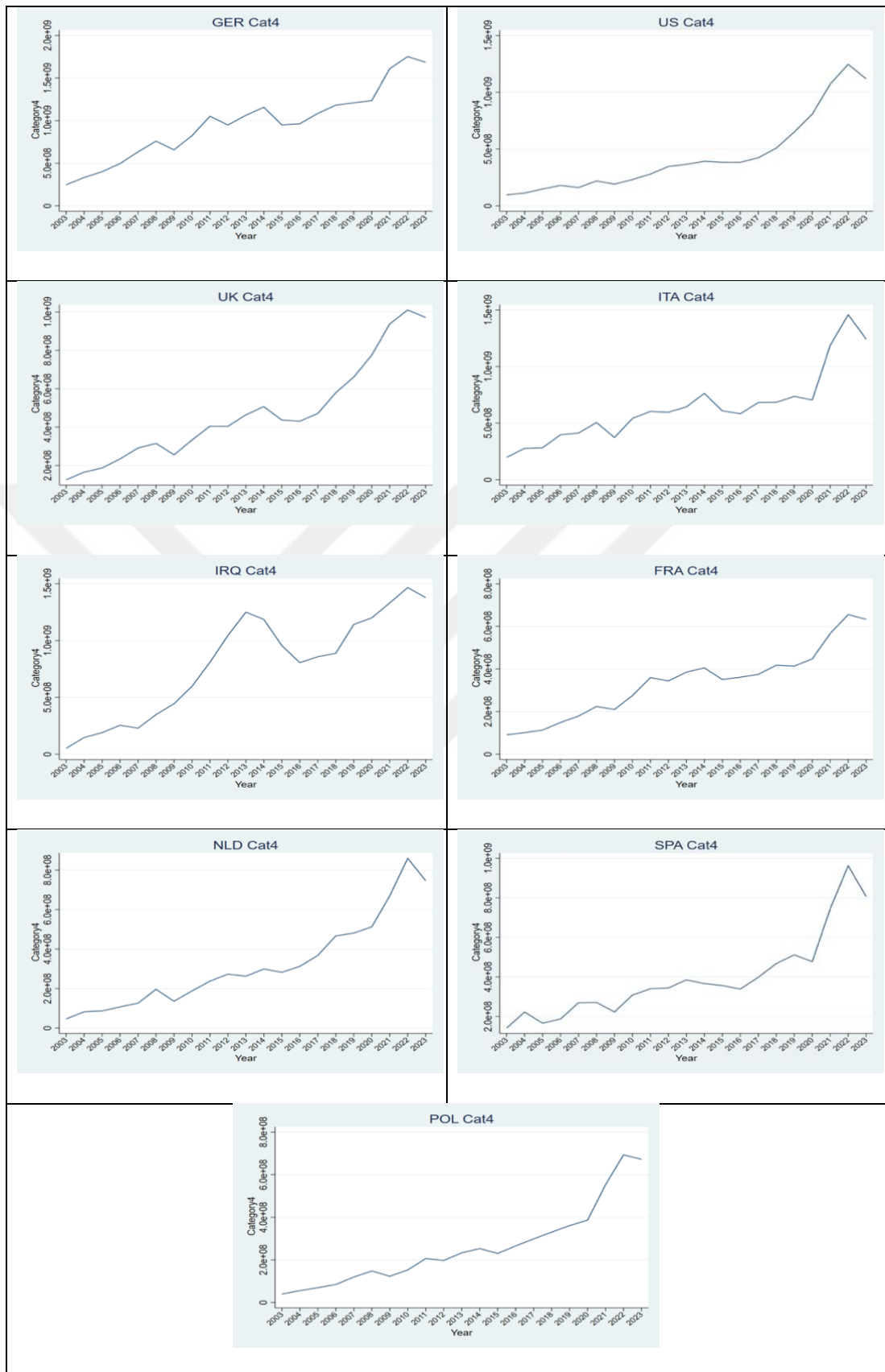


Figure 9. Category 4 export volume by year

Turkey's chemical and plastics exports followed a generally rising trend from 2003 to 2023, in line with growing global demand for petrochemicals, plastics, and related products. The sector's export growth was steady but exhibited sensitivity to global economic cycles and commodity price fluctuations. A clear downturn was evident during the 2008–2009 Global Financial Crisis when chemical export volumes dropped as worldwide industrial activity and trade contracted sharply – demand for chemicals (used in manufacturing, construction, etc.) fell and prices for many chemical products plunged in that period. This export decline was reversed as the global economy recovered: by 2010 and 2011, Turkey's chemical exports were growing again, buoyed by rising commodity prices and revived industrial demand. The early 2010s saw continued expansion, with only a modest impact from Europe's debt crisis; while Europe's slowdown around 2012 slightly softened demand, many chemical exports are destined for a diverse set of markets (including emerging economies) and some sub-sectors (like plastics packaging or basic chemicals) maintained momentum, resulting in just a brief plateau rather than a significant drop. In 2018, the Turkish Lira crisis introduced turbulence for chemical exporters. The sharp depreciation of the lira dramatically increased the cost of imported feedstocks (like oil derivatives and raw chemical inputs) and energy, which squeezed production margins and could have constrained output. As a result, chemical export growth stalled around 2018–2019, though it did not collapse – some producers managed to keep exports flowing by adjusting prices, and global demand at that time was relatively firm. The data suggest the sector weathered the currency crisis with a flat or slightly reduced export volume, before resuming growth. The COVID-19 pandemic in 2020 had a mixed impact: initially, there was a dip in chemical exports as global manufacturing and mobility ground to a halt (lowering demand for

industrial chemicals and plastics, especially in Q2 2020). However, certain chemical sub-sectors experienced surging demand (for example, plastics for medical supplies, disinfectants, and protective equipment saw increased orders), which helped offset losses. By the end of 2020 and into 2021, Turkish chemical exports were on a sharp upswing. A combination of global supply shortages and a rapid rebound in commodity prices led to a significant surge in export values and volumes for chemicals and plastics in 2021–2022. By 2023, export volumes in this category had reached record levels, making chemicals one of Turkey’s top export earners – this late-period boom reflects both recovery from the pandemic shock and the sector’s benefit from high global prices for chemical products.

Structurally, the chemicals and plastics export sector is characterized by high sensitivity to external factors, notably commodity prices, input costs, and exchange rates. It is an import-intensive sector – producers rely on imported oil, natural gas, or chemical feedstocks as raw materials. This means that a depreciating Turkish lira, while potentially improving the competitiveness of final chemical products abroad, simultaneously raises production costs dramatically, which can cap the ability to increase export volumes (as seen in 2018). The sector’s fortunes are also tied to global commodity cycles: during periods of high oil and commodity prices, the value (and often volume) of chemical exports tends to rise, whereas global downturns or price crashes can depress export revenues. Another structural aspect is that chemical exports are somewhat diversified across markets (including Europe, the Middle East, and Asia), which can provide resilience – for instance, strong demand from certain regions can partly compensate for weakness in others. However, all major markets tend to be synchronous during global crises, so the sector is still exposed to worldwide economic shocks. The 2003–2023 period demonstrates that while

Turkey's chemical and plastics industry has grown significantly and can seize opportunities (e.g., filling supply gaps or ramping up output when global demand spikes), it remains vulnerable to exchange rate volatility and input cost fluctuations. Ensuring stable growth in this sector may require strategies like securing more local inputs, improving energy efficiency, and hedging against price swings, given its structural reliance on external resources and the volatile nature of global chemical markets.

5.1.8 Time series category 5

This section discusses the export volume trends of Turkey's Food and Agricultural Products sector from 2003 to 2023. The analysis highlights the key patterns in agricultural and food exports over this period, noting any disruptions due to economic crises or exchange rate changes. It also examines how export volumes recovered following such disruptions and outlines the sector-specific vulnerabilities and structural factors affecting food and agricultural export performance.

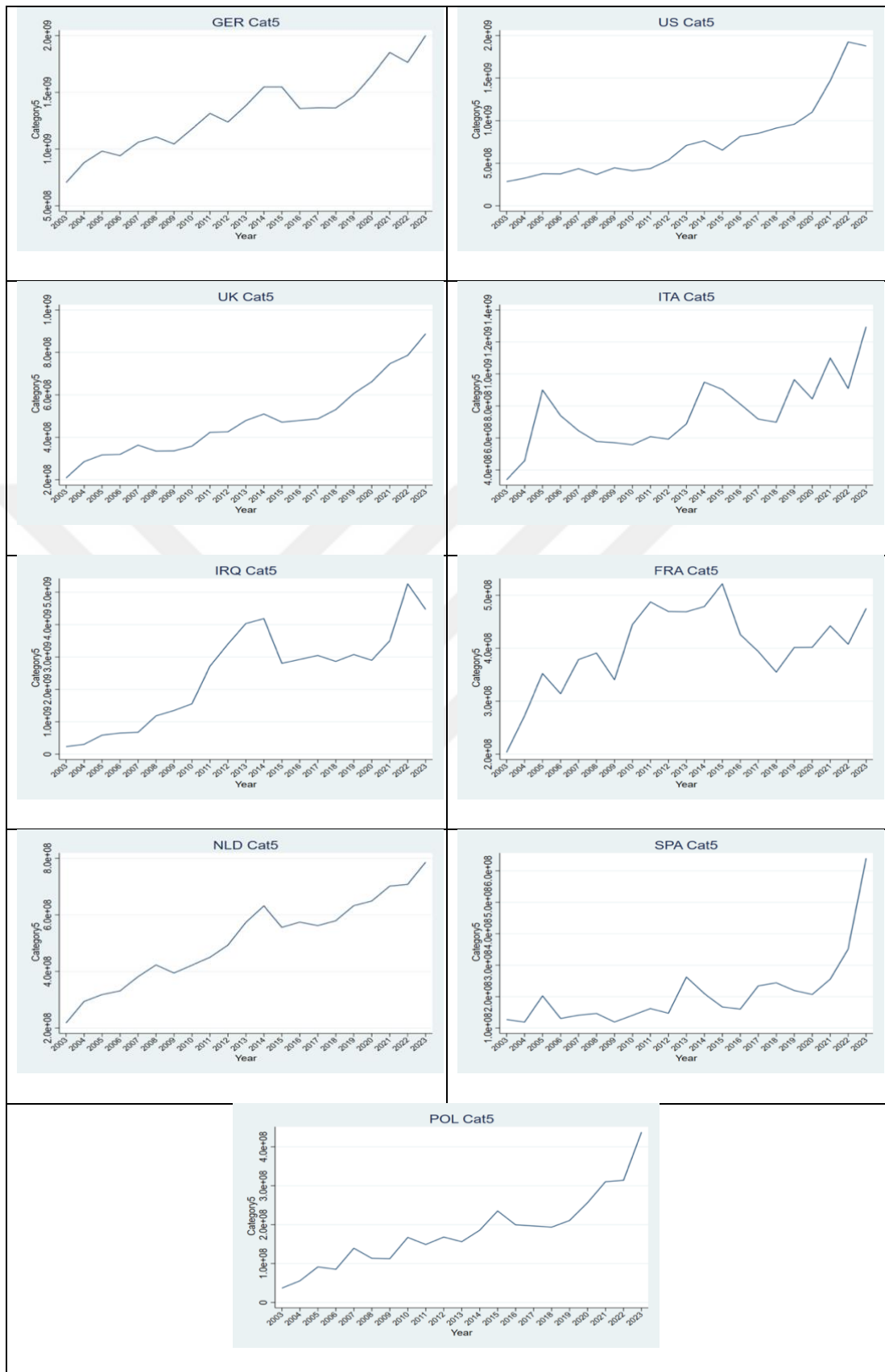


Figure 10. Category 5 export volume by year

Turkey's food and agricultural exports steadily increased between 2003 and 2023, reflecting the country's rich agricultural output and expanding food processing industry. Compared to manufacturing sectors, the food and agriculture category shows more stable growth, as global demand for food is relatively inelastic and less prone to severe swings. Even so, the time series reveals some fluctuations aligned with major events. During the 2008–2009 Global Financial Crisis, food exports saw a mild slowdown – there was a brief dip in export growth in 2009 as worldwide trade contracted, but the decline was limited since essential food demand held up even amid the recession. By 2010, food and agricultural exports were growing again, quickly recovering any lost ground. In the early 2010s, Turkey's food exports continued on an upward path largely uninterrupted by the European debt crisis; staple demand in Europe and the Middle East remained solid, although some high-value or luxury food items faced softer demand during those years. A notable disruption outside of global financial cycles occurred in the mid-2010s due to regional geopolitical factors – for example, conflicts and instability in neighboring markets (such as the war against ISIS in Iraq and Syria around 2014–2016) temporarily curtailed demand and logistical routes for Turkish agricultural exports in those areas. This is reflected in a short-lived flattening of export growth to Iraq and certain regions during that period, though alternative markets and humanitarian food needs helped compensate to some extent. The 2018 Turkish Lira crisis did not significantly dent food export volumes; if anything, Turkish food products became cheaper on international markets, which helped sustain export growth. Farmers and food exporters benefited from currency-driven competitiveness, although they also contended with higher costs for imported inputs like fertilizer. The net effect in 2018–2019 was a largely resilient food export performance – no major drop is

evident, and some subsectors saw continued growth. In 2020, the COVID-19 pandemic initially posed challenges (disruptions in transport logistics and shifting demand from restaurants to retail groceries), but the food and agriculture sector proved remarkably resilient. Any decline in exports during the early lockdown phase was relatively minor and short-term; global importers still needed food supplies, and Turkey was able to continue exporting many agricultural commodities and processed foods. By late 2020, food exports had stabilized, and in 2021–2022 they accelerated, partly due to global supply chain adjustments and Turkey stepping in to meet demand when other exporters faced pandemic-related or geopolitical constraints.

Overall, the trend from 2003 to 2023 is a consistent rise in food and agricultural export volumes, with only modest dents during even the worst global downturns. The food and agricultural export sector's performance underscores several important structural characteristics. It is less volatile than industrial exports because basic food demand is constant worldwide; this inherent stability is a strength, making the sector a reliable export earner even in crisis times. Additionally, Turkey's diverse range of agricultural products (from produce, grains, and nuts to prepared foods) and its mix of export markets (EU, Middle East, and others) provide a buffer against isolated shocks. However, the sector is not without vulnerabilities. It remains highly dependent on climatic conditions and harvest yields – for instance, droughts or poor crop years can limit export supply regardless of external demand. There are also instances of trade policy and quality-related disruptions; for example, occasional bans or restrictions (either by Turkey, to protect domestic food prices, or by importing countries, due to health and safety standards) can cause temporary drops in certain food exports. Moreover, while the 2018 currency depreciation improved competitiveness, the sector does rely on some imported inputs (fuel,

fertilizers, seeds), meaning prolonged lira weakness can eventually raise production costs for farmers and food processors. Another structural aspect is the reliance on neighboring emerging markets (like Iraq and other Middle Eastern countries) – these markets’ political and economic stability can directly influence Turkey’s agricultural export volumes. Despite these challenges, the long-term trajectory indicates that Turkey’s food and agricultural exports have grown robustly, capitalizing on the country’s comparative advantage in this area. The sector’s relative resilience to global crises highlights its role as a stabilizing component of Turkey’s export portfolio, even as it must adapt to climate change and global market standards in the future.

5.1.9 Time series category 6

This section examines the export volume trends of Turkey’s Electronics and Electrical Equipment sector over the period 2003–2023. The analysis focuses on key patterns in electronics exports, noting the impact of economic crises and exchange rate volatility on the sector. It also outlines the recovery patterns observed after disruptions and the structural vulnerabilities that affect the performance of electronics and electrical goods exports.

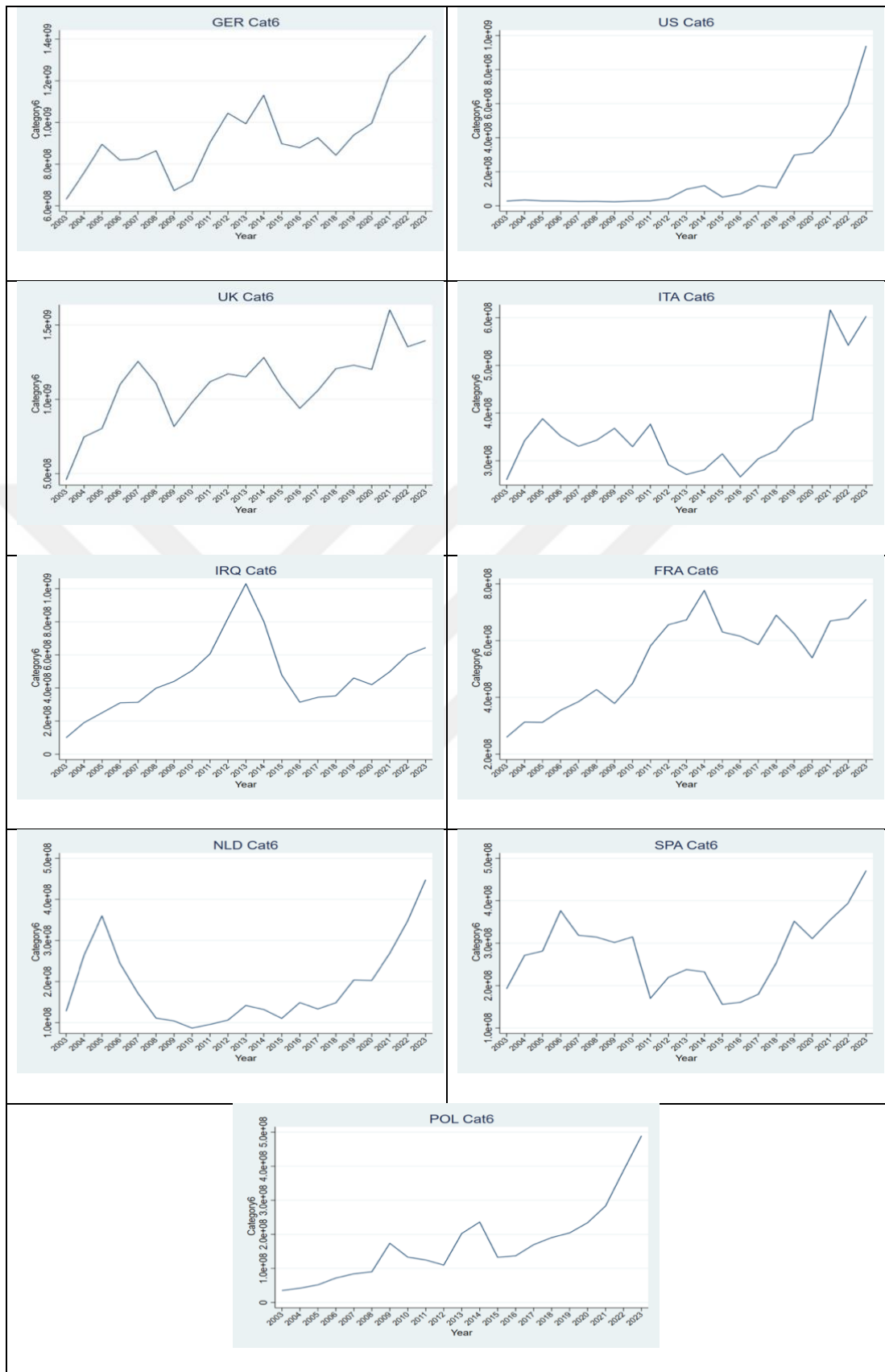


Figure 11. Category 6 export volume by year

Exports of electronics and electrical equipment from Turkey grew significantly from 2003 to 2023, starting from a relatively modest base and expanding as the country developed its capacity in consumer electronics, appliances, and electrical machinery. The overall trend is upward, reflecting increased foreign investment and the rise of Turkish brands (especially in appliances and home electronics) making inroads into global markets. This growth, however, was interspersed with periods of disruption due to global economic events. The 2008–2009 Global Financial Crisis brought a notable decline in electronics export volumes in 2009, as international demand for durable goods and consumer electronics dropped and supply chains temporarily contracted. Turkish manufacturers saw fewer orders for items like televisions, appliances, and electrical components during that recession. Following the crisis, a recovery took hold: by 2010–2011, electronics exports were climbing again, boosted by renewed consumer demand and Turkey’s cost advantages. The early-to-mid 2010s continued on a growth path, with only a slight pause around 2012 in line with the European economic slowdown – given Europe is a key market for Turkish electronics (e.g. household appliances), a dip in EU consumer spending then led to a brief moderation in export growth. In 2018, the Turkish Lira crisis injected uncertainty into this sector. The sudden depreciation of the lira made Turkish electronic goods cheaper abroad, potentially stimulating demand, but simultaneously made it more expensive to import the necessary high-tech components (such as semiconductors, specialized chips, and other inputs crucial for electronics manufacturing). This dual effect meant that while some exporters could increase volumes by leveraging lower prices, others were constrained by supply costs and tighter profit margins. Overall, electronics export growth slowed around 2018–2019, but did not dramatically decline – the sector managed to

