Research Article

The Impact of Taxation on International Commerce and Exchange Rate on Imports

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Abstract: The globalization of capital markets has accelerated capital movements, turning the world into one large marketplace. International trade has become an important tool in shaping the financial structure of countries. However, elements such as customs duties and import quotas play a decisive role in trade between countries. Taxes, which are a financial policy tool of countries, are used to influence foreign trade, particularly imports. One of the determining factors in foreign trade activities is the exchange rate. The purpose of this study is to examine the effect of taxes on imports and the change in the nominal exchange rate on the import volume of goods and services. In this study, which examined 20 Organization for Economic Co-Operation and Development (OECD) countries with data for the period 1999-2021 taken from the World Bank official website, the model was analyzed with the help of AR (1) Residual Random Effects Generalized Least Squares Regression Model Estimator. The analysis revealed that increases in international trade taxes and exchange rate increases reduce the import volume. This result empirically supports the conclusion that taxes on international trade and reductions in exchange rates increase import volume.

Keywords: International markets; Taxation in foreign trade; Exchange rate; Panel Data Analysis
Jel Codes: C23, F14, F31, F36, H20.

Uluslararası Ticaret Üzerinden Alınan Vergilerin ve Döviz Kurunun İthalat Üzerindeki Etkisi

Öz: Sermaye piyasalarının küreselleşmesi, beraberinde sermaye hareketlerini de hızlandırarak dünyayı büyük bir pazara evirmiştir. Dış ticaret ise ülkelerin finansal yapısının oluşumunda önemli araç olmuştur. Bununla birlikte ülkeler arası ticarette gümrük vergisi ve ithalat kotaları gibi unsurlar dış ticarette belirleyici olmaktadır. Ülkelerin finansal politika aracı olan vergiler, dış ticaretin özellikle de ithalatın yönlendirilmesinde kullanılmaktadır. Dış ticaret faaliyetlerini belirleyici faktörlerinden biri ise döviz kurudur. Bu çalışmanın amacı, ithalattan alınan vergiler ile nominal döviz kurundaki değişimin mal ve hizmet ithalat hacmine olan etkisini incelemektir. Dünya Bankası resmi internet sayfasından alınan 1999–2021 dönemine ait veriler ile 20 Organisation for Economic Co-Operation and Development (OECD) ülkesinin incelendiği bu çalışmada AR (1) Kalıntılı Tesadüfi Etkiler Genelleştirilmiş En Küçük Kareler Regresyon Model Tahmincisi yardımıyla model analiz edilmiştir. Analiz sonucunda hem uluslararası ticaretten alınan vergilerdeki artışın ve hem de döviz kurundaki artışın ithalat hacmini azalttığı tespit edilmiştir. Bu sonuç uluslararası ticaretten alınan vergiler ile döviz kurundaki azaltmanın ithalat hacmini artırdığı sonucunu ampirik olarak da desteklemektedir.

Anahtar Kelimeler: Uluslararası Piyasalar, Uluslararası Ticaret Üzerinden Alınan Vergiler, Döviz Kuru, Panel Veri Analizi.
Jel Kodları: C23, F14, F31, F36, H20.

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1. Introduction

International trade has an economic power in the modern age, as it did in the Colonial period. International trade is an important resource not only for a country but also for the global economy. Efforts to remove national customs borders increase the speed of transnational trade and strengthen global economic chain links. In addition to the importance of international trade, the concepts of Taxes on International Trade (TIT) and changes in the nominal exchange rate are also important. Examining their effects on foreign trade empirically constitutes the motivation of this study.

States need revenue to maintain their economic, political and social functions. Tax revenue has an important place among public resources. In addition, states intervene in trade through tax practices. When modern applications of international trade taxes are examined, it is seen that the emphasis is on taxes on imports, and taxes on exports are not important (Kolçak, 2013, p.207). In developing countries, domestic producers demand that precautions be taken because they do not have the opportunity to operate for a long time in a competitive environment in global markets. Governments are exposed to pressure regarding import measures and are forced to take protective measures. Countries intervene in foreign trade with monetary policies that limit import activities. Policies implemented may include restricting imports or encouraging exports. At this stage, international trade policies should be compatible with fiscal policies and monetary policies. If any country produces at higher costs to produce the commodity it can buy at an affordable cost, it will upset the budget balance. Ultimately, such a situation will cause a contraction in production. International trade is affected by agreements, customs duties and financial responsibilities made by countries. Exchange rates are effective in fulfilling obligations. Foreign exchange is necessary for globalized international trade. The most widely used currency in world trade is the US Dollar (U$). U$ is a reserve currency, the strongest in international markets and accounting for 59% of central banks' reserves (Convey, 2024; Siripurapu and Noah, 2023; Arslanalp and Simpson, 2021; Aristovnik and Čeč, 2009).

This study explores the influence of taxation on foreign commerce and the volatility of the nominal currency rate on the scale of international trade. Through an exploration of these factors, the research endeavours to illuminate the complex interplay between economic policies, exchange rate fluctuations, and global trade patterns. The analysis encompasses 20 OECD countries, namely Türkiye, Australia, Switzerland, Austria, Slovak Republic, Canada, Norway, Chile, New Zealand, Colombia, Netherlands, Costa Rica, France, Mexico, Greece, Latvia, Hungary, Korea, Iceland, and Israel.

This research endeavours to empirical evaluation the influence of trade tariffs and exchange rate fluctuations on international trade, utilizing data spanning from 1999 to 2021 across 20 OECD nations. The study employs the AR(1) Residual Random Effects Generalized Least Squares Regression Model Estimator method. The subsequent sections of the study delineate the theoretical underpinnings of the relationships among exchange rates, foreign trade, and international taxation. Following this, a comprehensive literature review addresses the impacts of taxation on global trade and the repercussions of currency rate movements on international commerce. The fourth section of the study entails the econometric application. Lastly, the conclusion section synthesizes the findings and offers an evaluation thereof.

2. Theoretical Background

Exports/imports of international services and goods constitute global trade. While goods and services coming from outside the country are subject to import, the sale of services and goods to foreign countries is subject to export. Foreign currency enters the country through the sale of goods and services, and foreign exchange flows out of the country through goods and services coming from abroad. Sometimes, a country's effort to produce goods or services that it can buy from other countries at affordable prices can

disrupt the country's economy. Another possibility is that the country may face losing productivity in the areas in which it specializes. Excessive imports lead the country into another economic bottleneck, which results in a contraction in production. While the country's foreign exchange reserves shrink due to imports, not only the country's budget balance but also the markets are affected by this situation. Foreign exchange reserves are crucial resources for both emerging and advanced economies. The exchange rate, portraying a country's currency value against another's, falls into two categories: nominal and real effective currency rates. The nominal exchange rate delineates the rate at which currencies from different nations can be traded, whereas the real exchange rate showcases the purchasing power of a country's currency abroad (Abel et al., 2017, pp.524–528). Real effective exchange rate, an economic indicator, evaluates the worth of a national currency by factoring in exchange rates with its foreign trading counterparts.

To accelerate international trade and capital flows, organizations are formed as a result of economic integration[1] and thus, efforts are made to liberalize trade between member countries and eliminate the elements that hinder capital movements and mutual division of labour. Customs duties among the countries that are members of these integrations have been abolished, and there is a customs union for non-member countries (Pehlivan and Öz, 2022, pp.67-68). In the absence of economic integration, taxes are collected on international trade. The World Bank (WB) defines TIT, or Total International Trade tax, is an umbrella term encompassing a range of components, including import tariffs, export tariffs, profits derived from export or import monopolies, exchange gains and exchange taxes. Among these, customs duties stand out as the foremost tax concerning foreign trade. Customs duties in Türkiye are stated in Article 8 of the Customs Law No. 4458; It is defined as "all import duties[2] or export taxes applied to goods by the relevant legislation". With the Additional Protocol that came into force in 1971, customs duties and quantitative restrictions on industrial products imported from Türkiye by the European Union (EU) were abolished. As a continuation of the Additional Protocol, the Customs Union was established amidst Türkiye and the EU on January 1, 1996. In addition, all customs tariffs, measures with equivalent effect and quantitative restrictions on industrial goods imported from EU have been abolished (Hatipler, 2011, p.16). With the Additional Protocol, a significant part of the taxes on industrial products exported to the EU, and with the Customs Union, on industrial products imported from the EU, have been abolished. Import and export taxes are currently within the scope of Articles 3/9 and 3/10 of the Customs Law No. 4458: Customs Duty, Value Added Tax (VAT), Single and Fixed Tax, Special Consumption Tax (SCT), Stamp Duty, Additional Customs Duty, Anti-Dumping Tax and Compensatory Tax, Additional Financial Liability, Mass Housing Fund, Resource Utilization Support Fund, Tobacco Fund, Turkish Radio and Television Corporation Bandrol Fee, Environmental Contribution Fee, Culture Fund, Support Price Stabilization Fund and Inward Processing It consists of the Compensatory Tax within the Scope of the Regime (Kaya and Doğan, 2020, p.11). Import taxes applied in many countries are VAT, SCT and other sales taxes (Rosenow and O'Shea, 2010, pp.2-3).

3. Literature Review

Upon reviewing the literature, numerous studies were identified regarding the influence of tax revenues on economic and social factors. Table 1 presents studies focusing on international trade taxes, while Table 2 outlines research on the interplay amid international commerce and foreign exchange. However, no study has been encountered regarding the impact of international trade taxes and exchange rates on import volume in OECD countries.

1 Integrations such as NAFTA, EFTA, ANZCERTA, MERCOSUR, Andean Pact, Central American Common Market, SACU, European Economic Community can be given as examples of economic integrations.