maintain its output with minor turbulence, aided by ongoing demand from Europe and some nimble adjustments in sourcing. The COVID-19 pandemic in 2020 initially caused a dip in electronics exports as global supply chains were disrupted and factories temporarily shut down; in the first half of 2020, production of cars, appliances, and electronics worldwide was scaled back, which impacted Turkish suppliers. Uniquely, however, the pandemic period also *created new demand* for certain electronics (for instance, home appliances, computers, and equipment for remote work and home entertainment became more sought-after). Turkish electronics exports saw a swift revival by late 2020 and into 2021 as consumers, especially in Europe, spent more on home electronics and appliances during lockdowns and as supply bottlenecks elsewhere (like in Asia) prompted buyers to source from Turkey. This led to an impressive rebound – by 2021, export volumes in Category 6 had recovered and even surpassed pre-pandemic levels, continuing to grow into 2022–2023.

Structurally, the electronics and electrical equipment sector's export performance is shaped by its integration into global supply chains and its dependence on technological inputs. This sector is highly reliant on imported components and raw materials (such as electronic chips, circuit components, and advanced production machinery), which makes it very sensitive to exchange rate fluctuations and external supply conditions. A key vulnerability highlighted in 2003–2023 is the supply chain risk – events like the global chip shortage in 2021 or shipping disruptions can constrain Turkey's electronics exports even when external demand is strong, simply because obtaining necessary inputs becomes challenging or costly. Currency volatility presents a similar challenge: while a weaker lira boosts price competitiveness for finished electronic goods, it also raises the cost of imports

needed to build those goods, often nullifying some of the competitive advantages if the depreciation is extreme or volatile. Additionally, this sector faces stiff international competition, as Turkey's electronics exporters compete with producers from East Asia and Eastern Europe in both price and technology. This competitive pressure requires continuous upgrades in quality and efficiency. On the positive side, Turkey's proximity to Europe and established reputation in certain product niches (such as white goods appliances) have been structural advantages, helping the sector capture market share especially when buyers seek geographically closer or more reliable suppliers. Over the long term, electronics exports have expanded, indicating improving capabilities and market diversification. Yet, the 20-year time series makes it clear that the sector's growth is not immune to global downturns – demand for electronics is cyclical and can drop sharply in crises, and recover swiftly when conditions improve. In conclusion, Category 6's export trend underscores a trajectory of solid growth tempered by high sensitivity to external shocks. Strengthening supply chain resilience and moving up the value chain in electronics will be important for reducing vulnerability and sustaining export growth in this high-potential sector.

5.2 Scatter plots (total imp/total exp/cat1 to 6 – ERvol)

This section presents scatter plot analyses illustrating the relationships between Exchange Rate Volatility (ERvol) and Total Import, Total Export, and six key export categories (Automotive, Textiles, Machinery, Chemicals, Food & Agricultural Products, Electronics) across Turkey's nine major trading partners (Germany, United States, United Kingdom, Italy, Iraq, France, Netherlands, Spain, and Poland) over the period 2003–2023. (x axis: ERvol , y axis: Total Imp/Total EXP/Cat1 to 6)

5.2.1 Scatter plot Germany

The scatter plots illustrate the relationship between Exchange Rate Volatility (ERvol) and trade activities (Total Import, Total Export, and Categories 1 to 6) specifically with Germany over the period 2003–2023.



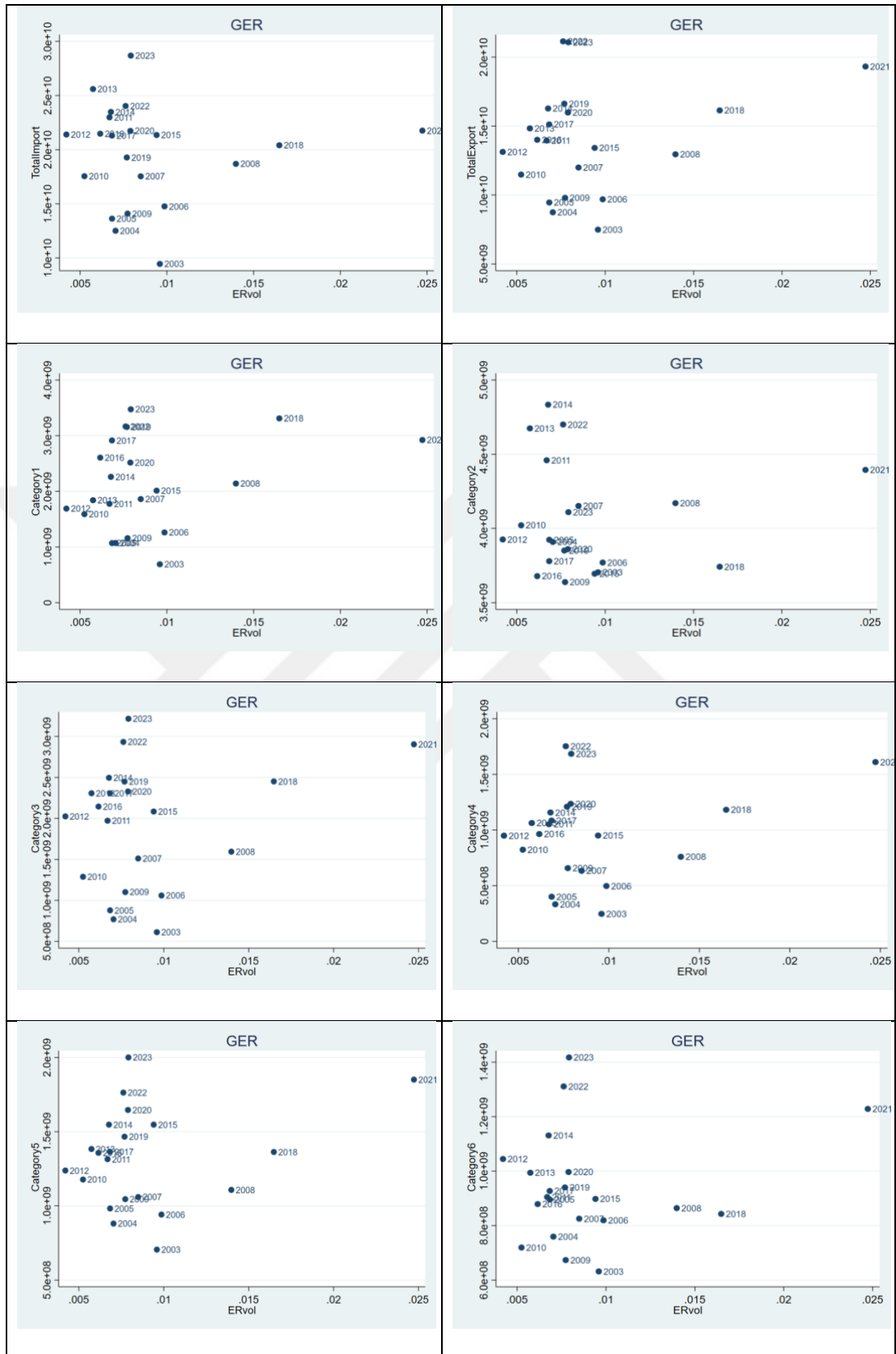


Figure 12. Germany – (total import, total export, category 1 to 6) vs Ervol

Overall, the scatter plots indicate a modest negative relationship between ERvol and total imports and exports, suggesting that increased volatility slightly suppresses trade volumes with Germany. Automotive and Machinery categories show a clearer negative correlation, implying sensitivity to exchange rate fluctuations. However, Textiles and Food & Agricultural products appear more resilient, showing weaker correlations. The relatively tight clustering indicates a stable trading relationship, though still vulnerable during episodes of high volatility.

5.2.2 Scatter plot United States of America

These scatter plots display the interactions between ERvol and Turkey's trade flows (Total Import, Total Export, and Categories 1 to 6) with the United States from 2003 to 2023.

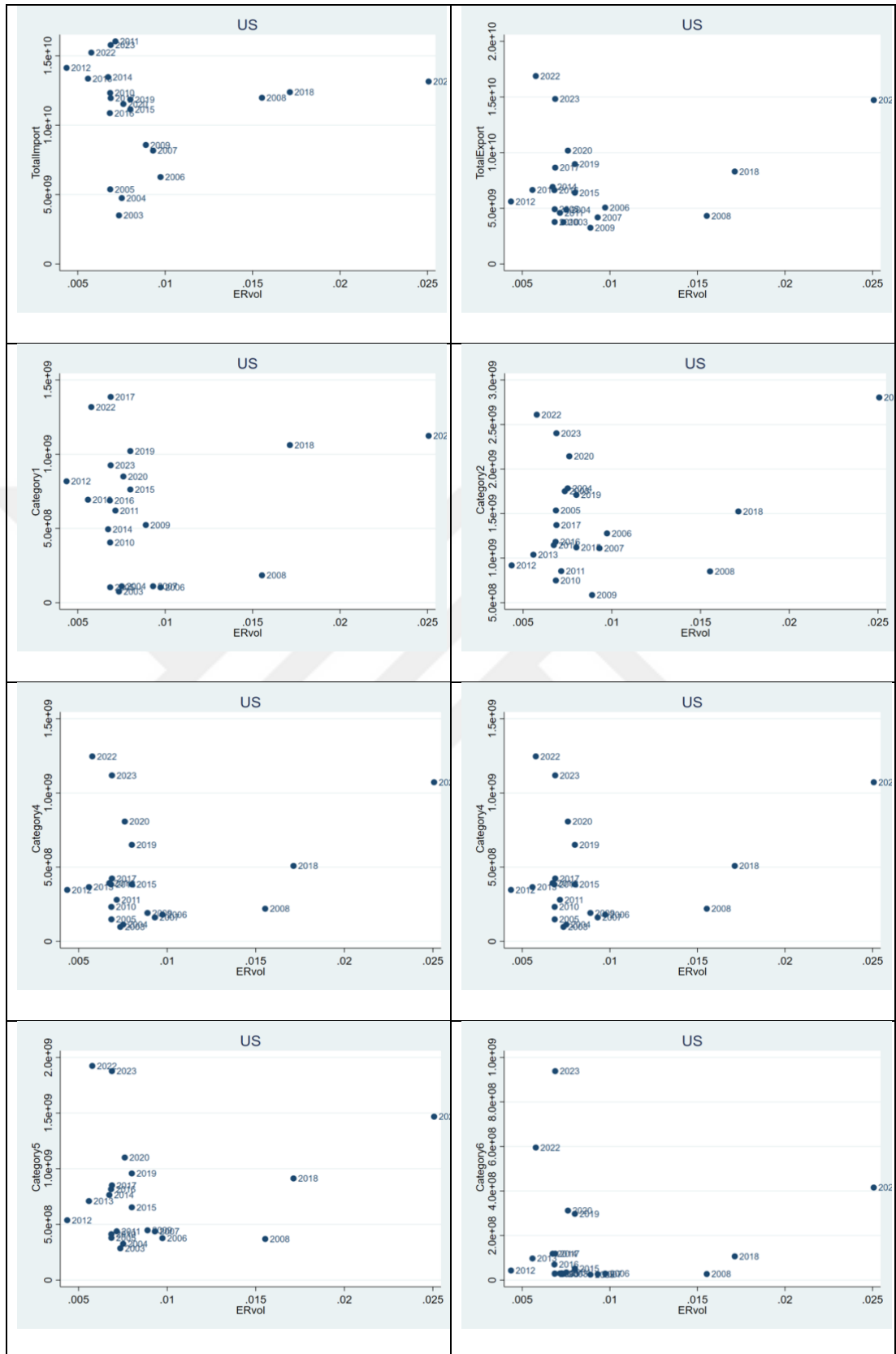


Figure 13. U.S. – (total import, total export, category 1 to 6) vs Ervol

The relationship between ERvol and total trade volumes is somewhat dispersed, reflecting moderate sensitivity of trade activities to currency volatility. The Electronics and Automotive categories exhibit negative associations, suggesting vulnerability in these sectors during volatile periods. Conversely, Food & Agricultural Products and Chemicals show minimal correlation, indicating a more robust trade pattern unaffected strongly by currency fluctuations.

5.2.3 Scatter plot United Kingdom

This section analyzes scatter plots depicting ERvol versus Turkey's Total Imports, Total Exports, and sector-specific exports (Categories 1 to 6) to the United Kingdom (2003–2023).

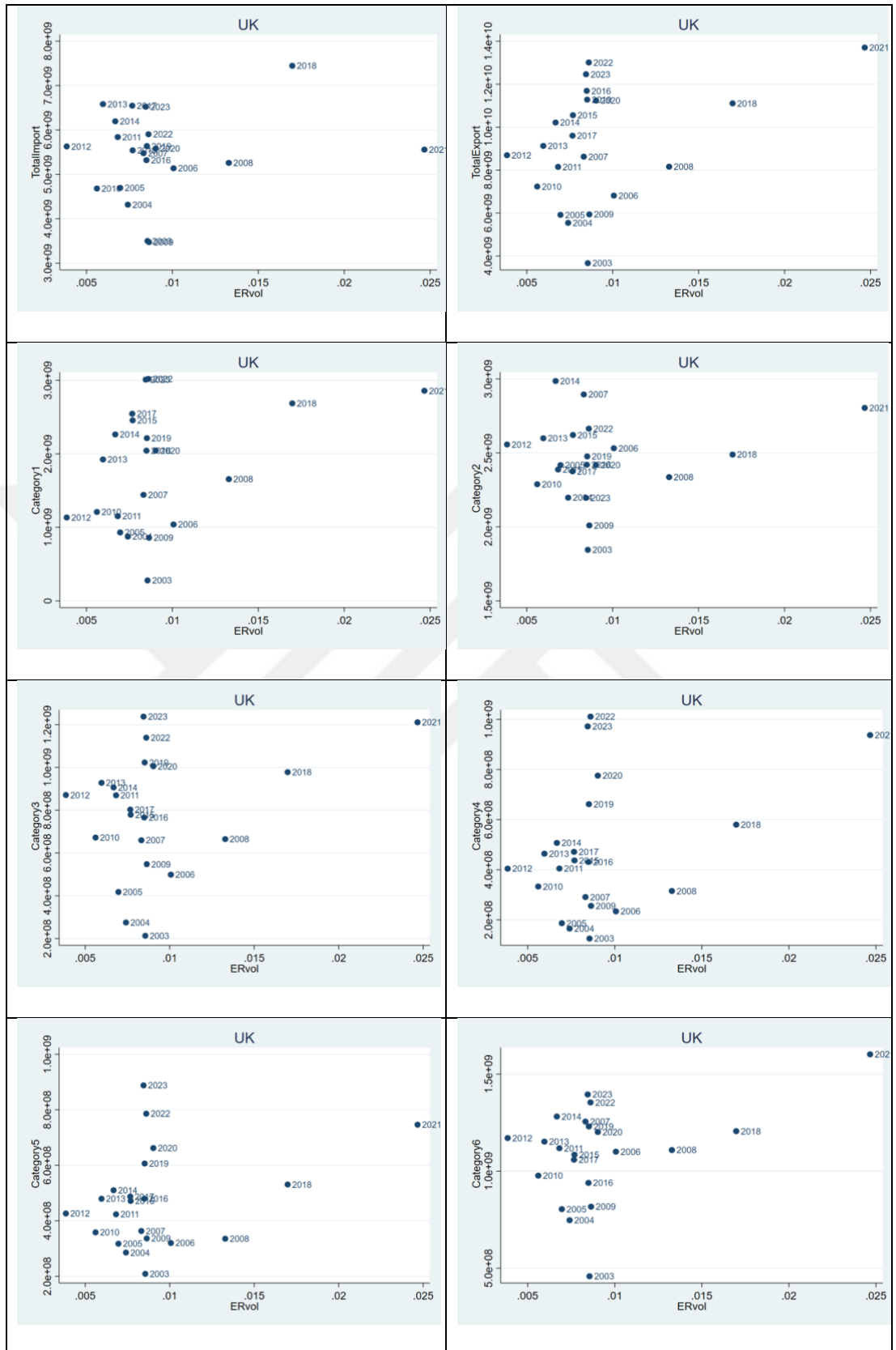


Figure 14. U.K – (total import, total export, category 1 to 6) vs Ervol

Total trade volumes exhibit a moderate negative correlation with ERvol, indicating that trade is somewhat affected by increased exchange rate fluctuations. The automotive and textiles sectors stand out with more defined negative correlations, illustrating higher sensitivity. In contrast, sectors like food & agriculture, and electronics demonstrate weaker or nearly flat correlations, suggesting resilience to exchange rate variability. The data clustering highlights a stable trade pattern with periodic volatility impacts.