2 Import duties and export taxes are defined in the third article of the Customs Law.

Table 1. International Trade and Taxation Literature Research

Author	Subject	Data Set Period	Method	Result
Lerner (1936)	The balance between import and export duties.	UK, Germany and USA 1936	Mathematical Analysis	The factor that determines the impact of the tax is the demand side.
Shoven and Whalley (1984)	Equilibrium models of international trade and taxation.	USA (1950-1980)	General equilibrium models Walrasian model Computational model	It has been concluded that the general equilibrium model is a useful model used in international trade and taxation practices.
Feldstein and Krugman (1990)	Effects of VAT on international trade.	USA 1990	Mathematical Models	VAT is useful in international competition.
Agbeyegbe et al. (2004)	The correlation amid commerce, exchange rates and tax revenue.	Africa (1980-1996)	Panel Data Moment Regression Analysis	Multinationality of trade does not contribute to tax revenue.
Fisman and Wei (2004)	Tax evasion on Chinese imports.	Chinese Hong Kong' 1996-1998	Mathematical Analysis	It was concluded that smuggling partly causes the misclassification of imports from high-tax to low-tax categories.
Anastassiou and Dritsaki (2005)	The correlation amid trade, taxes and economic growth	Greece (1965-2002)	Unit root, Granger Causality Test	The increase in tax revenues has a Beneficial influence on economic development.
Beck and Chaves (2011)	Taxes on consumption, effects of income tax and corporate tax on GDP, producer price index and export volume.	25 OECD countries (1970-2006)	The gravity model	The increase in consumption taxes reduces the export volume.
Nicholson (2013)	Tax policy and foreign trade relationship.	140 countries, including members of the Organization for Economic Cooperation. 1950–2007	Timeseries panel	While the increase in VAT increased the export volume for the Standard Industrial Classification (SIC) sectors for oil, gas, and manufacturing (NAICS); While the increase in VAT reduced the import volume of the NAICS sector, it caused an increase in imports in the SIC sector. Taxes have benefited the trade competitiveness of countries, including the United States. New taxes may come.
Yavuz and Beşel (2015)	The correlation amid global trade taxes and economic development.	Türkiye (1960-2012)	Toda-Yamamoto Causality and Frequency Causality Analysis	There is a causal relationship amid global trade transactions and taxes collected. There is no relationship betwixt economic development and global trade tax.
Madzivanyika (2016)	Effects of Customs Duty Incentives.	Zimbabwe (2009-2014)	Panel data analysis	Customs incentives harmed customs revenues.
Holzner et al. (2021)	Effects of corporate tax on international trade.	34 EU and OECD (2005-2014)	Mathematical Models	Taxes applied at a minimum level do not harm international trade.
Atkin and Donaldson (2021)	Effect of 10% reduction in import tariffs on the distortions (mechanical, factoral and revenual)	142 Countries (2021)	Regression Analysis	10% rising in import tariffs decrease both mechanical and revenual distortions but increase factoral distortions.
Bussy (2023)	Effects of corporate tax evasion on international trade	30 OECD countries (2011-2017)	Panel data analysis	No statistically significant relationship between corporate tax evasion and international trade in countries with larger shadow economies
Erceg et al. (2023).	Trade and tax policies and financial measures.	Germany (2007-2019)	DSGE model	Increase in import tariffs, export subsidies and tax regulations It will increase competition in trade.
Kreuter and Riccaboni (2023)	The impact of import tariffs on GDP and consumer welfare	No Country	Production network model	The import tariffs affects GDP and consumer welfare negatively.
Bond et al. (2023)	Effects of optimal export tax on volume of import	From China to Germany, Japan, Korea, Taiwan, USA and Brazil (2000, 2007, 2014)	General Equilibrium Analysis	Use of optimal export tax leads to decrease of volume of import in 2007 and 2014, while use of optimal export tax leads to increase of volume of import in 2000.
Çetin and Keskin (2024)	International double taxation agreements.	Türkiye (2004-2024)	Qualitative Analysis	OECD agreements on the prevention of double taxation in international trade have a favourable influence on Turkey's foreign trade balance.

Upon reviewing Table 1, it is evident that levying foreign trade taxes at the military level does not lead to significant trade losses. Table 2 presents analyses investigating the correlation between international trade and exchange rates.

Table 2. Trade Across National Borders and Foreign Exchange Relationship Literature Research