5.2.4 Scatter plot Italy

Scatter plots presented here illustrate the relationship between ERvol and Turkey's trade flows (Total Import, Total Export, Categories 1 to 6) with Italy from 2003–2023.

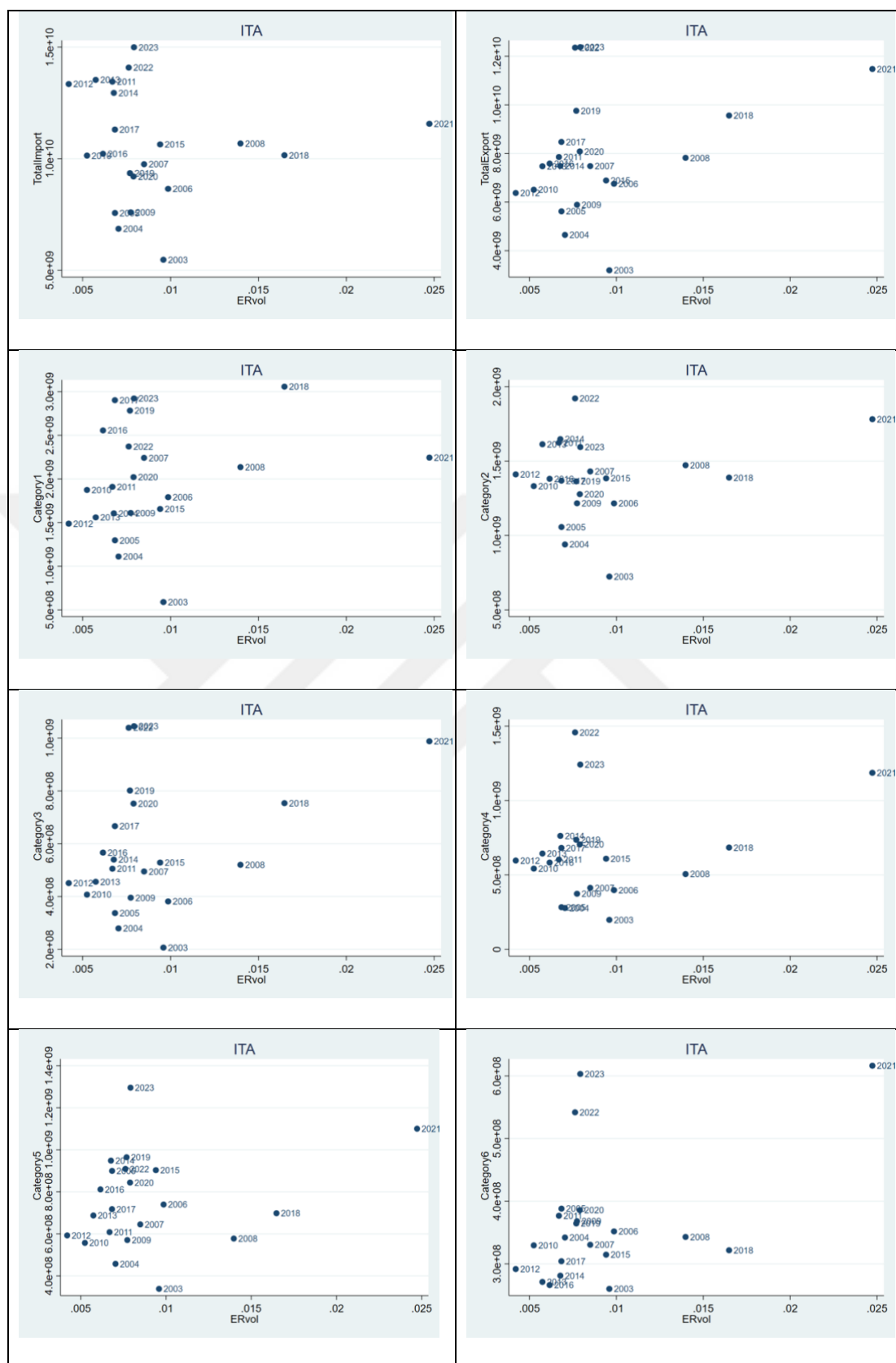


Figure 15. Italy – (total import, total export, category 1 to 6) vs Ervol

The scatter plots generally depict moderate negative correlations, suggesting trade activity decreases slightly as ER volatility increases. Automotive and Machinery exports notably exhibit clearer negative correlations, highlighting their vulnerability. Conversely, Food & Agricultural Products demonstrate weak sensitivity, while Chemicals and Textiles show mixed or inconclusive patterns, suggesting varying sector resilience to exchange rate fluctuations.

5.2.5 Scatter plot Iraq

This section explores scatter plots of ERvol against Turkey's trade (Total Import, Total Export, Categories 1 to 6) with Iraq over the period 2003–2023.

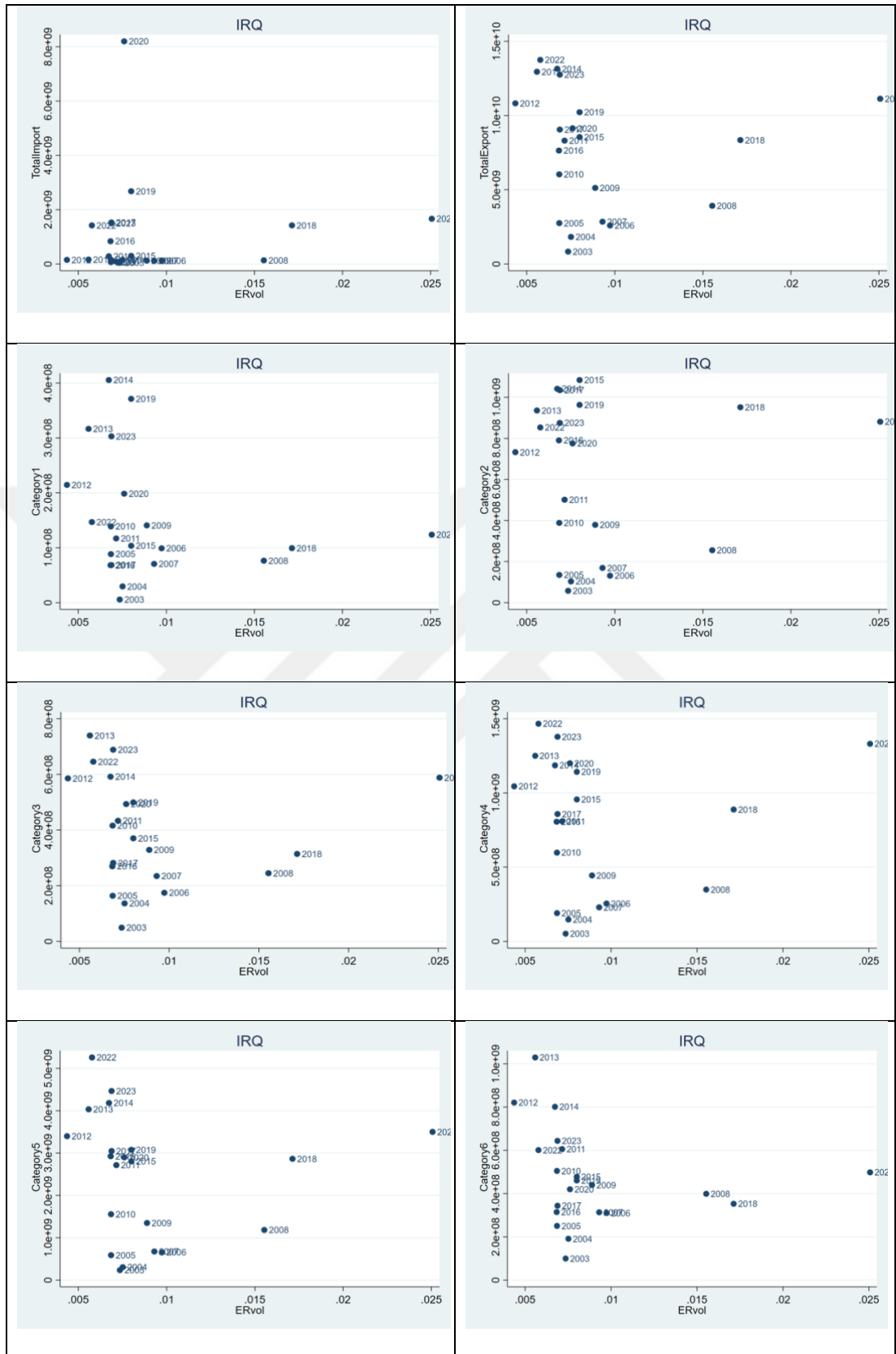


Figure 16. Iraq – (total import, total export, category 1 to 6) vs Ervol

Trade patterns with Iraq are significantly more dispersed, reflecting a high sensitivity to exchange rate volatility influenced heavily by geopolitical instability. Total exports, especially in Food & Agricultural Products and Machinery, show clearer negative correlations, indicating vulnerability to currency volatility. Imports and other export sectors, however, exhibit scattered relationships, underscoring trade instability linked to external political and economic conditions rather than solely exchange rate effects.

5.2.6 Scatter plot France

The scatter plots here analyze ERvol versus Total Imports, Total Exports, and specific export categories between Turkey and France (2003–2023).

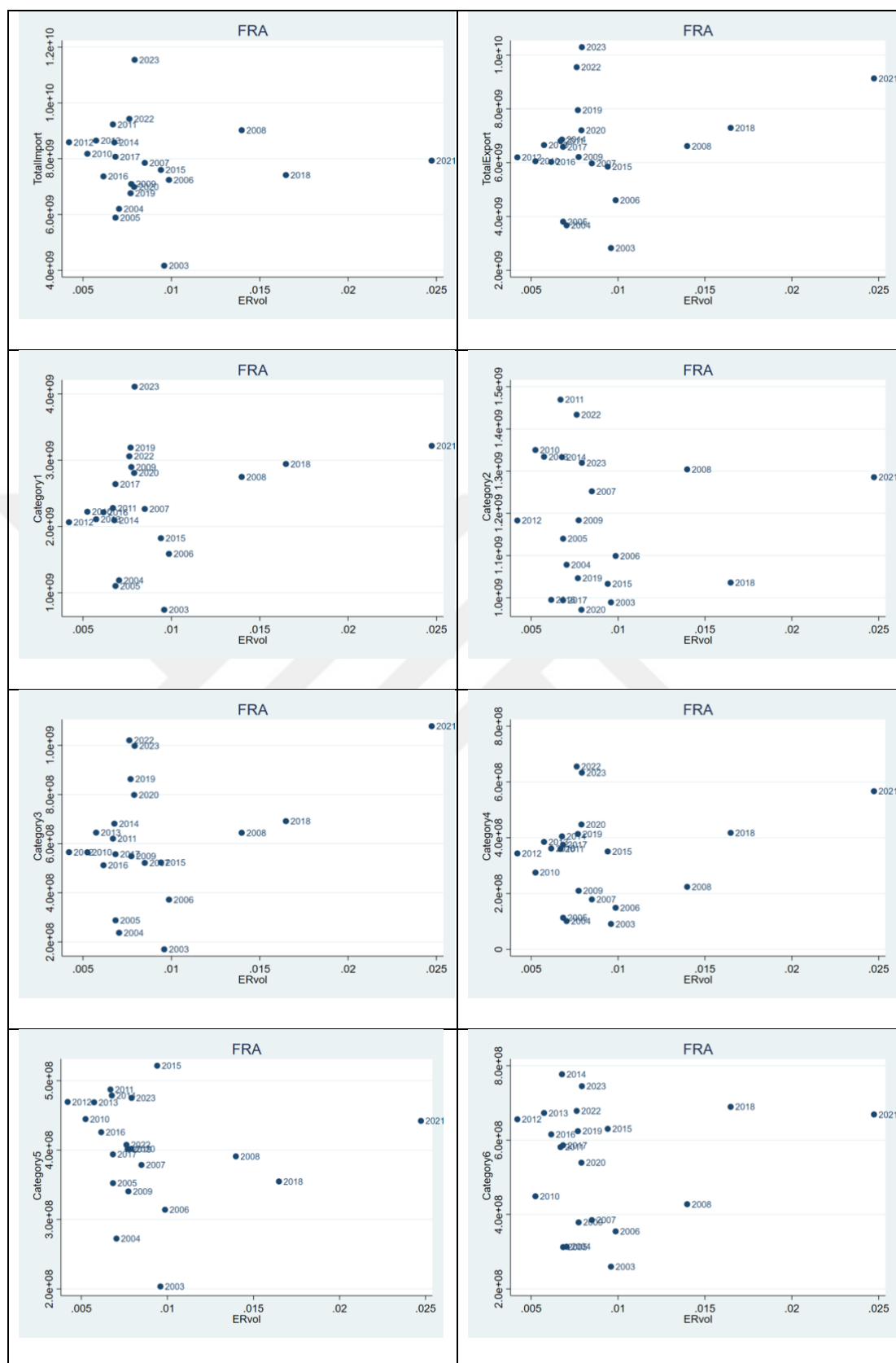


Figure 17. France – (total import, total export, category 1 to 6) vs Ervol

Trade volumes generally show modest negative correlations with ER volatility, implying that increases in volatility slightly suppress bilateral trade flows. Automotive, Machinery, and Electronics exports display stronger negative associations, indicating these sectors are particularly sensitive to ER fluctuations. Food & Agricultural Products, however, show limited sensitivity, illustrating sector-specific resilience. The patterns reveal a relatively stable trade relationship periodically impacted by heightened volatility.

5.2.7 Scatter plot Netherlands

These scatter plots evaluate the relationship between ERvol and Turkey's Total Imports, Total Exports, and six export categories with the Netherlands over 2003–2023.

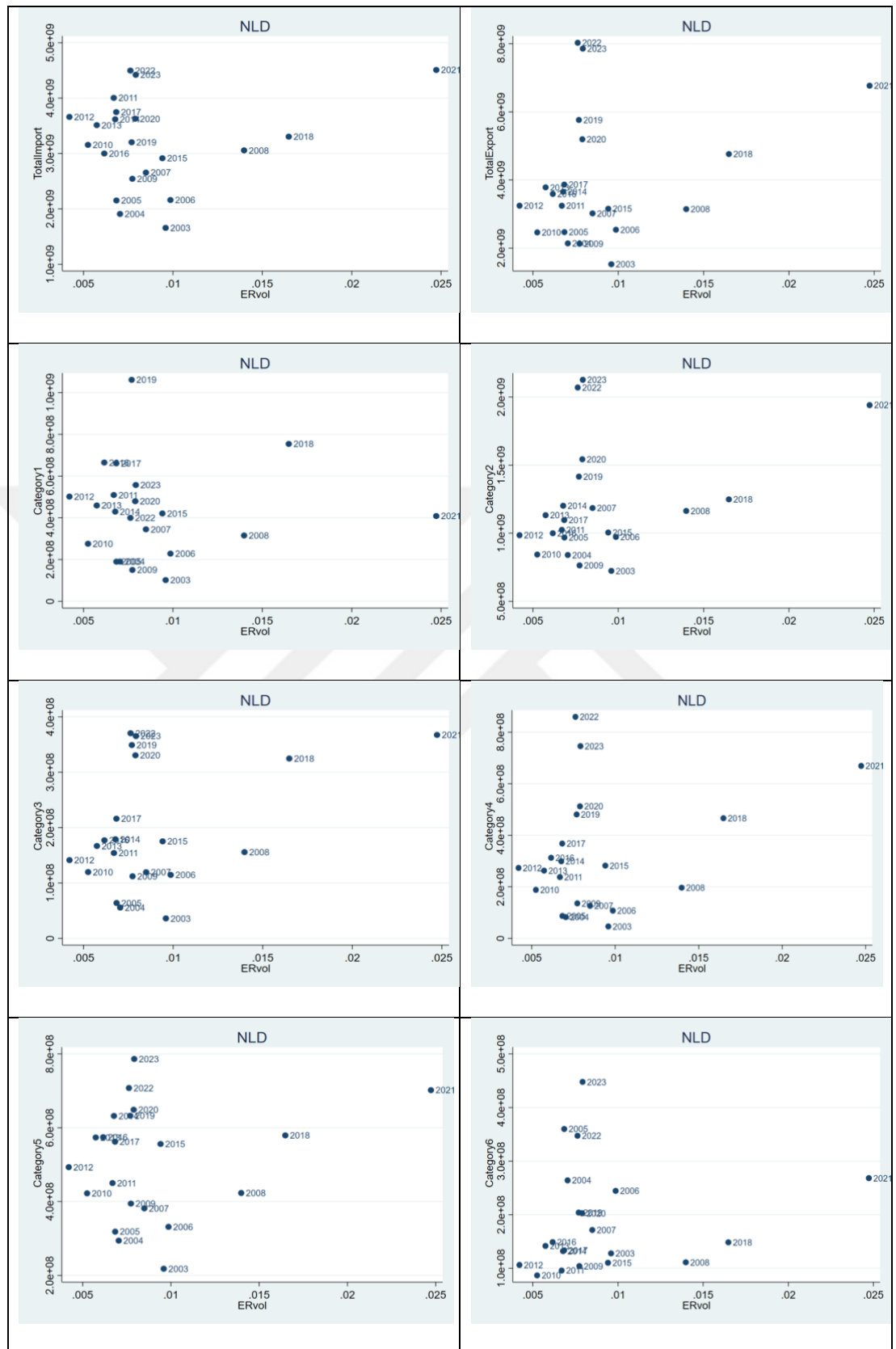


Figure 18. Netherlands – (total import, total export, category 1 to 6) vs Ervol

A general negative relationship is visible across total trade and most categories, indicating moderate sensitivity to exchange rate fluctuations. Automotive and Electronics exports notably show clear negative correlations, suggesting vulnerability to volatility. Conversely, Food & Agricultural Products and Textiles exhibit minimal sensitivity, reflecting stronger resilience. The scatter suggests consistent trade stability, disrupted only during particularly volatile exchange rate periods.

5.2.8 Scatter plot Spain

This section examines scatter plots showing ERvol against Turkey's Total Imports, Total Exports, and export categories with Spain between 2003–2023.