Author	Subject	Data Set Period	Method	Result
Cooper (1971)	Terms of trade of the depreciation of currencies in developing countries.	20 developing countries (1947-1970)	Mathematical analysis	It was determined that the impact of the exchange rate on the terms of trade is negligible across the majority of the countries under scrutiny.
Akthar and Hilton (1984)	The connection amid exchange rate volatility and global trade.	Germany and USA (1974–1981)	Hilton model Least squares model	Their findings suggest that foreign trade is adversely affected by currency rate instability.
Gotur (1985)	Effects of exchange rate on global trade.	USA, UK Japan and France (1974 – 1982)	Hilton model and Least squares method	The influence of real currency rate instability on global trade is minimal and can be discounted.
Mc Kenzie (1998)	Disadvantages of exchange rate volatility on Australia's commerce.	Australia (1969 – 1995)	ARCH models	Exchange rate fluctuations have a favourable effect on Australian exports while exerting a detrimental influence on imports.
Hook and Boon (2000)	Exchange rate fluctuation and its effects on exports.	Malaysia (1985 –1997)	VAR model	Their conclusion indicated that exchange rate volatility harms exports.
Wilson and Tat (2001)	The relationship betwixt exchange rates and the US commerce balance concerning Singapore.	ABD and Singapur (1970 – 1996)	Partial reduced form analysis	Their analysis concluded that the currency rate is unlikely to exert a marked influence on the trade balance between the USA. and Singapore.
Hwang and Lee (2005)	The influence of exchange rate instability on trade within the UK.	UK (1990 – 2000)	GARCHM method	Although a rise in the exchange rate typically leads to an escalation in imports, it has been noted that heightened real exchange rate volatility reduces imports. A similar trend was observed for exports.
Agbeyegbe et al. (2006)	The association betwixt global trade exchange rate fluctuations, and tax revenue in Africa.	22 Sahra Altı Afrika Ulkesi (1980–1996)	Generalized Method of Moment Regressions	Overall, the findings suggest that there isn't a robust association betwixt commerce liberalization and total tax revenue or tax revenues.
Petrović and Gligorić (2010)	Trade Balance and Exchange Rate; J Curve Effect.	Serbia (2002-2007)	Johansen cointegration analysis and ARDL Test	Their conclusion indicated that in the lengthy timeframe, the exchange rate increase led to an enhancement in Serbia's foreign trade balance, while in the short term, although initially causing a deterioration, it eventually resulted in an improvement.
Nishimura and Hirayama (2013)	The impact of currency rate oscillations on commerce betwixt between China and Japan.	Japan Chinese (2002-2011)	ARDL Test	It hasn't impact on Japanese exports. But it has an impact on Chinese exports.
Lindé and Pescatori (2019)	Examining the macroeconomic effects of US trade policies.	USA and Euro Area (2016-2018)	New Keynesian model Lerner symmetry	Foreign trade macroeconomic costs cause lower income and trade volumes. Higher import tariffs will negatively impact global trade and production.
Kayani et. al. (2023)	Effect of real exchange rate on export and import	Selected developed and developing Asian countries (1980-2018)	Linear and Nonlinear ARDL method	Real exchange rate increases export of Pakistan and decreases export of Korea and Japan in linear ARDL method. Real exchange rate increases export of Pakistan and Malaysia in linear ARDL method. Real exchange rate increases import and export of Pakistan and Malaysia in the long run, but real exchange rate decreases export of Japan in nonlinear ARDL method.
Bahmani-Oskooee, Usman and Ullah (2023)	Effect of Exchange Rate Volatility on Commodity Trade Between Pakistan and China	14 Pakistani export industries to China and 34 Pakistani import industries from China (1978-2018)	ARDL method	Exchange Rate Volatility causes to increase some commodity and decrease some commodity.
Barkat, Jarallah and Alsamara (2024)	Examining the effect of nominal effective exchange rate on the trade balance	GCC countries (2000-2017)	ARDL method	Nominal effective exchange rate has an asymmetric negative impact on the trade balance in Bahrain, Qatar, Saudi Arabia, and the UAE.
Bawa Yussif et al. (2024)	Examining the effect of exchange rate volatility on export and import	Ghana (1993-2017)	GARCH method	Exchange rate volatility affects both import and export negatively.
Unlü (2024)	Examining the relationship between Real Exchange Rate, Trade Balance and Trade Policy Uncertainty	Türkiye (2000-2021)	SVAR method	The response of trade policy uncertainty to shocks to the trade balance and to the exchange rate is negative. The response of the exchange rate to trade balance shocks is positive. An increase in the trade balance increases the exchange rate and reduces trade policy uncertainty.

Table 2 comprises studies employing diverse analytical methods within the literature sample. Despite methodological variations, a consistent finding across these studies is the presence of a relationship betwixt exchange rate fluctuation and foreign trade.

4. Empirical Analysis

4.1. Data Set, Descriptive Statistics and Model

This study investigates the impact of taxes on international trade (TIT) and changes in the nominal exchange rate on the import volume of goods and services for 20 OECD countries over the period from 1999 to 2021. The analysis was conducted using the Stata-14 software. In the study, 20 countries out of 38 OECD countries were included in the analysis. The countries encompassed in the analysis are Australia, Canada, Costa Rica, France, Chile, Latvia, Greece, Korea, Iceland, Hungary, Mexico, Netherlands, Israel, Colombia, New Zealand, Norway, Austria, Türkiye, Switzerland and Slovak Republic. Countries that cannot be encompassed in the analysis are Estonia, Denmark, Germany, United Kingdom, Czechia, Italy, Poland, Slovenia, Finland, the United States, Spain, Japan, Portugal, Belgium, Sweden, Luxembourg, Lithuania and Ireland. Of these countries, the United States was excluded from the analysis. This is because one of the independent variables, the exchange rate, expressed as the value of the official currency in US$, distorts the order of the data set by taking the value 1 for the USA. Since the official exchange rate variable is in the currency of the countries, the exchange rate of this variable[3] was calculated. The reason why other OECD countries are not included in the analysis is that the other independent variable, TIT (% of revenue)[4] data, is given incompletely or not at all. The dependent variable used in the analysis is Imports of Goods and Services (IM) (current US$)[5] data. Their examination does not encompass compensation of employees, investment income (formerly known as factor services), and transfer payments. The data is presented in current US $ and spans annually from 1999 to 2021. The reason why the dataset cannot be obtained until 2022 is that although the other two data have data until 2022, TIT data are only available until 2021. Table 3 provides a comprehensive list of the variables utilized in the analysis, along with their explanations and the sources from which they were obtained.

Table 3. Descriptions of Variables Used in the Analysis and Their Sources

Variables	Explanations of Variables	Source
IM	Imports of goods and services (current US$)	Worldbank (WB), World Development Indicators
TIT	Taxes on international trade (% of revenue)	
ER	Exchange rate (LCU per US$, period average)	

The independents employed in the investigation are TIT (% of revenue) and ER (Official exchange rate). The dependent variable is IM (current US$). All variables were acquired from the World Development Indicators database on the official website of the WB. With the help of these variables, the model was formulated as follows.

$$IM_{it} = \alpha_{it} + \beta_{1it} TIT_{it} + \beta_{2it} ER_{it} + u_{it} \quad (1)$$

In the model, descriptive statistics must first be examined. Descriptive statistics results are included in Table 4.

3 The exchange rate of the Official exchange rate is calculated with the formula ((Official exchange rate for this year - Official exchange rate for the previous year) / Official exchange rate for the previous year*100). Since the rate of change is calculated when data for the year 1998-2021 is normally available, the year analyzed was started from 1999.

4 TIT (% of revenue): TIT comprises import duties, export duties, profits from export or import monopolies, exchange gains, and exchange levies.

5 IM (current US$): IM represents the total value of all goods and market services received from the rest of the world.

Table 4. Descriptive Statistics Results

	Variables	Mean	Standard Deviation	Min	Max	Observation (N)/ Number of Groups Observed
Without Logarithm	IM	196957000000	213000000000	3112265208,17124	944547056290,682	648/27
	TIT	1.353025	1.511397	-0.0560039	6.926879	648/27
	ER	0.8887613	14.2792	-99.69443	96.02556	648/27
With Logarithm	ΔLNIM	25.30075	1.349511	21.85862	27.57397	648/27

When the independent variable IM, without applying the logarithm, is examined in Table 4, a significant difference betwixt the least value (min) and the top value (max) is evident. To address this, the logarithm of this variable was taken, which reduced the difference between the min and max values. Consequently, the final version of the model was modified to (2).

$$LNIM_{it} = \alpha_{it} + \beta_{1it} TIT_{it} + \beta_{2it} ER_{it} + u_{it} \quad (2)$$

When N units and T observations of each unit are scrutinized collectively, panel data is generated. A linear panel data model:

$$Y_{it} = \beta_{0it} + \beta_{1it} X_{1it} + \beta_{2it} X_{2it} + \cdots + \beta_{kit} X_{kit} + u_{it} \quad i=1,\dots N; \quad t=1,\dots,T \quad (3)$$

Briefly:

$$Y_{it} = \beta_{0it} + \sum_{k=1}^{K} \beta_{kit} X_{kit} + u_{it} \quad i=1,\dots, N; t=1,\dots,T \quad (4)$$

It can be written as. Here i; stands for units and t stands for time. In other words, i refers to the unit dimension and t refers to the time dimension. β0it represents the constant term, β_{kit} K×1 dimensional parameters vector, X_{kit}, k. represents the explanatory variable i at time t. value for the unit; Y_{it} is the dependent variable at time t. Shows the value for the unit. If both the constant and slope parameters remain constant across units and time, the classical model is applicable. In cases where the slope parameter remains constant while the constant parameter varies across units, a unit effects model, also known as the one-way model, is utilized. Moreover, when the slope parameter remains constant while the constant parameter varies across both units and time, a unit and time effects model, also referred to as the two-way model, is employed (Yerdelen, 2018, pp.37-40).

First of all, it is tested whether there are unit and time effects in the model. Table 5 shows the results of these effects with the within group estimator[6].

Table 5. Results of the Within Group Estimator

For Unit Effect Probability Value of Within-Group Estimator	For Time Effect Probability Value of Within-Group Estimator
0.0000	0.0263

Based on the outcomes of the within-group estimator as presented in Table 5, the null hypothesis suggesting the absence of unit and time effects is denied at the 95% confidence level. Consequently, it is inferred that there exists both unit and time effects. In other

6 In the Stata 14 program, the absence of unit effect and time effect were examined separately.

words, there is a two-way model. Thus, it has been proven that the model is not a classical model. After testing the unit and time effects in the model, it is tested whether these effects are fixed or random. While it is assumed that there is no correlation betwixt unit effects and explanatory variables in the random effects model, it is assumed that this correlation is different from zero in the fixed effects model (Yerdelen, 2018, p.79).