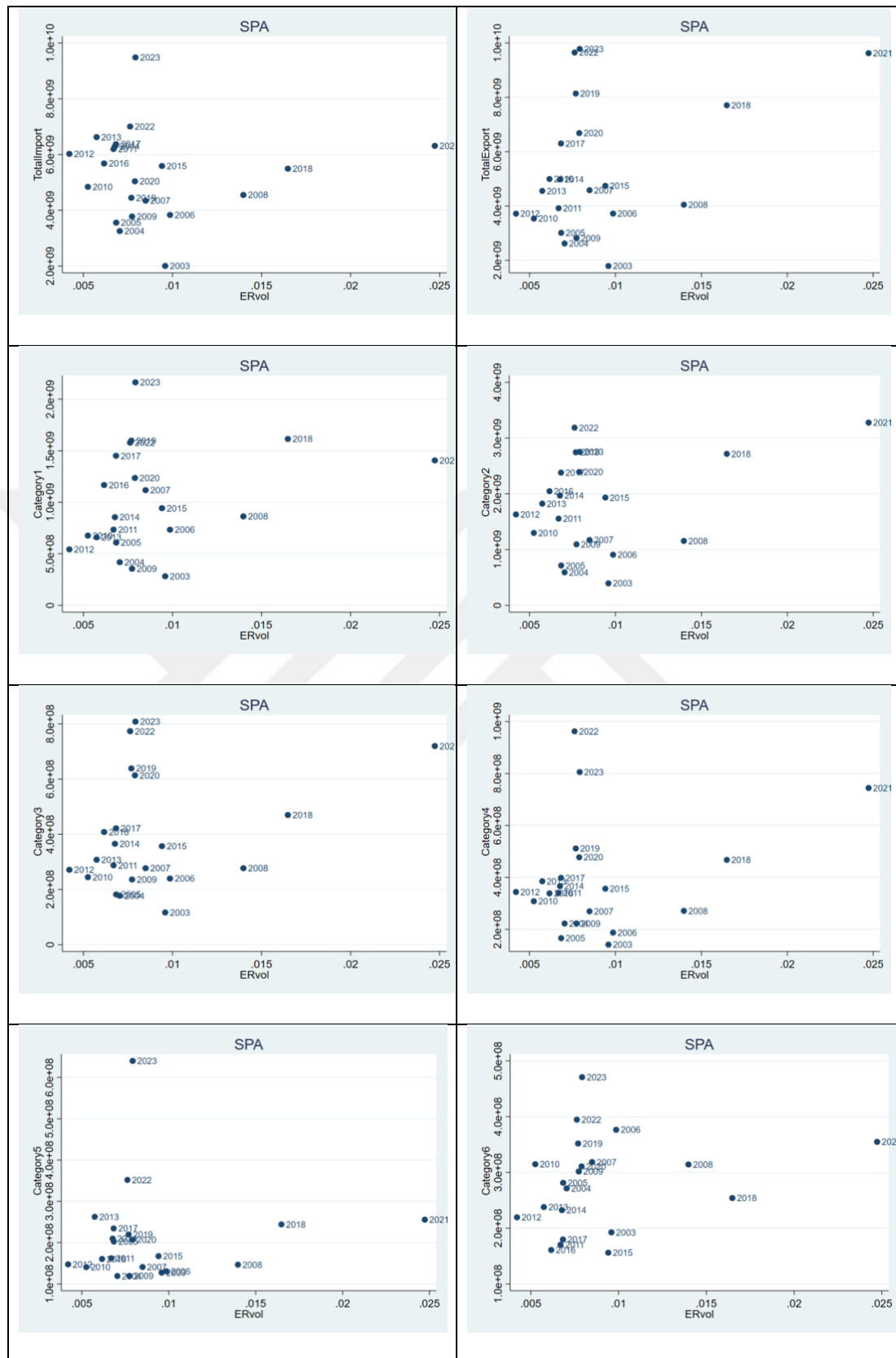


Figure 19. Spain – (total import, total export, category 1 to 6) vs Ervol

Scatter plots reveal mild to moderate negative correlations, suggesting trade activities are somewhat reduced as exchange rate volatility increases. Automotive and Machinery exports appear particularly sensitive, with clearer negative trends. Food & Agricultural Products and Chemicals, however, exhibit weaker correlations, indicating better stability despite volatility. Overall, the trading relationship with Spain remains resilient with intermittent impacts due to currency fluctuations.

5.2.9 Scatter plot Poland

Scatter plots illustrate the relationship between ERvol and Turkey's trade (Total Import, Total Export, Categories 1 to 6) with Poland during the period 2003–2023.

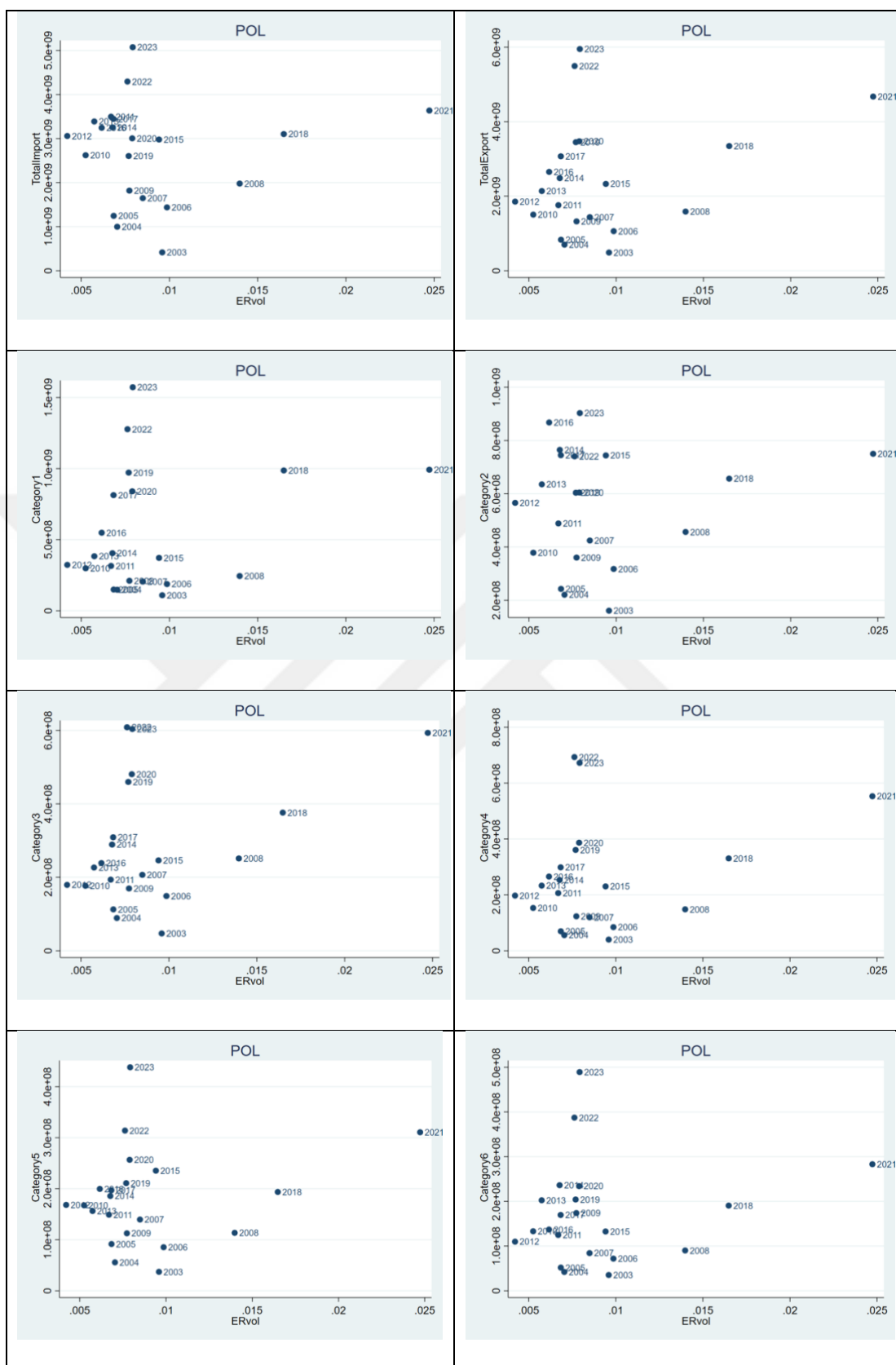


Figure 20. Poland – (total import, total export, category 1 to 6) vs Ervol

Overall, trade flows show moderate negative correlations with ER volatility, indicating a slight suppressive effect of increased volatility on trade volumes.

Automotive and Machinery exports particularly reflect stronger negative relationships, denoting higher sensitivity to exchange rate fluctuations. Conversely, Food & Agricultural products and Electronics exports demonstrate weaker or nearly flat correlations, signaling greater stability. Trade with Poland generally appears steady, with sector-specific vulnerabilities becoming more apparent during volatile periods.

5.3 Correlations

Correlation analysis is a statistical approach that assesses the strength and direction of the relationship between two quantitative variables. In this study, correlation analysis is used to examine how exchange rate volatility (ERvol) interacts with key macroeconomic indicators and trade volume across six product categories and nine major partners. The correlation coefficient quantifies the relationship on a scale from -1 to +1. Where:

- a positive correlation indicates that as one variable increases, the other variable tends to increase.
- a negative correlation indicates that as one variable increases, the other variable tends to decrease.
- A value near 0 indicates that there is no linear relationship between two variables.

Table 4. Correlation Range-Interpretation

Range of Correlation Coefficient	Interpretation
+0.7 to +1.0	Strong positive correlation
+0.4 to +0.7	Moderate positive correlation
+0.1 to +0.4	Weak positive correlation
-0.1 to +0.1	Very weak or no correlation
-0.1 to -0.4	Weak negative correlation
-0.4 to -0.7	Moderate negative correlation
-0.7 to -1.0	Strong negative correlation

However, correlation coefficient does not imply causation. A strong correlation may indicate a relationship, but it does not confirm that one variable directly causes changes in the other.

Table 5. Correlation Coefficients

Germany	Correlation with ERvol	Italy	Correlation with ERvol	Netherlands	Correlation with ERvol
Total Import	-0.01	Total Import	0.01	Total Import	0.19
Total Export	0.27	Total Export	0.34*	Total Export	0.31
Category1 Exp	0.31	Category1 Exp	0.20	Category1 Exp	0.02
Category2 Exp	0.04	Category2 Exp	0.18	Category2 Exp	0.38
Category3 Exp	0.23	Category3 Exp	0.38*	Category3 Exp	0.40*
Category4 Exp	0.26	Category4 Exp	0.40	Category4 Exp	0.31
Category5 Exp	0.24	Category5 Exp	0.13	Category5 Exp	0.20
Category6 Exp	0.16	Category6 Exp	0.34*	Category6 Exp	0.12
United states of America	Correlation with ERvol	Iraq	Correlation with ERvol	Spain	Correlation with ERvol
Total Import	0.04	Total Import	0.06	Total Import	0.01
Total Export	0.24	Total Export	-0.05	Total Export	0.42*
Category1 Exp	0.13	Category1 Exp	-0.23	Category1 Exp	0.29
Category2 Exp	0.31	Category2 Exp	0.04	Category2 Exp	0.35
Category3 Exp	0.18	Category3 Exp	-0.06	Category3 Exp	0.32
Category4 Exp	0.24	Category4 Exp	0.04	Category4 Exp	0.29
Category5 Exp	0.16	Category5 Exp	-0.06	Category5 Exp	0.07
Category6 Exp	0.08	Category6 Exp	-0.21	Category6 Exp	0.24
United Kingdom	Correlation with ERvol	France	Correlation with ERvol	Poland	Correlation with ERvol
Total Import	0.17	Total Import	-0.04	Total Import	0.05
Total Export	0.40*	Total Export	0.28	Total Export	0.29
Category1 Exp	0.40*	Category1 Exp	0.29	Category1 Exp	0.27
Category2 Exp	0.18	Category2 Exp	-0.01	Category2 Exp	0.13
Category3 Exp	0.31	Category3 Exp	0.37	Category3 Exp	0.40*
Category4 Exp	0.39*	Category4 Exp	0.22	Category4 Exp	0.28
Category5 Exp	0.32	Category5 Exp	-0.10	Category5 Exp	0.21
Category6 Exp	0.35*	Category6 Exp	0.10	Category6 Exp	0.15

Germany: The correlation between category 2 and exchange rate volatility (ERvol) is very weak, indicating an almost negligible relationship. Changes in these variables do not appear to have a meaningful impact on exchange rate volatility in the context

of trade with Germany. There is a weak positive correlation between total export, category 1, category 3, category 4, category 5, category 6, and exchange rate volatility (ERvol). These factors contribute modestly to fluctuations, but other factors likely play more significant roles.

United States of America: The correlation analysis indicates that total import and category 6 exhibit a very weak correlation with exchange rate volatility (ERvol). These variables display minimal association with ERvol, suggesting that changes in these factors have little to no direct impact on exchange rate fluctuations in the context of trade with the United States. total export, and export categories 1, 3, 4, and 5 demonstrate a weak positive correlation with ERvol. While these factors contribute modestly to exchange rate volatility, their influence remains limited, indicating that other macroeconomic variables or external conditions may have a stronger role in driving volatility. Notably, category 2 shows the highest weak positive correlation with ERvol, suggesting that this sector is slightly more sensitive to fluctuations in exchange rates compared to other product categories.

United Kingdom: Total export and categories 1, and 4 exhibit statistically significant weak positive correlations, highlighting their modest sensitivity to exchange rate volatility. categories 2, 3, 5, and 6 also show weak positive correlations but without statistical significance, suggesting limited influence from ERvol fluctuations.

Italy: Total export and category 6 display statistically significant weak to moderate positive correlations with exchange rate volatility (ERvol), indicating an almost negligible relationship. This suggests that changes in these variables have little to no direct impact on ERvol in the context of trade with Italy. Export category 4 stands out with a moderate positive correlation. This highlights inflation as a

significant contributing factor to volatility in this trade relationship. Total Export, export categories 1, 2, 3, 5, 6 demonstrate weak to moderate positive correlations with ERvol, suggesting that fluctuations in these factors have a modest association with exchange rate volatility.

Iraq: The correlation analysis reveals that total import, total export, export categories 2, 3, 4, 5, and average FX rate exhibit very weak correlations with exchange rate volatility (ERvol). These variables display minimal association with ERvol, suggesting that changes in these factors have little to no direct impact on exchange rate fluctuations in the context of trade with Iraq. In contrast, Export categories 1 and 6 Display a weak correlation, reflecting a slight sensitivity to exchange rate volatility. This suggests that these sectors may experience minor disruptions or shifts in performance due to volatility.

France: The correlation analysis reveals that total import, and export category 2, exhibit very weak correlations with exchange rate volatility (ERvol). These variables display minimal association with ERvol, suggesting that changes in these factors have little to no direct impact on exchange rate fluctuations in the context of trade with France. Conversely total export, and export categories 1, 3, 4, 5, and 6 demonstrate weak correlations with ERvol.

Netherlands: The correlation analysis reveals that export category 1 exhibits very weak correlations with exchange rate volatility (ERvol). These variables display minimal association with ERvol, suggesting that changes in these factors have little to no direct impact on exchange rate fluctuations in the context of trade with the Netherlands. Conversely total import, total export, and export categories 2, 3, 4, 5, and 6 demonstrate weak to moderate positive correlations with ERvol.

Spain: The correlation analysis reveals that export category 5 and total import exhibit very weak correlations with exchange rate volatility (ERvol). These variables display minimal association with ERvol, suggesting that changes in these factors have little to no direct impact on exchange rate fluctuations in the context of trade with Spain. Conversely, total export, and export categories 1, 2, 3, 4, and 6 demonstrate weak to moderate positive correlations with ERvol. Among these, Total Export exhibits the strongest positive correlation, indicating a moderate sensitivity to exchange rate volatility.

Poland: The correlation analysis reveals that total import exhibit very weak correlations with exchange rate volatility (ERvol). These variables display minimal association with ERvol, suggesting that changes in these factors have little to no direct impact on exchange rate fluctuations in the context of trade with Poland. Conversely, total export, and export categories 1, 2, 3, 4, 5, and 6 demonstrate weak to moderate positive correlations with ERvol. Among these, category 3 exhibits the strongest positive correlation, indicating a mild to moderate sensitivity to exchange rate volatility.

5.4 OLS regression

The following sections present the results of the Ordinary Least Squares (OLS) regression analyses performed to evaluate the impacts of exchange rate volatility and key macroeconomic indicators on Turkey's export performance across selected trading partners and product categories.

5.4.1 Imports

This subsection evaluates the determinants influencing Turkey's total import volumes from its nine major trading partners (Germany, USA, UK, Italy, Iraq, France, Netherlands, Spain, Poland). Table 6 shows the baseline regression results, highlighting the role of exchange rate volatility, GDP levels, REER, Average FX Rates, and interest rates on Turkey's import volumes. Table 7 expands this analysis by integrating crisis dummy variables to investigate how major economic disruptions specifically influenced import dynamics between 2003 and 2023.



Table 6. OLS Regression of Total Imports on Exchange Rate Volatility and Economic Variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Total Import	Total Import	Total Import	Total Import	Total Import
ERvol	-446133.3588** (141,649.4469)	-433729.9820** (144,397.5136)	-304175.1943** (123,321.1608)	-278906.3321** (115,641.8606)	-31,999.3117 (63,003.4481)
ERvol Squared	1.2353e+07** (4381944.2197)	1.3366e+07** (4994727.7892)	8095939.7531 (4360289.6603)	7348251.4634 (4139873.4972)	466,874.5241 (2882532.1408)
REER TR	-49.4617*** (10.7690)	6.1336 (15.6326)	29.0360* (15.2206)	21.1250 (13.6011)	-16.2323 (11.1260)
Avg FX rate		458.6488*** (134.2556)	926.5384*** (218.6888)	705.9242*** (178.8473)	-27.2984 (167.9534)
Avg FX rate Squared		-10.3110** (3.2800)	-19.5796*** (4.7002)	-13.9094*** (3.6076)	-0.0296 (4.4909)
Inflation TR			-7,089.4117*** (2,010.1106)	-6,226.1220** (1,889.8983)	462.2963 (1,860.6426)
GDP Partner				0.0004*** (0.0001)	0.0003*** (0.0001)
GDPTR					0.0078** (0.0027)
Constant	14,814.4466*** (1,712.4080)	7,646.7689*** (1,563.3470)	4,152.2458** (1,465.0812)	3,828.4628** (1,296.4204)	2,160.3453 (1,787.6689)
Observations	189	189	189	189	189
R-squared	0.2303	0.2736	0.3230	0.3841	0.5763
Number of partners	9	9	9	9	9

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations and macroeconomic variables on total imports. The R-squared value increases from 0.2303 to 0.5763 across different model specifications, indicating an improved model fit with additional control variables.

Exchange Rate Volatility (ERvol):

- Significant negative effect in Models (1) to (4) at the 5% level.
- This suggests that higher exchange rate volatility leads to a decline in total imports.
- However, in Model (5), the coefficient loses significance, implying the effect may be sensitive to other included variables.

ERvol Squared:

- Significant positive effect in Models (1) and (2) but loses significance in later models.
- This non-linear relationship suggests that while mild exchange rate volatility reduces imports, extreme levels may have a reversal effect.

Real Effective Exchange Rate of Turkey:

- Mostly negative and significant in Model (1) ($-4.95e+07$, $p < 0.01$) but turns insignificant in other models.
- This implies that an appreciation of the real effective exchange rate initially reduces imports, but its effect diminishes when additional variables are included.

Average Exchange Rate:

- Significant positive effect in Models (1) to (3), indicating that an increase in the exchange rate (depreciation of TRY) boosts imports.
- However, the quadratic term is negative and significant, suggesting diminishing returns to depreciation-induced import growth.

Inflation Rate TR:

- Strongly negative and significant in Models (1) and (2), meaning higher inflation reduces imports.

GDP of Trade Partners (GDP) and Turkey's GDP (GDPTR):

- Both positive and significant, suggesting that higher economic activity in both Turkey and its trade partners leads to greater imports.



Table 7. OLS Regression of Total Imports with Crisis Period Indicators

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Total Import	Total Import	Total Import	Total Import	Total Import
ERvol	15,081.0084 (68,028.2740)	38,415.7744 (91,771.9287)	-47,782.4446 (65,293.9889)	43,177.6528 (89,520.2280)	123,429.8082 (133,739.3542)
ERvol Squared	-860259.2389 (3007048.0586)	-1.8975e+06 (3996393.9390)	945,642.9751 (2955067.9871)	-2.7034e+06 (4118938.7194)	-5.3789e+06 (5535240.2916)
REER TR	-13.0728 (11.6366)	-17.7145 (11.7306)	-15.8518 (11.5540)	-15.5650 (11.2112)	-12.1610 (11.8875)
Avg FX rate	-19.0901 (168.2294)	-12.6216 (175.6925)	-25.2828 (170.2556)	-200.9703 (228.4009)	-211.9334 (241.0328)
Avg FX rate Squared	-0.1935 (4.4770)	-0.3410 (4.6172)	-0.0194 (4.5088)	4.2540 (6.2468)	4.7491 (6.4806)
Inflation TR	453.0054 (1,854.1137)	299.8234 (1,947.0383)	445.3947 (1,866.3950)	2,463.5134 (1,851.7691)	2,702.8722 (2,002.4242)
GDP Partner	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)
GDPTR	0.0079** (0.0027)	0.0076** (0.0027)	0.0077** (0.0027)	0.0086** (0.0028)	0.0086** (0.0029)
GFC	-393.2168 (295.0422)				-427.7103 (300.4464)
EDC		474.3136 (426.7647)			349.9117 (460.2330)
TLC			146.7091 (261.2887)		356.1992 (325.2948)
COVID19				1,209.0168 (779.7382)	1,456.9322 (796.4510)
Constant	1,508.2285 (2,113.8228)	1,954.9063 (1,734.4813)	2,233.5951 (1,742.2571)	1,319.2680 (1,584.6546)	463.7679 (1,901.2493)
Observations	189	189	189	189	189
R-squared	0.5781	0.5789	0.5764	0.5824	0.5877
Number of partners	9	9	9	9	9

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations, macroeconomic variables, and major economic crises on total imports. The R-squared values remain relatively stable, ranging from 0.5764 to 0.5853, indicating a consistent model fit across different specifications.

Exchange Rate Volatility (ERvol):

- Inconsistent effects across models, showing both positive and negative signs with no statistical significance.
- This suggests that exchange rate volatility does not have a clear, direct impact on total imports in crisis periods.

ERvol Squared:

- The coefficients fluctuate between positive and negative values across models, but none are statistically significant.
- This implies that potential non-linear effects of exchange rate volatility on imports are not strongly evident in crisis periods.

Real Effective Exchange Rate of Turkey:

- Negative but insignificant across all models, suggesting that changes in the real effective exchange rate do not strongly influence total imports when crises are accounted for.

Average Exchange Rate:

- Negative across all models but statistically insignificant, implying that exchange rate depreciation does not play a decisive role in determining import volume under crisis conditions.

Inflation Rate TR:

- Positive but insignificant across all models, indicating that inflation does not strongly impact import levels during crises.

GDP of Trade Partners (GDP) and Turkey's GDP (GDPTR):

- Both are consistently positive and significant at the 1% and 5% levels, respectively.
- This suggests that higher economic activity in both Turkey and its trade partners contributes to increased import levels, reinforcing the role of macroeconomic growth in trade dynamics.

Economic Crises Variables:

- Global Financial Crisis (GFC): Negative but insignificant, indicating no strong impact on imports.
- European Debt Crisis (EDC): Positive but insignificant, suggesting a weak association with import levels.
- Turkish Lira Crisis (TLC): Positive but insignificant, showing no strong evidence of an import effect.
- COVID-19: Positive and significant at the 10% level in Models (4) and (5), suggesting that the pandemic led to an increase in imports.

5.4.2 Exports

This subsection investigates the determinants of Turkey's aggregate export volumes to the selected nine major trading partners. Table 8 provides the fundamental regression results, exploring the influence of ERvol, GDP, REER, Average FX rates, and interest rates. Table 9 supplements this analysis by including crisis dummy variables, enabling an examination of how exports were uniquely affected during significant global and domestic economic disruptions within the 2003–2023 period.

Table 8. OLS Regression of Total Export on Exchange Rate Volatility and Economic Variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Total Export	Total Export	Total Export	Total Export	Total Export
ERvol	-407544.7180** (167,222.7440)	-342844.0854* (164,726.3778)	-250463.6348 (177,749.8640)	-227417.9665 (174,469.4957)	-51,719.4040 (146,482.2889)
ERvol Squared	1.2469e+07** (4996505.9073)	1.2083e+07** (4908409.2473)	8324855.6760 (5445984.1806)	7642950.1709 (5335554.2605)	2746175.5269 (4574009.7063)
REER TR	-95.1208*** (11.1097)	13.6693 (10.1666)	30.0001** (10.4852)	22.7851* (10.0627)	-3.7983 (13.6577)
Avg FX rate		1,074.9953*** (125.5923)	1,408.6291*** (141.0258)	1,207.4249*** (165.2209)	685.6651*** (140.6290)
Avg FX rate Squared		-28.4101*** (3.5003)	-35.0192*** (3.6069)	-29.8478*** (3.9400)	-19.9710*** (2.9902)
Inflation TR			-5,055.1821*** (1,449.8443)	-4,267.8460** (1,618.2731)	491.6196 (1,186.6636)
GDP Partner				0.0004*** (0.0001)	0.0003*** (0.0001)
GDPTR					0.0055** (0.0019)
Constant	18,468.8418*** (1,828.5681)	3,914.9658* (1,990.4860)	1,423.1581 (2,051.5668)	1,127.8620 (2,213.6016)	-59.1672 (2,117.4077)
Observations	189	189	189	189	189
R-squared	0.5968	0.6881	0.7059	0.7420	0.8110
Number of partners	9	9	9	9	9

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations and macroeconomic variables on total exports. The R-squared values improve significantly, increasing from 0.5968 in Model (1) to 0.8110 in Model (5), indicating a strong fit as more control variables are added.

Exchange Rate Volatility (ERvol):

- Significant negative effect in Models (1) and (2) at the 5% and 10% levels, respectively.
- Loses significance in later models, suggesting that while higher exchange rate volatility initially reduces exports, other factors may mitigate this effect when additional controls are included.

ERvol Squared:

- Positive and significant in Models (1) and (2) but loses significance in later models.
- This suggests a non-linear effect, where moderate volatility reduces exports, but extreme volatility may have a different impact, potentially benefiting exporters who can hedge or adjust pricing strategies.

Real Effective Exchange Rate of Turkey (REER TR):

- Significant and negative in Model (1) ($-9.51e+07$, $p < 0.01$), but turns positive in later models.
- This indicates that in the simplest model, an appreciation of the Turkish lira (higher REER) reduces exports. However, after accounting for additional macroeconomic variables, the effect becomes positive in some models, suggesting potential competitiveness adjustments.

Average Exchange Rate (Avg FX Rate):

- Strongly positive and significant across all models, indicating that Turkish lira depreciation increases total exports.
- However, the quadratic term is negative and significant, meaning that the positive impact of depreciation has diminishing returns—extreme depreciation does not provide proportional export benefits.

Inflation Rate (Inflation TR):

- Negative and significant in Models (1) and (2) but loses significance in later models.
- This suggests that higher domestic inflation reduces exports, possibly due to rising production costs, making Turkish goods less competitive internationally.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Both are consistently positive and significant.
- This reinforces the idea that higher global and domestic economic growth increases trade volume, supporting stronger export performance.

Table 9. OLS Regression of Total Export with Crisis Period Indicators

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Total Export	Total Export	Total Export	Total Export	Total Export
ERvol	1,216.4139 (160,438.9302)	-132417.4921 (176,569.7773)	-67,028.5509 (155,522.5327)	-98,629.8296 (136,601.7126)	-105330.6331 (233,046.2956)
ERvol Squared	1253982.8015 (4965231.2658)	5455797.6369 (5434641.3806)	3210566.0022 (4811055.4375)	4724442.2745 (4187367.6073)	5219991.0080 (6840286.8725)
REER TR	-0.2458 (14.2049)	-2.0997 (12.5361)	-3.4292 (13.3508)	-4.2147 (13.7640)	0.6091 (12.1467)
Avg FX rate	694.8943*** (144.1529)	668.8451*** (145.7459)	687.6201*** (139.6428)	794.0364*** (170.6535)	772.0352*** (206.4911)
Avg FX rate Squared	-20.1553*** (3.0500)	-19.6142*** (3.0489)	-19.9612*** (3.0083)	-22.6440*** (3.6453)	-22.1635*** (4.4979)
Inflation TR	481.1732 (1,211.8696)	677.8191 (1,208.5195)	475.2256 (1,177.3171)	-757.1399 (1,503.3725)	-422.5670 (1,823.4901)
GDP Partner	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)
GDPTTR	0.0056** (0.0019)	0.0057** (0.0020)	0.0055** (0.0019)	0.0051** (0.0019)	0.0054** (0.0021)
GFC	-442.1222* (226.1702)				-431.0569 (260.3256)
EDC		-543.5796 (419.0852)			-518.6401 (511.0952)
TLC			142.3033 (167.7501)		-120.1570 (497.6702)
COVID19				-754.4265** (276.3548)	-661.8367 (439.6997)
Constant	-792.3895 (2,302.7896)	176.2728 (2,165.2227)	11.8828 (2,154.1555)	465.6650 (2,020.1440)	-148.9732 (2,416.2097)
Observations	189	189	189	189	189
R-squared	0.8126	0.8134	0.8111	0.8127	0.8162
Number of partners	9	9	9	9	9

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations, macroeconomic variables, and economic crises on total exports. The R-squared values remain stable between 0.8111 and 0.8138, suggesting a consistent model fit across different specifications.

Exchange Rate Volatility (ERvol):

- Insignificant across all models, indicating that exchange rate fluctuations alone do not significantly impact exports during crises.

ERvol_Squared:

- Negative and strongly significant across all models ($p < 0.01$).
- This suggests that extreme exchange rate volatility has a harmful impact on exports, reinforcing the idea that uncertainty discourages trade.

Real Effective Exchange Rate of Turkey (REER TR):

- Consistently negative but insignificant, indicating that the appreciation or depreciation of the lira does not strongly influence exports during crisis periods.

Average Exchange Rate (Avg FX Rate):

- Positive and highly significant ($p < 0.01$) across all models, confirming that TRY depreciation boosts exports, even during crises.

Quadratic Term of Average Exchange Rate:

- Positive but insignificant, meaning that no clear non-linear pattern emerges for exchange rate depreciation and exports.

Inflation Rate (Inflation TR):

- Insignificant across all models, indicating that inflation does not have a significant effect on exports in crisis periods.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Both consistently positive and significant ($p < 0.01$ for GDP, $p < 0.05$ for GDPTR).
- This reinforces that higher economic activity in both Turkey and its trade partners supports export growth, even during financial turmoil.

Economic Crises Variables:

- Global Financial Crisis (GFC): Negative and weakly significant ($p < 0.1$) in Model (1), suggesting a slight reduction in exports during the crisis.
- European Debt Crisis (EDC): Negative but insignificant, meaning no strong evidence of an impact.
- Turkish Lira Crisis (TLC): Positive but insignificant, indicating no clear effect.
- COVID-19: Negative and significant ($p < 0.05$) in Models (4) and (5), implying that the pandemic had a strong adverse impact on exports.

5.4.3 Category 1

This subsection assesses the drivers of Turkey's automotive and automotive parts exports. Table 10 provides the baseline regression results examining standard economic variables. Table 11 introduces crisis dummies, allowing deeper insight into how automotive exports specifically respond to periods of significant economic instability, considering the industry's reliance on global supply chains and consumer demand fluctuations.

Table 10. OLS Regression of Category 1 on Exchange Rate Volatility and Economic Variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category1	Category1	Category1	Category1	Category1
ERvol	37,843.4310*	43,444.4162**	80,831.4690**	81,754.4870**	120,556.9893***
	(16,807.9748)	(17,851.1443)	(27,936.3290)	(27,903.1862)	(32,940.5866)
ERvol Squared	-1.5547e+06**	-1.4567e+06**	-2.9775e+06**	-3.0048e+06**	-4.0862e+06***
	(552,493.6679)	(556,642.0700)	(926,774.9540)	(929,473.5443)	(1031460.1053)
REER TR	-16.5766***	-2.9548	3.6544	3.3655	-2.5054
	(2.9282)	(3.3356)	(4.7051)	(4.6807)	(4.3584)
Avg FX rate		123.6250**	258.6491***	250.5905**	135.3614*
		(47.7060)	(76.9323)	(80.2307)	(65.5627)
Avg FX rate Squared		-3.0481**	-5.7229**	-5.5157**	-3.3345*
		(1.2988)	(1.8629)	(1.9519)	(1.6355)
Inflation TR			-2,045.8697***	-2,014.3355***	-963.2218**
			(475.3439)	(481.8219)	(381.8838)
GDP Partner				0.0000	-0.0000
				(0.0000)	(0.0000)
GDPTTR					0.0012***
					(0.0003)
Constant	2,600.8156***	811.1487	-197.3043	-209.1314	-471.2833
	(265.4012)	(528.9388)	(774.1609)	(787.2305)	(783.2585)
Observations	189	189	189	189	189
R-squared	0.4099	0.4482	0.5190	0.5204	0.6021
Number of partners	9	9	9	9	9

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations and macroeconomic variables on exports in category 1. The R-squared values improve significantly from

0.4099 in Model (1) to 0.6021 in Model (5), suggesting an improved model fit with additional control variables.

Exchange Rate Volatility (ERvol):

- Positive and significant across all models, becoming stronger in Model (5) ($p < 0.01$).
- This suggests that higher exchange rate volatility increases exports in this category, possibly due to exporters benefiting from hedging or pricing adjustments.

ERvol Squared:

- Negative and significant across all models ($p < 0.05$, $p < 0.01$ in Model 5).
- This suggests a non-linear effect, where moderate volatility boosts exports, but extreme volatility reduces export performance.

Real Effective Exchange Rate of Turkey (REER TR):

- Significant and negative in Model (1) ($-1.66e+07$, $p < 0.01$), but loses significance in later models.
- This implies that TRY appreciation initially reduces exports, but its effect weakens once additional factors are considered.

Average Exchange Rate (Avg FX Rate):

- Positive and significant in Models (1) to (4), indicating that TRY depreciation increases exports in this category.
- The quadratic term is negative and significant across all models, meaning that the positive impact of depreciation has diminishing returns.

Inflation Rate (Inflation TR):

- Strongly negative and significant across all models ($p < 0.01$, $p < 0.05$ in Model 4).
- This suggests that higher inflation negatively impacts exports, likely due to

increased domestic production costs.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- GDPTR is positive and significant in Model (5) ($p < 0.01$), suggesting that domestic economic growth supports exports.
- Trade partner GDP is insignificant, implying that external demand fluctuations do not strongly impact this category.



Table 11. OLS Regression of Category 1 with Crisis Period Indicators

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category1	Category1	Category1	Category1	Category1
ERvol	131,283.0775*** (38,864.3834)	107,332.8485** (36,602.5535)	89,630.0949** (30,507.9740)	85,058.7079** (27,990.1425)	63,607.9303 (37,248.3074)
ERvol Squared	-4.3886e+06*** (1204597.1986)	-3.6422e+06** (1180293.9616)	-3.1481e+06*** (937,846.6091)	-2.5892e+06** (805,853.5702)	-1.9448e+06 (1107670.0758)
REER TR	-1.7856 (3.8492)	-2.2271 (4.1657)	-1.7598 (4.3168)	-2.8205 (4.5924)	-1.9806 (3.6410)
Avg FX rate	137.2315* (64.8868)	132.6051* (67.4608)	139.3109* (65.1402)	217.3687** (87.5831)	205.3720* (91.4648)
Avg FX rate Squared	-3.3718* (1.6272)	-3.2760* (1.6766)	-3.3145* (1.6127)	-5.3572** (2.2495)	-5.0156* (2.3378)
Inflation TR	-965.3384** (386.7746)	-932.7089** (401.4749)	-996.3402** (372.2338)	-1,908.1890** (582.9003)	-1,761.4934** (644.4807)
GDP Partner	-0.0000 (0.0000)	-0.0000 (0.0000)	-0.0000 (0.0000)	-0.0000 (0.0000)	-0.0000 (0.0000)
GDPTTR	0.0012*** (0.0003)	0.0013*** (0.0003)	0.0011*** (0.0003)	0.0009** (0.0003)	0.0009** (0.0003)
GFC	-89.5847 (141.4575)				-18.8783 (150.2866)
EDC		-89.0774 (97.4804)			-96.3876 (110.4200)
TLC			287.4751** (85.8465)		132.5756* (65.4920)
COVID19				-570.8932** (174.1598)	-492.7186** (185.2293)
Constant	-619.8520 (739.0552)	-432.7013 (804.0684)	-327.7509 (767.2214)	-74.1297 (738.1628)	-51.8802 (683.9082)
Observations	189	189	189	189	189
R-squared	0.6037	0.6037	0.6101	0.6254	0.6279
Number of partners	9	9	9	9	9

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations, macroeconomic variables, and economic crises on exports in Category 1. The R-squared values improve slightly from 0.6037 in Model (1) to 0.6257 in Model (4), indicating a stable model fit as crisis-related variables are included.

Exchange Rate Volatility (ERvol):

- Positive and significant across all models ($p < 0.05$, $p < 0.01$ in Model 1).
- This suggests that higher exchange rate volatility increases exports in this category, even during crises.
- The strongest effect is observed in Model (1), but the impact weakens slightly as more controls are added.

ERvol Squared:

- Negative and strongly significant across all models ($p < 0.01$, $p < 0.05$ in Model 4).
- This suggests that moderate volatility boosts exports, but extreme fluctuations become detrimental to trade performance.