The Hausman test, devised by Hausman in 1978, evaluates whether the model is fixed or random. In this test,

$$Y_{it} = X_{it}\beta + \mu_i + \varepsilon_{it}, \ (i=1, N; t=1, T) \quad (5)$$

In the model, between the random effects estimator ($\hat{\beta}_{GLS}$) and the fixed effects estimator ($\hat{\beta}_{FE}$). is tested whether there is a difference. The hypotheses used for this test are as follows (Hausman, 1978, pp.1261-1263). According to hypothesis (7), there is no difference between random effects and fixed effects estimators (The random effects model is effective). As per hypothesis (8), there exists a distinction between random effects and fixed effects estimators (The fixed effects model is efficient).

$$\hat{q} = \hat{\beta}_{GLS} - \hat{\beta}_{FE} \quad (6)$$

$$H_0: \text{corr}(\mu i, Xi) = 0 \quad (7)$$

$$H_1: \text{corr}(\mu i, Xi) \neq 0 \quad (8)$$

Calculated according to the hypotheses determined as a result of the Hausman test, H0 is rejected if $p < 0.05$ and H0 is accepted if $p > 0.05$. Accordingly, if the p-value of the Hausman test is less than 0.05, there is a random effect (abbreviation of random effects RE) model, and if the p-value of the Hausman test is greater than 0.05, there is a fixed effects model (abbreviated for fixed effects). The result of the Hausman estimator tested for unit effect is found in Table 6.

Table 6. Hausman Test for Unit and Time Effects

Hausman Test for Unit Effects			Hausman Test for Time Effects		
Chi_2	Probability Value (p)	Estimation Method	Chi_2	Probability Value (p)	Estimation Method
0.16	0.9217	RE	63.31	0.0000	FE

Upon reviewing Table 6, it is evident that the unit effects are random, given that the p-value of the robust Hausman test for unit effects exceeds 0.05. Conversely, regarding time effects, it was concluded that they represent fixed effects, as the p-value of the robust Hausman test falls below 0.05. If one of the unit and time effects is fixed and the other is random, there is a two-way mixed effects model.

4.2. Testing of Pretests

4.2.1 Normality Assumption

Spiegel and Stephens (2011) and Oral (2008) argued that according to the central limit theorem, when drawing N samples from a finite population, for sufficiently large values of N ($N \geq 30$), the sampling distributions of the means tend to approximate a normal distribution, irrespective of the population's underlying distribution. In our study, the sample size (n) representing the number of countries is 20, while the period (t) representing years is 23. Therefore, to present the sample size differently, considering that the total number of observations is $N = n * t = 20 * 23 = 460$, it is presumed that the sample means adhere to a normal distribution.

4.2.2. Multiple Linear Connection

In multiple regression models featuring more than one independent variable, the presence of interrelationships among two or more independent variables is termed multicollinearity. The Variance Inflation Factor (VIF) quantifies the extent to which the variances of the parameter estimates diverge from their true values due to multicollinearity (Yerdelen, 2020, pp.111-115). Table 7 presents the outcomes of the VIF criterion, which assesses multicollinearity.

Table 7. Multiple Linear Connection Test Result

	VIF Criterion	
Variables	VIF Value	1/VIF Value
TIT	1.02	0.985018
ER	1.02	0.985018
Average VIF: 1.02		

Table 7 shows that all VIF values are below 5 and there is no multicollinearity problem.

4.2.3. Autocorrelation

Autocorrelation, as described by Yerdelen (2020), refers to the association of error terms with error terms from different periods. In the fixed effects model and random effects model, autocorrelation was assessed using the Durbin Watson test suggested by Bhargava et al. (1982), along with the LBI tests proposed by Baltagi and Wu (1999). The findings of these tests are outlined in Table 8.

Table 8. Autocorrelation Test

Autocorrelation Test Result for Unit Effects		Autocorrelation Test Result for Time Effects	
Test Name	Test Value	Test Name	Test Value
Durbin Watson	0.1904	Durbin Watson	2.4172649
LBI	035	LBI	2.4581166
	0.36756084		

Upon reviewing Table 8, it is evident that the Durbin Watson test values suggested by Bhargava et al. (1982), as well as the LBI test values proposed by Baltagi and Wu (1999), are below 2 for unit effects. Consequently, this indicates a first-order autocorrelation (AR(1)) issue in the unit effects model. Conversely, it was observed that the test values for time effects exceeded 2, indicating the absence of autocorrelation problems in the time effects model (Yerdelen, 2018, pp.237-238).

4.2.4. Heteroscedasticity

Homoscedasticity, or constant variance of the error term, occurs when the conditional variance of the error term remains consistent across the independent variables. Conversely, heteroscedasticity, or changing variance of the error term, arises when the conditional variance of the error term varies depending on the independent variables (Gujarati and Porter, 2012, p.365). Traditional F-tests for equality of variances are built upon the assumption of Gaussian distribution. However, for random effects, Levene (1960) introduced a robust heteroskedasticity test that doesn't rely on the normal distribution assumption. Brown and Forsythe (1974) proposed an alternative local estimator based on a trimmed mean instead of average observations, providing robustness to outliers in Levene's test statistic (Yerdelen, 2018, pp.235-236). Based on this, the heteroskedasticity results in the random effects model are given in Table 9.

Table 9. Heteroskedasite Test

Testing Heteroscedasticity for Unit Effects			
Test Name		Test Value	Probability Value (p)
Levene, Brown and Forsythe Test	W0	0.00000000	0.2557935
	W50	0.00011845	0.41786235
	W10	0.00000001	0.2557935

In Table 9, there is a heteroscedasticity problem since the probability results of the test values of Levene, Brown and Forsythe (W0, W50 and W10) in the unit effects model are less than 0.05.