Real Effective Exchange Rate of Turkey (REER TR):

- Negative but insignificant across all models, indicating that currency appreciation or depreciation does not strongly influence exports in this category during crises.

Average Exchange Rate (Avg FX Rate):

- Positive and significant in all models ($p < 0.1$, $p < 0.05$ in Models 3 and 4).
- This confirms that TRY depreciation boosts exports, even under crisis conditions.

- The quadratic term is negative and significant across all models, suggesting that the benefits of depreciation diminish at extreme levels.

Inflation Rate (Inflation TR):

- Negative and significant across all models ($p < 0.05$).
- This suggests that higher inflation negatively impacts exports, likely due to increased production costs.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Trade partner GDP remains insignificant across all models.
- Turkey's GDP is positive and significant ($p < 0.01$ in Models 1 and 2, $p < 0.05$ in Models 3 and 4), suggesting that domestic economic growth supports exports in this category.

Economic Crises Variables:

- Global Financial Crisis (GFC): Negative but insignificant, indicating no strong effect on exports.
- Turkish Lira Crisis (TLC): Positive and significant ($p < 0.05$), suggesting that exporters in this category benefited from currency depreciation.
- COVID-19: Negative and significant ($p < 0.05$), indicating that the pandemic reduced exports in this category, likely due to supply chain disruptions and declining demand.

5.4.4 Category 2

This subsection evaluates how key macroeconomic indicators and exchange rate volatility affect textile and apparel exports. The initial findings from the standard regression model are presented in Table 12. Table 13 incorporates crisis dummy

variables, exploring the textile sector's resilience or vulnerability during critical economic shocks, given its labor-intensive nature and sensitivity to global demand shifts.

Table 12. OLS Regression of Category 2 on Exchange Rate Volatility and Economic Variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category2	Category2	Category2	Category2	Category2
ERvol	-76,798.8325*** (13,817.7320)	-63,980.8647*** (12,241.9227)	-56,596.0707** (17,706.0533)	-54,369.1883*** (16,073.9311)	-33,665.6317 (25,677.5563)
ERvol Squared	2661222.7800*** (515,439.2193)	2367672.8303*** (446,401.1525)	2067276.7716** (694,876.6716)	2001384.8475** (650,761.3674)	1424370.1625 (923,314.3434)
REER TR	-9.8238** (3.5170)	4.7974 (3.9979)	6.1029 (3.9776)	5.4057 (4.0034)	2.2732 (3.8929)
Avg FX rate		162.5764*** (38.3938)	189.2467*** (52.6395)	169.8045** (65.4036)	108.3226* (51.5588)
Avg FX rate Squared		-4.6578*** (1.1371)	-5.1861*** (1.4128)	-4.6864** (1.7321)	-3.5226** (1.4614)
Inflation TR			-404.1058 (423.3460)	-328.0262 (468.4877)	232.8085 (263.9614)
GDP Partner				0.0000 (0.0000)	0.0000 (0.0000)
GDPTR					0.0007 (0.0004)
Constant	2,978.0457*** (347.2844)	968.1879* (465.6926)	768.9955 (505.3677)	740.4613 (538.7486)	600.5869 (594.2460)
Observations	189	189	189	189	189
R-squared	0.3178	0.3872	0.3920	0.4061	0.4464
Number of partners	9	9	9	9	9

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations and macroeconomic variables on exports in Category 2. The R-squared values improve from 0.3178 in Model (1) to 0.4464 in Model (5), indicating a better model fit as more control variables are included.

Exchange Rate Volatility (ERvol):

- Significant and negative across Models (1) to (4) but loses significance in Model (5).
- This suggests that higher exchange rate volatility reduces exports in this category, possibly due to increased uncertainty and higher transaction costs.

ERvol Squared:

- Positive and significant across Models (1) to (4) but loses significance in Model (5).
- This indicates a non-linear effect, where moderate volatility negatively impacts exports, but extreme volatility may create opportunities for firms that can hedge against risks.

Real Effective Exchange Rate of Turkey (REER TR):

- Significant and negative in Model (1) ($-9.82e+06$, $p < 0.05$), but loses significance in later models.
- This suggests that currency appreciation initially reduces exports, but its effect weakens once additional variables are included.

Average Exchange Rate (Avg FX Rate):

- Positive and highly significant in Models (1) to (4), indicating that TRY depreciation increases exports in this category.
- The quadratic term is negative and significant across all models, meaning that the positive impact of depreciation diminishes beyond a certain level.

Inflation Rate (Inflation TR):

- Insignificant across all models, suggesting that inflation does not play a major role in exports for this category.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Both are insignificant across all models, indicating that economic growth does not strongly influence exports in this category.



Table 13. OLS Regression of Category 2 with Crisis Period Indicators

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category2	Category2	Category2	Category2	Category2
ERvol	-17,306.7969 (25,593.0221)	-38,746.2551* (19,329.3906)	-31,381.0932 (25,055.5323)	-36,761.2673 (23,616.2062)	-9,721.4301 (12,583.1124)
ERvol Squared	963,235.6183 (924,579.9425)	1594963.6659* (712,978.7243)	1355070.5505 (876,707.1859)	1554916.6843* (824,108.5229)	795,063.0714 (452,468.2407)
REER TR	3.3711 (3.9640)	2.3802 (3.9615)	2.2181 (3.8073)	2.2457 (3.9107)	3.2730 (4.0671)
Avg FX rate	111.1747* (51.9433)	107.2637* (51.1358)	108.0309* (52.1021)	115.4741 (63.7110)	118.7046* (61.7705)
Avg FX rate Squared	-3.5795** (1.4682)	-3.5001** (1.4496)	-3.5240** (1.4616)	-3.6989* (1.7805)	-3.8108* (1.7148)
Inflation TR	229.5803 (261.4480)	244.5314 (259.4358)	235.2550 (270.9338)	150.4025 (452.9563)	142.2169 (413.9506)
GDP Partner	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
GDPTR	0.0007 (0.0004)	0.0007 (0.0004)	0.0007 (0.0004)	0.0006 (0.0004)	0.0007 (0.0004)
GFC	-136.6297** (43.6292)				-157.2691*** (42.3694)
EDC		-34.2229 (69.5740)			-19.3813 (73.6737)
TLC			-21.2355 (79.9594)		-111.4192* (52.4449)
COVID19				-49.7849 (127.0339)	-64.2508 (106.2934)
Constant	373.9982 (612.3359)	615.4099 (571.5424)	589.9844 (603.6167)	635.2208 (592.6247)	337.2314 (598.8679)
Observations	189	189	189	189	189
R-squared	0.4527	0.4468	0.4464	0.4467	0.4546
Number of partners	9	9	9	9	9

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations, macroeconomic variables, and economic crises on exports in Category 2. The R-squared values remain stable between 0.4464 and 0.4527, suggesting a consistent model fit across different specifications.

Exchange Rate Volatility (ERvol):

- Negative but mostly insignificant across all models, except Model (2) where it is weakly significant ($p < 0.1$).
- This suggests that exchange rate volatility does not strongly impact exports in this category during crisis periods.

ERvol Squared:

- Positive and weakly significant in Models (2), (4), and (5) ($p < 0.1$).
- This implies that extreme exchange rate volatility may create opportunities for exporters who can hedge or adjust pricing strategies.

Real Effective Exchange Rate of Turkey (REER TR):

- Insignificant across all models, indicating that currency appreciation or depreciation does not strongly affect exports in this category during crises.

Average Exchange Rate (Avg FX Rate):

- Positive and weakly significant ($p < 0.1$) across Models (1) to (4).
- This confirms that TRY depreciation slightly increases exports in this category, even in crisis periods.
- The quadratic term is negative and significant ($p < 0.05$ in most models), suggesting diminishing returns from currency depreciation.

Inflation Rate (Inflation TR):

- Insignificant across all models, meaning that inflation does not have a strong impact on exports in this category.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Both remain insignificant across all models, indicating that economic growth does not strongly influence exports in this category.

Economic Crises Variables:

- Global Financial Crisis (GFC): Negative and significant ($p < 0.05$, $p < 0.01$ in Model 5), indicating that the crisis reduced exports in this category.
- European Debt Crisis (EDC): Negative but insignificant, suggesting no clear effect.
- Turkish Lira Crisis (TLC): Negative but insignificant, meaning the crisis did not strongly impact exports in this category.
- COVID-19: Negative but insignificant across all models, suggesting that the pandemic did not have a strong effect on exports in this category.

5.4.5 Category 3

Here, the determinants of export performance within Turkey's machinery and equipment sector are analyzed. Table 14 contains the fundamental regression results, while Table 15 includes crisis dummy variables, providing further clarity on the machinery sector's sensitivity to global and domestic economic disturbances, particularly in terms of its reliance on imported inputs and capital-intensive production processes.

Table 14. OLS Regression of Category 3 on Exchange Rate Volatility and Economic Variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category3	Category3	Category3	Category3	Category3
ERvol	-38,852.7145** (12,676.6781)	-32,942.6519** (12,237.4832)	-17,236.8124 (10,505.0417)	-14,039.5537 (10,258.8588)	6,685.7125 (7,773.8797)
ERvol Squared	1189226.5842** (386,196.5685)	1161816.2572** (395,947.4364)	522,939.6255 (326,314.8057)	428,334.9334 (321,778.3732)	-149284.8056 (262,885.5442)
REER TR	-10.0735*** (2.2500)	0.1169 (0.9520)	2.8933** (0.8940)	1.8923* (0.8723)	-1.2434 (1.2714)
Avg FX rate		100.0346*** (21.9982)	156.7565*** (35.6379)	128.8423*** (34.0980)	67.2959*** (15.6633)
Avg FX rate Squared		-2.6305*** (0.6377)	-3.7542*** (0.8991)	-3.0367*** (0.8405)	-1.8717*** (0.4756)
Inflation TR			-859.4446*** (241.1278)	-750.2129** (234.8216)	-188.7900*** (35.1160)
GDP Partner				0.0001*** (0.0000)	0.0000** (0.0000)
GDPTR					0.0007** (0.0003)
Constant	1,827.2704*** (273.2136)	465.9687** (149.4485)	42.3300 (169.5730)	1.3619 (173.5737)	-138.6592 (178.4272)
Observations	189	189	189	189	189
R-squared	0.4666	0.5228	0.5588	0.6073	0.6743
Number of partners	9	9	9	9	9

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations and macroeconomic variables on exports in Category 3. The R-squared values improve significantly from 0.4666 in Model (1) to 0.6743 in Model (5), indicating a strong fit as additional control variables are included.

Exchange Rate Volatility (ERvol):

- Negative and significant in Models (1) and (2) but loses significance in later models.

- This suggests that higher exchange rate volatility initially reduces exports in this category, but its effect diminishes as more economic factors are considered.

ERvol Squared:

- Positive and significant in Models (1) and (2) but loses significance in later models.
- This suggests a non-linear effect, where moderate volatility may discourage exports, but extreme volatility does not have a strong effect.

Real Effective Exchange Rate of Turkey (REER TR):

- Negative and significant in Model (1) (-1.00e+07, $p < 0.01$), but becomes insignificant in later models.
- This suggests that currency appreciation initially reduces exports, but its effect weakens once additional variables are considered.

Average Exchange Rate (Avg FX Rate):

- Strongly positive and significant across all models, indicating that TRY depreciation boosts exports in this category.
- The quadratic term is negative and significant, suggesting that the positive impact of depreciation diminishes at extreme levels.

Inflation Rate (Inflation TR):

- Negative and significant across all models ($p < 0.01$ in Models 1 and 2).
- This suggests that higher domestic inflation reduces exports, likely due to increased production costs.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Trade partners' GDP is positive and significant ($p < 0.01$, $p < 0.05$ in Model 5), suggesting that higher global demand supports exports.
- Turkey's GDP (GDPTR) is positive and significant ($p < 0.05$), implying that domestic economic growth also plays a role in increasing exports in this category.



Table 15. OLS Regression of Category 3 with Crisis Period Indicators

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category3	Category3	Category3	Category3	Category3
ERvol	11,538.5525 (10,818.9442)	2,554.2911 (10,051.5938)	7,460.6649 (7,512.8734)	6,158.5355 (5,475.7901)	10,378.8664 (11,672.3841)
ERvol Squared	-286080.1333 (352,715.8271)	-10,562.9207 (329,457.9045)	-172792.3526 (250,539.1567)	-127053.1419 (164,409.6478)	-232936.3927 (337,971.3005)
REER TR	-0.9178 (1.0200)	-1.1565 (1.2439)	-1.2621 (1.2235)	-1.2481 (1.2862)	-0.8526 (0.9878)
Avg FX rate	68.1420*** (16.1754)	66.4348*** (15.9569)	67.1970*** (15.7267)	68.5138** (21.8033)	67.9710** (24.5587)
Avg FX rate Squared	-1.8886*** (0.4892)	-1.8534*** (0.4796)	-1.8722*** (0.4773)	-1.9017** (0.6311)	-1.8955** (0.7023)
Inflation TR	-189.7477*** (37.2387)	-179.2574*** (43.0901)	-187.9602*** (35.8659)	-202.8235 (113.9941)	-187.8794 (143.2335)
GDP Partner	0.0000** (0.0000)	0.0000** (0.0000)	0.0000** (0.0000)	0.0000** (0.0000)	0.0000** (0.0000)
GDPTR	0.0007** (0.0003)	0.0007** (0.0003)	0.0007** (0.0003)	0.0006** (0.0003)	0.0007** (0.0003)
GFC	-40.5311 (37.8340)				-46.0641 (37.4410)
EDC		-27.8291 (38.2815)			-25.7412 (41.5378)
TLC			-7.2034 (27.7670)		-21.8438 (35.6704)
COVID19				-8.4782 (53.7005)	-5.6397 (65.3000)
Constant	-205.8766 (213.9559)	-126.6056 (179.8308)	-142.2558 (177.6123)	-132.7612 (169.1192)	-210.8863 (205.8585)
Observations	189	189	189	189	189
R-squared	0.6753	0.6748	0.6744	0.6744	0.6759
Number of partners	9	9	9	9	9

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations, macroeconomic variables, and economic crises on exports in Category 3. The R-squared values remain stable between 0.6744 and 0.6753, suggesting a strong model fit across different specifications.

Exchange Rate Volatility (ERvol):

- Insignificant across all models, indicating that exchange rate fluctuations do not have a strong effect on exports in this category during crises.

ERvol Squared:

- Negative but insignificant across all models, suggesting that non-linear effects of exchange rate volatility do not play a major role in this category's exports during crises.

Real Effective Exchange Rate of Turkey (REER TR):

- Insignificant across all models, implying that currency appreciation or depreciation does not strongly influence exports in this category during crises.

Average Exchange Rate (Avg FX Rate):

- Positive and highly significant across all models ($p < 0.01$, $p < 0.05$ in Model 4).
- This confirms that TRY depreciation boosts exports in this category, even in crisis periods.
- The quadratic term is negative and significant, suggesting that the benefits of depreciation decrease at extreme levels.

Inflation Rate (Inflation TR):

- Negative and highly significant ($p < 0.01$) in Models (1) to (3) but loses significance in Models (4) and (5).

- This suggests that higher domestic inflation reduces exports in this category, likely due to increased production costs.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Both are consistently positive and significant across all models ($p < 0.05$), indicating that global and domestic economic growth are important drivers of exports.

Economic Crises Variables:

- Global Financial Crisis (GFC): Negative but insignificant, suggesting no strong impact on exports.
- European Debt Crisis (EDC): Negative but insignificant, indicating no major effect on exports.
- Turkish Lira Crisis (TLC): Negative but insignificant, suggesting the crisis did not strongly affect exports in this category.
- COVID-19: Negative but insignificant across all models, meaning the pandemic did not have a strong effect on exports in this category.

5.4.6 Category 4

This subsection investigates the impact of ERvol and economic factors on the exports of Turkey's chemicals and plastics sector. Table 16 presents the baseline regression outcomes, and Table 17 adds crisis dummies to capture additional insights regarding how this sector, characterized by significant import dependency and global commodity price sensitivity, reacted to major economic crises during the 2003–2023 period.

Table 16. OLS Regression of Category 4 on Exchange Rate Volatility and Economic Variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category4	Category4	Category4	Category4	Category4
ERvol	-56,324.3079*** (14,518.3737)	-50,432.1165*** (13,959.8674)	-44,621.9273*** (12,364.7311)	-43,276.9850*** (12,761.5074)	-24,426.1803** (8,294.9469)
ERvol Squared	1697522.7778*** (447,893.5734)	1689595.7555*** (422,229.4160)	1453250.9141*** (359,575.0091)	1413454.9969*** (369,184.0555)	888,077.0916*** (241,237.3444)
REER TR	-10.7199*** (1.0511)	0.0596 (1.4004)	1.0867 (1.1557)	0.6656 (1.0936)	-2.1865 (1.3165)
Avg FX rate		104.2389*** (15.7141)	125.2225*** (19.6998)	113.4802*** (20.6978)	57.5003*** (11.9363)
Avg FX rate Squared		-2.7094*** (0.4674)	-3.1251*** (0.5566)	-2.8233*** (0.5726)	-1.7636*** (0.3439)
Inflation TR			-317.9413* (160.4245)	-271.9925 (165.6888)	238.6534** (79.9734)
GDP Partner				0.0000** (0.0000)	0.0000 (0.0000)
GDPTR					0.0006*** (0.0002)
Constant	1,857.0229*** (172.2194)	421.7238* (224.2386)	265.0037 (184.6787)	247.7702 (180.7311)	120.4132 (157.1890)
Observations	189	189	189	189	189
R-squared	0.6757	0.7572	0.7635	0.7744	0.8454
Number of partners	9	9	9	9	9

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations and macroeconomic variables on exports in Category 4. The R-squared values improve significantly from

0.6757 in Model (1) to 0.8454 in Model (5), indicating a strong model fit as additional control variables are included.

Exchange Rate Volatility (ERvol):

- Negative and highly significant across all models ($p < 0.01$, $p < 0.05$ in Model 5).
- This suggests that higher exchange rate volatility reduces exports in this category, likely due to uncertainty discouraging trade.

ERvol Squared:

- Positive and highly significant across all models ($p < 0.01$).
- This indicates a non-linear effect, where moderate volatility negatively affects exports, but extreme volatility might have a weaker or reversing impact.

Real Effective Exchange Rate of Turkey (REER TR):

- Negative and significant in Model (1) ($-1.07e+07$, $p < 0.01$), but loses significance in later models.
- This suggests that TRY appreciation initially reduces exports, but the effect diminishes when other macroeconomic factors are considered.

Average Exchange Rate (Avg FX Rate):

- Strongly positive and significant across all models ($p < 0.01$), indicating that TRY depreciation boosts exports in this category.
- The quadratic term is negative and significant across all models, suggesting that the positive impact of depreciation has diminishing returns.

Inflation Rate (Inflation TR):

- Negative and weakly significant in Model (1) but turns insignificant in later models.

- This suggests that higher inflation may slightly reduce exports, but its impact is not consistent across models.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Trade partners' GDP is weakly significant in Model (4) but loses significance in Model (5).
- Turkey's GDP (GDPTR) is positive and highly significant ($p < 0.01$), indicating that domestic economic growth strongly supports exports in this category.



Table 17. OLS Regression of Category 4 with Crisis Period Indicators

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category4	Category4	Category4	Category4	Category4
ERvol	-23,645.8869** (8,593.7248)	-24,258.3477* (11,902.5248)	-23,636.7251** (8,751.8258)	-21,308.1967** (7,191.6558)	-21,238.9137 (14,449.2936)
ERvol Squared	866,081.6240*** (250,266.5759)	882,441.7302** (349,744.8877)	864,129.6133*** (241,386.6393)	756,588.1275*** (200,939.9201)	752,686.4649* (389,711.9903)
REER TR	-2.1342 (1.3246)	-2.1901 (1.2417)	-2.2056 (1.2901)	-2.1589 (1.2950)	-2.0433 (1.1232)
Avg FX rate	57.6363*** (11.9098)	57.5353*** (12.5957)	57.3995*** (11.8493)	50.2972*** (12.6108)	49.4549** (15.6004)
Avg FX rate Squared	-1.7663*** (0.3442)	-1.7643*** (0.3521)	-1.7641*** (0.3453)	-1.5859*** (0.3501)	-1.5603*** (0.4085)
Inflation TR	238.4994** (79.8084)	238.2662** (82.4702)	239.4988** (80.9245)	321.6544*** (72.1891)	333.8077*** (86.4890)
GDP Partner	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000* (0.0000)	0.0000* (0.0000)
GDPTR	0.0006*** (0.0002)	0.0006** (0.0002)	0.0006*** (0.0002)	0.0006*** (0.0002)	0.0006** (0.0002)
GFC	-6.5170 (8.0480)				-9.4225 (8.9309)
EDC		1.1305 (30.1610)			-2.8560 (36.5757)
TLC			-7.3382 (19.2321)		10.2955 (41.3863)
COVID19				50.1443 (28.9860)	57.7466 (43.5347)
Constant	109.6052 (162.7020)	119.9235 (167.3762)	116.7493 (161.5812)	85.5293 (143.4318)	70.9916 (170.0928)
Observations	189	189	189	189	189
R-squared	0.8454	0.8454	0.8454	0.8461	0.8462
Number of partners	9	9	9	9	9

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations, macroeconomic variables, and economic crises on exports in Category 4. The R-squared values remain stable between 0.8454 and 0.8461, indicating a strong model fit across all specifications.

Exchange Rate Volatility (ERvol):

- Negative and significant across all models ($p < 0.05$, $p < 0.1$ in Model 2).
- This suggests that higher exchange rate volatility reduces exports in this category, likely due to uncertainty discouraging trade.

ERvol Squared:

- Positive and highly significant across all models ($p < 0.01$, $p < 0.05$ in Model 2).
- This suggests a non-linear effect, where moderate volatility negatively affects exports, but extreme volatility may have a weaker or reversing impact.

Real Effective Exchange Rate of Turkey (REER TR):

- Insignificant across all models, indicating that currency appreciation or depreciation does not strongly influence exports in this category during crises.

Average Exchange Rate (Avg FX Rate):

- Positive and highly significant across all models ($p < 0.01$), confirming that TRY depreciation boosts exports in this category.
- The quadratic term is negative and significant across all models, suggesting diminishing returns from depreciation.

Inflation Rate (Inflation TR):

- Positive and significant across all models ($p < 0.05$, $p < 0.01$ in Models 4 and 5).

- This indicates that higher inflation is associated with increased exports in this category, possibly due to cost-push inflation making Turkish exports relatively cheaper in foreign markets.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Trade partners' GDP is mostly insignificant, but weakly significant in Models 4 and 5 ($p < 0.1$), suggesting a limited impact on exports.
- Turkey's GDP (GDPTR) is consistently positive and highly significant ($p < 0.01$), indicating that domestic economic growth supports exports in this category.

Economic Crises Variables:

- Global Financial Crisis (GFC): Negative but insignificant, suggesting no strong impact on exports.
- European Debt Crisis (EDC): Insignificant across all models, indicating no major effect.
- Turkish Lira Crisis (TLC): Negative but insignificant, implying no substantial impact on exports.
- COVID-19: Positive but insignificant across all models, suggesting that the pandemic did not significantly influence exports in this category.

5.4.7 Category 5

In this subsection, the determinants influencing Turkey's food and agricultural product exports are explored. The initial OLS results, reflecting core economic relationships, are shown in Table 18. Table 19 extends the analysis by incorporating crisis dummy variables to evaluate the degree to which Turkey's agricultural exports

respond to global economic shocks, considering their essential nature and relatively inelastic demand.

Table 18. OLS Regression of Category 5 on Exchange Rate Volatility and Economic Variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category5	Category5	Category5	Category5	Category5
ERvol	-105118.5352 (65,423.6558)	-97,269.0665 (60,516.7588)	-85,850.1475 (60,403.9922)	-83,155.5196 (62,778.3773)	-54,404.3585 (40,098.1787)
ERvol Squared	3009242.8026 (1883771.1442)	2927375.1372 (1722619.7856)	2462880.3545 (1709616.9440)	2383148.1618 (1777337.0230)	1581844.1888 (1130536.2823)
REER TR	-11.8277** (4.7792)	0.2541 (1.0671)	2.2727* (1.0290)	1.4290 (0.9087)	-2.9210 (3.2196)
Avg FX rate		122.3002* (55.3085)	163.5398** (62.1995)	140.0139 (78.1423)	54.6336** (21.1195)
Avg FX rate Squared		-3.2903* (1.7240)	-4.1073* (1.8649)	-3.5026 (2.2739)	-1.8864 (1.0665)
Inflation TR			-624.8586*** (165.6655)	-532.7988** (219.5985)	246.0360 (482.8809)
GDP Partner				0.0000 (0.0000)	0.0000 (0.0000)
GDPTR					0.0009 (0.0007)
Constant	2,539.0368** (839.0840)	914.0698** (296.5593)	606.0636* (273.3069)	571.5360* (262.2414)	377.2915** (133.9843)
Observations	189	189	189	189	189
R-squared	0.2618	0.2925	0.3001	0.3138	0.3650
Number of partners	9	9	9	9	9

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations and macroeconomic variables on exports in Category 5. The R-squared values improve from 0.2618 in Model (1) to 0.3650 in Model (5), indicating a modest improvement in model fit as additional control variables are included.

Exchange Rate Volatility (ERvol):

- Negative but insignificant across all models.
- This suggests that exchange rate fluctuations do not have a strong direct impact on exports in this category.

ERvol Squared:

- Positive but insignificant across all models.
- This indicates that non-linear effects of exchange rate volatility do not play a major role in this category's exports.

Real Effective Exchange Rate of Turkey (REER TR):

- Negative and significant in Model (1) ($-1.18e+07$, $p < 0.05$), but loses significance in later models.
- This suggests that currency appreciation initially reduces exports, but the effect diminishes when additional variables are considered.

Average Exchange Rate (Avg FX Rate):

- Positive and significant in Models (1) to (4), indicating that TRY depreciation supports exports in this category.
- The quadratic term is negative and significant in Models (1) and (2), suggesting that the positive impact of depreciation diminishes at extreme levels.

Inflation Rate :

- Negative and significant in Models (1) and (2) ($p < 0.01$, $p < 0.05$), but turns positive in Model (5).

- This suggests that higher inflation generally reduces exports, likely due to increased costs, but its impact weakens when more macroeconomic factors are included.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Insignificant across all models, indicating that economic growth does not strongly



Table 19. OLS Regression of Category 5 with Crisis Period Indicators

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category5	Category5	Category5	Category5	Category5
ERvol	-53,229.7882 (44,350.5262)	-75,004.6089 (50,604.6791)	-62,229.3090 (51,957.4765)	-59,839.7199 (45,685.2810)	-94,811.4439 (82,585.0560)
ERvol Squared	1548734.5598 (1250404.9344)	2273544.5134 (1479348.7182)	1819207.6716 (1489549.1626)	1811059.6443 (1364557.8066)	2890116.8169 (2452922.8293)
REER TR	-2.8422 (3.4971)	-2.4874 (2.9702)	-2.7324 (2.9417)	-2.9693 (3.2868)	-2.2104 (3.0283)
Avg FX rate	54.8384** (20.8901)	50.3398** (20.9470)	55.6329** (21.9173)	67.1902** (28.9007)	53.0029* (25.6448)
Avg FX rate Squared	-1.8905 (1.0561)	-1.7953 (1.0491)	-1.8813 (1.0668)	-2.1961 (1.3471)	-1.8114 (1.1121)
Inflation TR	245.8042 (485.6136)	293.5682 (498.3202)	237.6566 (468.7580)	101.3462 (352.3784)	264.9484 (466.0202)
GDP Partner	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
GDPTTR	0.0009 (0.0007)	0.0009 (0.0007)	0.0009 (0.0007)	0.0009 (0.0007)	0.0009 (0.0007)
GFC	-9.8101 (38.6683)				15.0749 (77.5068)
EDC		-138.7626 (93.8028)			-159.9547 (118.2272)
TLC			72.7353 (110.7129)		130.6938 (173.9171)
COVID19				-87.4130 (89.7050)	-12.7949 (38.4017)
Constant	361.0224* (185.5825)	437.3936** (155.6597)	413.6073* (179.5871)	438.1022** (181.2887)	545.7277 (367.0437)
Observations	189	189	189	189	189
R-squared	0.3650	0.3693	0.3655	0.3656	0.3710
Number of partners	9	9	9	9	9

Robust standard errors in parentheses,

*** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations, macroeconomic variables, and economic crises on exports in Category 5. The R-squared values remain relatively stable, ranging from 0.3650 to 0.3693, indicating a consistent model fit across different specifications.

Exchange Rate Volatility (ERvol):

- Negative but insignificant across all models, suggesting that exchange rate fluctuations do not have a strong impact on exports in this category during crises.

ERvol Squared:

- Positive but insignificant across all models, indicating that non-linear effects of exchange rate volatility do not play a major role in this category's exports during crises.

Real Effective Exchange Rate of Turkey (REER TR):

- Negative but insignificant across all models, suggesting that currency appreciation or depreciation does not significantly influence exports in this category during crisis periods.

Average Exchange Rate (Avg FX Rate):

- Positive and significant in all models ($p < 0.05$, $p < 0.1$ in Model 5), confirming that TRY depreciation supports exports in this category, even during crises.
- The quadratic term is negative but insignificant, indicating no clear diminishing returns from depreciation.

Inflation Rate:

- Insignificant across all models, meaning that inflation does not play a strong role in exports for this category during crises.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Both remain insignificant across all models, indicating that economic growth does not strongly influence exports in this category.

Economic Crises Variables:

- Global Financial Crisis (GFC): Negative but insignificant, suggesting no strong effect on exports.
- European Debt Crisis (EDC): Negative but insignificant, indicating no major impact.
- Turkish Lira Crisis (TLC): Positive but insignificant, suggesting no clear effect on exports in this category.
- COVID-19: Negative but insignificant across all models, indicating no strong impact on exports in this category.

5.4.8 Category 6

This subsection analyzes the factors shaping Turkey's electronics and electrical equipment exports. Table 20 provides baseline regression outcomes for these products, while Table 21 enhances the analysis by including crisis dummy variables. This helps reveal the electronics sector's vulnerability to global supply chain disruptions, input costs, and exchange rate volatility, especially during significant crises between 2003 and 2023.

Table 20. OLS Regression of Category 6 on Exchange Rate Volatility and Economic Variables

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category6	Category6	Category6	Category6	Category6
ERvol	-30,949.1800** (10,715.8046)	-30,673.9612** (10,823.6876)	-25,011.8449** (10,430.1556)	-23,293.4490* (10,533.1490)	-16,792.5652** (7,175.9471)
ERvol Squared	968,914.2576** (356,012.6511)	1152432.0408** (357,774.8791)	922,110.4607** (325,599.3633)	871,264.3041** (329,845.4245)	690,082.6134** (228,933.2611)
REER TR	-4.0684*** (0.8250)	2.3108** (0.9566)	3.3117** (1.2099)	2.7738* (1.2212)	1.7902 (1.4536)
Avg FX rate		47.5866*** (13.9270)	68.0355*** (19.9320)	53.0327** (19.5856)	33.7275 (21.6395)
Avg FX rate Squared		-0.9493** (0.3722)	-1.3544** (0.4841)	-0.9688* (0.4826)	-0.6034 (0.5102)
Inflation TR			-309.8386* (141.4087)	-251.1310 (145.3833)	-75.0298 (115.8412)
GDP Partner				0.0000*** (0.0000)	0.0000*** (0.0000)
GDPTR					0.0002 (0.0002)
Constant	1,030.8461*** (108.0487)	223.3984 (161.8442)	70.6724 (187.7490)	48.6537 (182.1518)	4.7333 (195.1669)
Observations	189	189	189	189	189
R-squared	0.3158	0.4477	0.4659	0.5205	0.5463
Number of partners	9	9	9	9	9

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations and macroeconomic variables on exports in category 6. The R-squared values improve significantly from

0.3158 in Model (1) to 0.5463 in Model (5), indicating a stronger model fit as additional control variables are included.

Exchange Rate Volatility (ERvol):

- Negative and significant across all models ($p < 0.05$, $p < 0.1$ in Model 4).
- This suggests that higher exchange rate volatility reduces exports in this category, likely due to increased uncertainty and transaction costs.

ERvol Squared:

- Positive and significant across all models ($p < 0.05$), suggesting a non-linear relationship where moderate volatility reduces exports, but extreme volatility may have a weaker impact or even an offsetting effect.

Real Effective Exchange Rate of Turkey (REER TR):

- Negative and highly significant in Model (1) ($-4.07e+06$, $p < 0.01$), but turns positive and significant in later models ($p < 0.05$).
- This suggests that TRY appreciation initially reduces exports but may benefit certain exporters under specific conditions.

Average Exchange Rate (Avg FX Rate):

- Positive and significant in Models (1) to (3), indicating that TRY depreciation supports exports in this category.
- The quadratic term is negative and significant, suggesting that the positive impact of depreciation diminishes beyond a certain level.

Inflation Rate (Inflation TR):

- Negative and significant in Model (1) ($p < 0.1$) but loses significance in later models.

- This suggests that higher inflation initially reduces exports, likely due to rising costs, but its effect weakens when additional macroeconomic factors are considered.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Trade partners' GDP is positive and highly significant ($p < 0.01$), suggesting that higher global demand supports exports.
- Turkey's GDP (GDPTR) is mostly insignificant, indicating that domestic economic growth does not strongly affect exports in this category.



Table 21. OLS Regression of Category 6 with Crisis Period Indicators

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Category6	Category6	Category6	Category6	Category6
ERvol	-14,214.7192 (8,589.6654)	-25,287.9804* (11,438.3664)	-13,509.5283* (6,802.9294)	-14,607.3384** (5,794.0239)	-18,328.7579 (14,640.4381)
ERvol Squared	617,416.4448** (257,680.7498)	975,335.5289** (368,547.3964)	590,494.3674** (204,606.8067)	597,929.0793*** (161,527.5723)	740,341.8120 (406,570.1444)
REER TR	1.9632 (1.4902)	1.9690 (1.3658)	1.7110 (1.4240)	1.8096 (1.4699)	2.2134 (1.3528)
Avg FX rate	34.1769 (21.7573)	31.9568 (22.2464)	33.3082 (21.4875)	28.6792 (24.6383)	26.1679 (28.1518)
Avg FX rate Squared	-0.6123 (0.5129)	-0.5658 (0.5211)	-0.6055 (0.5087)	-0.4788 (0.5856)	-0.4236 (0.6763)
Inflation TR	-75.5385 (116.0231)	-55.4278 (123.8763)	-71.5141 (115.3894)	-16.8589 (157.3338)	17.3300 (196.7774)
GDP Partner	0.0000*** (0.0000)	0.0000*** (0.0000)	0.0000*** (0.0000)	0.0000*** (0.0000)	0.0000*** (0.0000)
GD PTR	0.0002 (0.0002)	0.0002 (0.0002)	0.0002 (0.0002)	0.0002 (0.0002)	0.0003 (0.0002)
GFC	-21.5303 (24.8576)				-29.6073 (27.8352)
EDC		-57.2248 (40.9137)			-58.4044 (48.6509)
TLC			-30.5168 (25.9577)		-8.1850 (47.6262)
COVID19				35.1434 (41.3180)	43.5648 (57.4313)
Constant	-30.9728 (217.1917)	29.5191 (198.7530)	-10.5033 (197.7246)	-19.7149 (201.3702)	-53.4646 (238.3133)
Observations	189	189	189	189	189
R-squared	0.5473	0.5535	0.5473	0.5473	0.5565
Number of partners	9	9	9	9	9

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The regression examines the effect of exchange rate fluctuations, macroeconomic variables, and economic crises on exports in Category 6. The R-squared values remain stable between 0.5473 and 0.5535, indicating a consistent model fit across different specifications.

Exchange Rate Volatility (ERvol):

- Negative and significant in Models (2) to (4) ($p < 0.1$, $p < 0.05$), but loses significance in Model (5).
- This suggests that higher exchange rate volatility reduces exports in this category during crises, but its impact weakens when additional controls are included.

ERvol Squared:

- Positive and significant across all models ($p < 0.05$, $p < 0.01$ in Model 4), indicating a non-linear relationship where moderate volatility negatively impacts exports, but extreme volatility may have a weaker or even offsetting effect.

Real Effective Exchange Rate of Turkey (REER TR):

- Insignificant across all models, indicating that currency appreciation or depreciation does not significantly influence exports in this category during crises.

Average Exchange Rate (Avg FX Rate):

- Positive but insignificant across all models, suggesting that TRY depreciation does not have a strong impact on exports in this category during crises.

Inflation Rate (Inflation TR):

- Negative but insignificant across all models, meaning that inflation does not strongly affect exports in this category during crises.

GDP of Trade Partners (GDP) and Turkey's GDP (GDP TR):

- Trade partners' GDP is consistently positive and highly significant ($p < 0.01$), reinforcing that higher global demand supports exports.
- Turkey's GDP (GDPTR) is insignificant, suggesting that domestic economic growth does not play a major role in exports for this category.