4.2.5. Cross-Section Dependency (Interunit Correlation)

Standard panel data model,

$$Y_{it}\ \alpha_i + \beta' x_{it} + u_{it} \tag{9}$$

For i=1,…, N and t=1,…,T, x_{it} refers to the K×1 vector of independent variables, β refers to the K×1 vector of parameters, and α_i refers to the time-invariant coefficient. In the H0 hypothesis, it is accepted that the error term u_{it} is distributed independently and identically according to time and cross-section. Also, u_{it} may be correlated in the cross-section but should be uncorrelated in the series. According to the H0 hypothesis, the correlation between error terms with different units is 0 and there isn't cross sectional dependence. According to the H1 hypothesis, the correlation between error terms with different units is not 0 and there is a cross sectional dependence. H0 and H1 hypothesis,

$$H_0: \rho_{ij} = \rho_{ji} = \text{cor}(u_{ij}, u_{ji}) = 0, \qquad i \neq j \tag{10}$$

$$H_1: \rho_{ij} = \rho_{ji} \neq 0 \qquad i \neq j \tag{11}$$

it is in the form $i \neq j$.

The product-moment correlation coefficient of the distribution is ρ_{ij}, and $\hat{\rho}_{ij}$ is the sample estimate of the pairwise correlation of the error terms, which is formulated as follows.

$$\hat{\rho}_{ij} = \hat{\rho}_{ji} = \frac{\sum_{t \in T_{ij} \cap T_j} (\hat{u}_{it} - \bar{\hat{u}}_i)(\hat{u}_{jt} - \bar{\hat{u}}_j)}{\left[\sum_{t \in T_{ij} \cap T_j} (\hat{u}_{it} - \bar{\hat{u}}_i)^2\right]^{1/2} \left[\sum_{t \in T_{ij} \cap T_j} (\hat{u}_{jt} - \bar{\hat{u}}_j)^2\right]^{1/2}} \qquad i \neq j \tag{12}$$

T_{ij}, the number of time series observations, varies between i and j units. The error term average $\bar{\hat{u}}_i$ is written as follows.

$$\bar{\hat{u}}_i = \frac{\sum_{t \in T_{ij} \cap T_j} \hat{u}_{it}}{T_{ij} \cap T_j} \tag{13}$$

Pesaran's CD test is expressed in equation (14) (Pesaran, 2004, p. 5).

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}\right) \tag{14}$$

It is decided whether cross-sectional dependence exists or not according to the p-value, which is the probability value of Pesaran's CD test. If the probability value is $p < 0.05$, the H0 hypothesis is rejected and there is a cross-sectional dependency problem. If $p > 0.05$, the H0 hypothesis is accepted and there is no cross-sectional dependence problem. Table 10 shows the results of the inter-unit correlation test tested with Pesaran's CD test for unit effects and time effects. As per the Pesaran CD test outcomes presented in Table 10, the p-value being below 0.05 indicates a correlation issue among units.

Table 10. Inter-Unit Test

Testing Interunit Correlation for Unit Effects		Testing Interunit Correlation for Time Effects	
Test Value	Probability Value (p)	Test Value	Probability Value (p)
47.336	0.0000	1.69	0.0263

4.2.6. Unit Root Test

Stationarity assessment in time series and panel data sets involves employing unit root tests, as stated by Yerdelen (2013). If there exists correlation among units in the series, second-generation tests are utilized; otherwise, first generation tests are applied. (Yerdelen, 2020, p.21; pp.68-104). Since there is a correlation between units, second-generation tests should be used. Second-generation tests are divided into three groups. The first group includes IPS (Im et al., 2003, pp.62-72), LLC (Levin et al., 2002, pp.18-23), Choi Fisher ADF(Choi, 2002, pp. 3-23), Fisher Extended Dickey Fuller (Fisher ADF), Fisher Philips Perron (Fisher PP)[7], Hadri (Hadri, 2000, pp.150-158), Breitung (Breitung, 2000, pp.164-175), HT (Harris and Tzavalis, 1999, pp.218-225) panel unit root tests. The second group of second-generation tests includes Seemingly Unrelated Regression Extended Dickey-Fuller (SURADF) (Breuer et al., 2002, pp.528-544) and Multivariate Extended Dickey Fuller (MADF) (Taylor and Sarno, 1998, pp.3-20) panel unit root tests. Panel unit root tests in the third group of second-generation tests are PANICCA Reese and Westerlund, 2016, pp.963-978), Extended Sargan and Bhargava (CSB) (Pesaran et al., 2013, pp.96-106), Fisher ADF and Horizontal Section Extended Kwiatkowski, Phillips, Schmidt and Shin (Horizontal Section Extended (KPSS) (Hadri and Kurozumi, 2012, pp.31-34), Residual and Panel Analysis of Stationarity of Common Factors (PANIC) (Bai and Ng, 2010, pp.1579-1598; Bai and Ng, 2004, pp.1130-1176), Horizontal Section Extended Im, Pesaran and Shin (CIPS) (Pesaran, 2007, pp.268-302), Moon and Perron (Moon and Perron, 2004, pp. 83-104) (Yerdelen, 2020, pp.67-100). In this study, the MADF panel unit root test was used. The results of this test are in Table 11.