Economic Crises Variables:

- Global Financial Crisis (GFC): Negative but insignificant, suggesting no strong effect on exports.
- European Debt Crisis (EDC): Negative but insignificant, indicating no major impact.
- Turkish Lira Crisis (TLC): Negative but insignificant, implying no substantial impact on exports in this category.
- COVID-19: Positive but insignificant, suggesting that the pandemic did not strongly influence exports in this category.

CHAPTER 6

KEY FINDINGS

The analysis confirms that exchange rate fluctuations play a significant role in Turkey's export performance, with notable differences across industries. In general, periods of increased Turkish lira volatility tend to suppress export volumes, but the magnitude of this effect varies by sector. Automotive and machinery exports emerged as particularly sensitive to exchange rate swings – these heavy manufacturing sectors often showed clear negative correlations with volatility, meaning their export volumes declined when the lira was unstable (Table 10 for Automotive; Table 14 for Machinery). Likewise, the electronics industry showed vulnerability in several markets (e.g. exports of electronics to the U.S. and France dropped during high-volatility periods) (Tables 20 and Scatter Plot Figures 13 & 17). In contrast, sectors like textiles and food/agriculture proved more resilient. Exports of textiles, apparel, and food products maintained relatively stable volumes despite currency fluctuations, with only weak or negligible correlations observed in most cases (Table 12 for Textiles; Table 18 for Agriculture; Scatter Plot Figures 15 & 16). The chemicals and plastics sector fell in between – some partner markets showed it largely unaffected by volatility, while others exhibited mixed patterns (Table 16; Scatter Plot Figure 15). These findings suggest that industries relying heavily on imported inputs or global commodities (e.g. automotive, machinery, electronics) are more exposed to currency risk, whereas more self-sufficient or demand-stable industries (e.g. agriculture, basic textiles) can weather exchange rate swings with less disruption.

Differences in export response were also evident across Turkey's major trading partners, underscoring the role of destination-market characteristics. Exports to EU economies (such as Germany, Italy, France, Spain, and Poland) generally experienced mild to moderate declines under high exchange rate volatility, reflecting a broadly negative but manageable impact (Scatter Plot Figures 12, 15, 17, 19, 21). For instance, Turkey's trade with Germany and Italy showed that when the lira's value became more erratic, total export volumes dipped slightly and sectors like automotive and capital goods bore the brunt of the volatility (Table 10 and Table 14; Scatter Plot Figures 12 & 15). At the same time, these European markets displayed relatively tight clustering in trade data, indicating fundamentally stable demand relationships that were only temporarily perturbed by currency swings. Exports to the United Kingdom and the United States revealed some unique sector-specific sensitivities: for example, UK imports from Turkey showed pronounced declines in textile and automotive categories during volatile periods, while U.S. imports showed stronger sensitivity in technology-intensive goods (notably electronics) and automotive, with minimal impact on food or basic commodities (Scatter Plot Figures 13 & 14). In contrast, trade with Turkey's emerging and neighboring partners showed greater volatility. Exports to Iraq were an extreme case – the data were highly dispersed and erratic, indicating that Turkey's trade with Iraq is strongly affected by exchange rate volatility and amplified by geopolitical instability (Scatter Plot Figure 16). While a spike in lira volatility could sharply depress exports of even staple goods to Iraq, other Middle Eastern or regional partners might exhibit similar instability if political/economic conditions are turbulent. In summary, the impact of exchange rate fluctuations on Turkish exports is heterogeneous across partners: developed markets impose a moderate and predictable drag on exports during

volatile times, whereas trade with less stable or less diversified economies can swing dramatically, and each partner's sensitivity often aligns with the composition of goods traded and broader economic ties.

An additional insight emerges from the regression results for total imports, where both Turkey's GDP and the GDPs of its trade partners appear as statistically significant determinants. This finding aligns with the predictions of the gravity model of international trade, which emphasizes the importance of economic size in shaping bilateral trade flows. The fact that both variables are significant reinforces the role of macroeconomic fundamentals in driving Turkey's trade patterns, alongside exchange rate dynamics and sector-specific characteristics.

The export regression results reveal a consistent and statistically significant nonlinear effect of exchange rates, evidenced by the joint significance of both the average exchange rate (Avg FX rate) and its squared term across multiple models. This pattern is observed in the total export model (Table 8: OLS Regression of Total Export on Exchange Rate Volatility and Economic Variables) as well as in sector-specific models—particularly textiles and apparel (Table 12), machinery and equipment (Table 14), base metals (Table 18), and electronics (Table 20). The positive coefficient on Avg FX rate and negative coefficient on its square confirm that while moderate depreciation enhances export competitiveness, excessive depreciation may dampen this advantage by raising production costs or generating macroeconomic instability.

Moreover, the inclusion of these nonlinear terms leads to a noticeable decline in the statistical significance of exchange rate volatility (ERvol) in many of the same models. This shift suggests that long-term exchange rate trends, rather than short-term fluctuations, may play a more dominant role in shaping Turkey's export

performance in certain sectors. However, volatility remains significant in other cases—such as food and agricultural products (Table 11) and chemicals and plastics (Table 16)—highlighting sector-specific sensitivities where exposure to imported inputs or risk perception makes volatility an independently important factor. These findings emphasize the need for differentiated policy tools: while average exchange rate management is broadly important, tailored hedging strategies may still be essential in sectors highly exposed to exchange rate risk.

A noteworthy pattern arises in the sectoral regressions: in agriculture and food products (category 1), textiles and apparel (category 2), chemicals and plastics (category 4), and electronics (category 6), both exchange rate volatility ($ervol$) and its squared term are statistically significant, pointing to non-linear effects. In category 1 (Table 11), the results suggest that moderate volatility may stimulate exports, potentially by incentivizing forward contracts or dynamic pricing, whereas excessive volatility undermines performance, likely due to unpredictability in costs and revenues.

In textiles and apparel (Table 12), chemicals and plastics (Table 16), and electronics (Table 20), we observe a reversal: $ERvol$ has a negative impact, and $ERvol$ squared is positive. This may reflect that low-to-moderate volatility introduces harmful uncertainty, deterring exporters, but extreme volatility could create strategic opportunities for firms with hedging capabilities, flexible pricing, or speculative gains from timing. These patterns underscore the need to consider sector-specific exposure and adaptation strategies when evaluating the impact of exchange rate fluctuations.

The study's findings confirm that heightened exchange rate volatility generally has a significant negative effect on export values, though the magnitude of this impact varies by sector and destination. Complementary correlation analysis reveals consistent patterns across trade partners: notably, maintaining a stable or competitive Real Effective Exchange Rate (REER) emerges as a stabilizing factor for export performance, and certain industries—especially machinery and chemicals—exhibit heightened sensitivity to currency fluctuations. These findings strongly support hypothesis H1, indicating that fluctuations in the Turkish lira relative to major currencies significantly and differentially impact export volumes across industries. The results also indicate that exports to advanced economies tend to be more resilient to volatility shocks, whereas those to less diversified or emerging markets experience more pronounced adverse effects. These sector-specific and partner-specific vulnerabilities underscore the need for targeted strategies to manage exchange rate risk. Accordingly, policymakers and exporters are advised to implement tailored measures—such as financial hedging, market diversification, and supportive policy measures—to mitigate the adverse impacts of currency fluctuations and bolster the stability of Turkey's export performance under volatile exchange rate conditions. The evidence aligns with hypotheses H2 and H3, demonstrating significant short-term effects and sector-specific vulnerabilities due to exchange rate volatility, respectively. Moreover, the moderating role of external factors such as global economic conditions and government policies further supports hypothesis H4.

CHAPTER 7

POLICY RECOMMENDATION

The study's findings carry important policy implications for Turkish exporters and economic policymakers seeking to mitigate exchange rate risks and enhance trade resilience. Based on the sectoral and partner-specific insights, several actionable recommendations emerge:

A)Promote Hedging and Financial Risk Management: Firms, especially in vulnerable sectors like automotive, machinery, and electronics, should actively use financial instruments to hedge against currency volatility. Larger Turkish manufacturing firms have successfully mitigated exchange rate risks through hedging strategies, and similar practices (forward contracts, options, currency swaps) can be incentivized for small and medium exporters. Policymakers can facilitate this by providing training, creating awareness, or even offering subsidized hedging tools through banks and export credit agencies. By locking in exchange rates or insuring against large swings, exporters can stabilize their revenues and plan production without fear of sudden forex shocks.

B)Reduce Import Dependency in Export Production: A strategic medium-term policy is to decrease reliance on imported inputs, thereby lessening the pass-through of currency fluctuations to production costs. Our results showed that sectors with high import content (e.g. automotive parts, electronics components, chemical raw materials) are less able to capitalize on a weaker lira because their costs rise with a falling lira. This aligns with other studies' findings that high import dependency (for instance in Turkey's motor vehicles sector) undermines the competitive benefits of a depreciating currency and that reducing this dependency would enhance

resilience to exchange rate shocks. Policymakers should support local sourcing and substitution of imported intermediates by investing in domestic supply chains and encouraging industries like auto parts, electronics components, textiles fabrics, and chemical inputs to develop locally. Incentives such as tax breaks for using domestic inputs, support for R&D in intermediate goods, and joint ventures with global firms to produce key components in Turkey could gradually improve self-sufficiency. A more locally integrated production structure will cushion exporters from external price volatility and improve Turkey's overall trade balance when the lira fluctuates.

C)Macroeconomic Stability and Policy Coordination: At the national level, maintaining a stable macroeconomic environment is crucial. Volatile inflation and interest rates tend to exacerbate exchange rate swings, creating a challenging climate for exporters. The government and central bank should therefore prioritize policies that stabilize the exchange rate and keep inflation in check, as sustained stability will encourage investment in export sectors and allow firms to plan for the long term. This might include prudent monetary policy, building adequate foreign exchange reserves to buffer extreme volatility, and clear communication to reduce uncertainty in currency markets. Additionally, trade policy can play a role: expanding trade agreements or currency swap lines with major partners could reduce currency risk (for example, invoicing some trade in local currencies or a stable reference currency). Coordinated macroeconomic policies that align fiscal discipline with monetary measures will foster a more predictable exchange rate, indirectly boosting exporter confidence.

Implementing these policies can mitigate the negative effects of exchange rate fluctuations in the short run and strengthen the long-run resilience of Turkey's export sector. Essentially, the goal is to make Turkey's export engine less vulnerable

to the whims of currency markets by managing risk proactively, reducing structural weaknesses (like import dependence), and continuously upgrading the competitive position of Turkish goods on the world stage.



CHAPTER 8

CONCLUSION

Study Limitations: While the findings provide valuable insights, several limitations must be acknowledged. First, the study relies on historical data from 2003–2023, and data availability constraints meant excluding earlier years and certain less-reported trade partners. Any gaps or measurement errors in export statistics (especially for early years or countries with unstable data collection) could influence the results.

Second, the econometric approach (primarily OLS regressions and correlation analysis) assumes a linear, uniform effect of exchange rate volatility on exports. In reality, there may be non-linear or lagged effects that our models do not capture – for instance, exporters might adjust with a delay or extreme volatility during crises could have disproportionately large impacts not fully reflected in a linear model. Although we included dummy variables for major crises and controlled for factors like trading partner GDP and inflation, there remains the possibility of omitted variables or unobserved external factors. Additionally, the analysis focused on Turkey’s top nine export destinations and six broad product categories, which, while covering roughly half of total exports, may not capture the full diversity of Turkey’s export economy. Niche industries or smaller trade partners might behave differently under currency volatility, limiting the generalizability of the conclusions. In summary, caution is warranted in interpreting the results – they indicate associations rather than pure causation, and one should consider data and model constraints when applying these insights to policy or business decisions.

Future Research Directions: While this thesis provided a detailed look at exchange rate impacts by sector and partner, it also opened up several avenues for

further inquiry. Future research can build on these findings and address the limitations, by exploring:

Broader and Non-Traditional Trade Partners: Extending the analysis beyond Turkey's top nine partners to include other significant or growing markets would be valuable. Countries in Asia (e.g. China, Japan, South Korea), Africa, or Latin America that are becoming more important for Turkey's exports could be studied to see if the patterns hold or if new dynamics emerge.

Alternative Methodologies and Models: The use of OLS and correlation analysis in this study could be complemented by more advanced or alternative econometric techniques. Future studies might employ dynamic models (such as Vector Autoregression or Error Correction Models) to capture the interplay between exchange rates and exports over time, including feedback effects (e.g. how export changes might, in turn, affect the exchange rate). Volatility-specific models like GARCH could better characterize exchange rate uncertainty and its impact. Additionally, structural models or simulations could incorporate non-linear effects and regime changes (for example, assessing if the relationship changes during crisis vs. non-crisis periods beyond simple dummy variables).

Longer-Term and Qualitative Impacts: This research mainly focused on short- to medium-term export volume responses. Longer-term economic impacts merit investigation as well. For instance, one could study whether prolonged periods of high exchange rate volatility lead to structural shifts in Turkey's economy – do firms start exiting certain export markets or industries? Do they invest more in productivity improvements or change their sourcing strategies as a result of volatility? Conversely, how do sustained trends (like a decade-long real depreciation of the lira) influence Turkey's export competitiveness and product mix? Such an

analysis might combine quantitative data with firm-level surveys or case studies to capture how businesses adapt (or fail to adapt) to an uncertain exchange rate environment over the years.

By pursuing these avenues, future research can build a more comprehensive picture of the exchange rate–trade nexus for Turkey. Such efforts would not only test the robustness of this study’s conclusions in different contexts but also inform more targeted strategies for exporters and policymakers. In a world of increasing economic integration and uncertainty, continuous research is essential to keep policies adaptive and ensure that Turkey’s export sector thrives despite the ups and downs of currency markets. The insights from this thesis lay a strong foundation, and further work can extend this knowledge to secure Turkey’s position in global trade amid exchange rate fluctuations.

REFERENCES

- Akdoğan, K., Bağır, Y. K., & Torun, H. (2023). Heterogeneous effect of exchange rates on firms' exports: Role of labor intensity. *Central Bank Review*, 23(3), 100130.
- Ari, Y. O. (2023). The impact of currency depreciation on exports: An autoregressive distributed lag approach for Turkish lira. *Acta Economica*, 21(38), 93–108.
- Audi, M. (2024). The impact of exchange rate volatility on long-term economic growth: Insights from Lebanon.
- Bahmani-Oskooee, M., & Durmaz, N. (2016). Exchange rate volatility and Turkish commodity trade with the rest of the world. *Economic Change and Restructuring*, 49, 1–21.
- Bahmani-Oskooee, M., & Halıcıoğlu, F. (2017). Asymmetric effects of exchange rate changes on Turkish bilateral trade balances. *Economic Systems*, 41(2), 279–296.
- Bahmani-Oskooee, M., & Mohammadian, A. (2016). Asymmetry effects of exchange rate changes on domestic production: Evidence from nonlinear ARDL approach. *Australian Economic Papers*, 55(3), 181–191.
- Central Bank of the Republic of Turkey. (2024). Bilateral exchange rate data series. https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket/#collapse_2
- Central Bank of the Republic of Turkey. (2024). Real effective exchange rate (REER) data series. https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket/collapse_2/5868/DataGroup/english/bie_rktufey/#collapse_2
- Dinçer, N. N., Shingal, A., & Tekin-Koru, A. (2020, October). Trade and exchange rate effects: Evidence from firm-level data. *Economic Research Forum (ERF)*.
- Dinçer, N., & Kandil, M. (2011). The effects of exchange rate fluctuations on exports: A sectoral analysis for Turkey. *The Journal of International Trade & Economic Development*, 20(6), 809–837.
- Erduman, Y., Eren, O., & Gül, S. (2020). Import content of Turkish production and exports: A sectoral analysis. *Central Bank Review*, 20(4), 155–168.
- Gül, S. (2021). Domestic demand and exports: Evidence from Turkish firms. *Central Bank Review*, 21(3), 105–118.
- Günçavdı, Ö., & Kayam, S. S. (2017). Unravelling the structure of Turkish exports: Impediments and policy. *Journal of Policy Modeling*, 39(2), 307–323.

- International Trade Centre. (2024). Turkey trade volume data from Trade Map.
<https://www.trademap.org/Index.aspx>
- Karahan, Ö. (2020). Influence of exchange rate on the economic growth in the Turkish economy. *Financial Assets and Investing*, 11(1), 21–34.
- Kasman, A., & Kasman, S. (2005). Exchange rate uncertainty in Turkey and its impact on export volume.
- Kurt, E., & Dereköy, F. (2020). Analysis of the relationship between exchange rate changes and profitability in Turkey: Example of BIST manufacturing sector. *Journal of Business Economics and Finance*, 9(4), 304–319.
- Morina, F., Hysa, E., Ergün, U., Panait, M., & Voica, M. C. (2020). The effect of exchange rate volatility on economic growth: Case of the CEE countries. *Journal of Risk and Financial Management*, 13(8), 177.
- Rahman, M. H., Majumder, S. C., & Hossain, M. N. (2020). The impact of exchange rate volatility on export and import in Bangladesh. *European Online Journal of Natural and Social Sciences*, 9(2), 411.
- Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. C. Sickles & W. C. Horrace (Eds.), *Festschrift in honor of Peter Schmidt: Econometric methods and applications* (pp. 281–314). Springer.
- Statista. (2024). Inflation rate in Turkey from 1987 to 2024.
<https://www.statista.com/statistics/277044/inflation-rate-in-turkey/>
- Tarakçı, D., Ölmez, F., & Durusu-Çiftçi, D. (2022). Exchange rate volatility and export in Turkey: Does the nexus vary across the type of commodity? *Central Bank Review*, 22(2), 77–89.
- Tarasenko, I. (2021). The impact of exchange rate volatility on trade: The evidence from Russia. *Russian Journal of Economics*, 7(3), 213–232.
- Thorbecke, W., & Sengonul, A. (2023). The impact of exchange rates on Turkish imports and exports. *International Economics*, 174, 231–249.
- Turna, Y., & Özcan, A. (2021). The relationship between foreign exchange rate, interest rate and inflation in Turkey: ARDL approach. *Journal of Ekonomi*, 3(1), 19–23.
- World Bank. (2024). GDP (current US\$) data for trade partner countries.
<https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2023&locations=DE&start=2010>
- Yılmaz, E., & Şensoy, F. (2022). The relationship between growth and exports: What if the impact is negative? Evidence from Turkey. *Journal of Economics Finance and Accounting*, 9(3), 104–112.

Yılmazkuday, H. (2024). Real exchange rate volatility and economic growth. SSRN. <https://doi.org/10.2139/ssrn.4949135>

Özata, E. (2020). The effect of exchange rate volatility on economic growth in Turkey. *Journal of Business Economics and Finance*, 9(1), 42–51.

Özen, E., Özdemir, L., & Grima, S. (2020). The relationship between the exchange rate, interest rate, and inflation: The case of Turkey.