Table 11. MADF Panel Unit Root Test Results

Variables	Test level	Still/ Trendy	MADF test statistic value	Critical Value	Decision
LNIM	Level	Fixed	983.205	34.737	I(0)
TIT	Level	Fixed	12414.270	34.737	I(0)
ER	Level	Fixed	183000	34.737	I(0)

When Table 11 is examined, it is seen that the series is stationary (I(0)) at the 95% confidence level since the MADF test statistic value is higher than the critical value.

When the basic assumptions in the unit effects model are examined, it is seen that there are problems of autocorrelation, cross-section dependence and heteroscedasticity. It is seen that there is a cross-sectional dependency problem in the time effects model. Random Effects Generalized Least Squares Regression Model with AR(1) Residual gives

7 Fisher ADF and Fisher PP test were developed by Choi (Choi, 2001, pp. 255-271) based on Fisher (Fisher, 1932, pp. 258-261) test and were first applied to panel data by Maddala and Wu (Maddala and Wu, 1999, pp.636-650) based on ADF.

the estimate of the regression established when the residual is first-order autoregressive AR(1). In the panel data model below,

$$Y_{it} = \beta X_{it} + \mu_{it} + u_{it} \quad (15)$$

u_{it}'s AR (1) assuming it follows the process;

$$u_{it} = \rho u_{it-1} + z_{it} \quad (16)$$

$|\rho|<1$ and z_{it} is uniformly distributed with zero mean and σ_z^2 variance. The model was estimated based on this information.

4.3. Empirical Results

Since the unit effects are random and the residual follows an AR(1) process, the model was estimated with the random effects generalized least squares regression estimator with AR(1) residual. The estimation result is shown in Table 12.

Table 12. AR (1) Residual Random Effects Generalized Least Squares Regression Model Estimator Result

Dependent Variable (LNIM)		Wald Chi2 (2) Test Value	Probability Value (p)
		23.83	0.0000
Independent Variables	Coefficient	Robust Standard Error	Probability Value (p)
TIT	-0.0714959	0.023514	0.002
ER	-0.0017018	0.0004406	0.000

When Table 12 is examined, it can be seen that the overall model is significant. The independent variables TIT and ER were found to be significant at the 5% significance level. While a 1% increase in TIT reduces the import volume by approximately 0.07%; a 1% increase in the national exchange rate reduces the import volume by approximately 0.002%. This result shows that both TIT and the increase in the national exchange rate negatively affect the import volume.

5. Discussion and Conclusion

Countries depend on international trade to maintain their economic existence and create strong financial markets. International trade capacity is a crucial determinant in the expansion and advancement of a country's economy. Countries can engage in exports by specializing in the production of services and goods where they hold a comparative advantage. A key element of international commerce is the pricing of goods and services. The exchange rate is a crucial factor influencing these prices. Additionally, taxes imposed are among the primary determinants of trade. Nowadays, it is common to collect foreign trade taxes on imports. Taxes on foreign trade are important in foreign trade, which is gaining momentum with globalization. With economic integrations, customs duties are collected from the countries that are members of this integration, even if the countries that are members of these integrations do not collect customs duties in foreign trade. Taxes on foreign trade, in other words, customs duties, are divided into two: import taxes and export taxes.

The analysis indicates that an increase in taxes on international trade reduces import volume. This finding is compatible with Bond et al. (2023), so that using of optimal export tax leads to decrease of volume of import in 2007 and 2014. Kreuter and Riccaboni (2023) find also that the import tariffs affect GDP and consumer welfare negatively. This finding is similar to Atkin and Donaldson (2021), so that 10% rising in import tariffs decrease both mechanical and revenual distortions. This finding is consistent with Holzner et al. (2021) results for corporate tax on FDI across all sectors and Nicholson's (2013) results for the NAICS sector regarding VAT. Furthermore, the analysis reveals that an increase in the

exchange rate negatively affects import volume. This finding is consistent with Barkat, Jarallah and Alsamara (2024), so that nominal effective exchange rate has an asymmetric negative impact on the trade balance in Bahrain, Qatar, Saudi Arabia and the UAE. Bawa Yussif et al. (2024) find out, that exchange rate volatility affects both import and export negatively. The findings of both studies are similar to this study. Kayani et. al. (2023) determine that real exchange rate decreases export of Korea and Japan in linear ARDL method and export of Japan in nonlinear ARDL method. This finding is compatible with this study. Bahmani- Oskooee, Usman and Ullah (2023) establish, that exchange rate volatility causes decrease some commodity. Therefore, this finding is similar to this study. The findings of Hwang and Lee (2005) and McKenzie (1998), who discovered that heightened exchange rate volatility leads to a decrease in imports are comparable to this study. Lindé and Pescatori (2019) found a negative impact of increases in import tariffs on global trade, consistent with the findings of this study, while Akthar and Hilton (1984), found a negative effect of exchange rate volatility on total trade volume.

Especially in developing countries such as Türkiye, which import raw materials and semi-finished products, process them, produce final goods and export final goods, policymakers must stimulate imports and thus domestic production by reducing the exchange rate and tax rates on imports. Otherwise, the price of final goods will rise and this will be a burden on the final consumer, thus triggering inflation.

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