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The Effects of Trade Wars on World Welfare

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Abstract

In this study, the effect of the trade wars between the USA and China on the countries' economies was investigated. The European Union, a global economic power, is also involved in the study. The relationship between countries' foreign trade, trade volumes, and world GDP has been examined with six different hypotheses. For this purpose, Granger and Toda-Yamamoto causality test and Johansen cointegration analysis were used. Evidence has been obtained that there is a causal relationship between the foreign trade of countries and the World GDP. Another finding is a long-term relationship between the foreign trade of countries and world GDP. As a result, it has been determined that trade wars negatively affect countries' welfare.

Key words: Economic Growth, Foreign Trade, Trade Wars, Level of Welfare

JEL Code: F13, F19, F38, F69

1. Introduction

With a protective approach, countries impose new taxes on imported products to develop the domestic industry. It also imposes quota restrictions on export products or increases the existing quota. For the same reasons, similar commercial arrangements are made for the countries under sanctions. This leads to the start of trade wars.

The trade war between China and the United States (USA) began on March 22, 2018, when President Trump announced that the US would impose tariffs on

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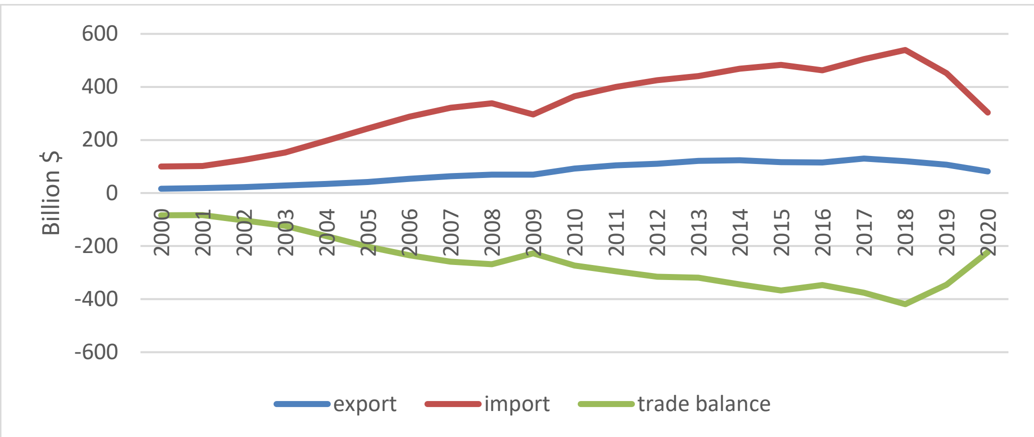
imported goods from China (25% tax increase on steel, 10% tax increase on aluminium) (Xu ve Lien, 2020). Figure 1 shows the last 20 years of US trade in goods with China. It is seen that the foreign trade deficit of the USA is in an increasing trend until 2018. In this situation, it is seen that the exports made by the USA to China do not meet the imports from China and that there are continuous and increasing deficits in the trade balance.

China's exports to foreign countries started to increase rapidly after becoming a member of the World Trade Organization in 2001. While China's exports to the USA were 100 billion dollars in 2000, they reached approximately 539 billion dollars in 2018. This growth in foreign trade has attracted the attention of many countries, especially the USA (Doifode & Narayanan, 2020).

As seen in Figure 1, the trade deficit of the USA with China in 2018 increased to approximately 418 billion dollars. This situation represents the most significant deficit in foreign trade between the USA and China. In addition, the foreign trade deficit of $ 418 billion represents 42% of the total foreign trade deficit in 2018 (Carvalho, Azevedo, & Massuquetti, 2019).

The trade wars between the US and China began when the United States introduced Section 232 of the Trade Expansion Act of 1962 (alleging a national security threat) to increase tariffs on steel and aluminium products. This has led to US trade disputes with significant steel and aluminium exporters, including China (Li, Balistreri, & Zhang, 2020). These trade disputes continued with mutual reprisals by countries. Table 1 shows the historical course of the trade wars between the USA and China.

Figure 1. Effect of Foreign Trade on US Trade War Between the US and China



Source: *US Census Bureau, https://www.census.gov/foreign-trade/balance/c5700.html (Date of access 24.11.2020).*
Note: *The chart has been prepared by the authors with the data compiled from the source.*

The US and China, the two largest economies globally, mutually raised import taxes on each other, which turned into a trade war. The US imposed additional import duties on steel and aluminium in March 2018. On the other hand, China retaliated with tariffs on aluminium, meat, fruit, and wine imported from the US in April. Other countries that export steel and aluminium to the US have also retaliated import duties against the US. The trade dispute between the US and China has intensified, and the US imposed an additional 25% import tax from China worth $ 50 billion ($ 34 billion in July 2018 and $ 16 billion in August 2018). Later, China imposed a 25% tariff on imports from the US, worth $ 50 billion. In September, the further escalating tariff hike caused the US to seize a 10% tariff increase worth $ 200 billion on imports from China (Bown, Jung, & Lu, 2018).

In late 2018, the US announced that it would increase its customs duty from 10% to 25% on imports of $ 200 billion from China and implemented it in May 2019. With this application from the USA, China increased the customs tax by 60 billion dollars on May 13 (Itakura, 2020). On the other hand, China imposed an additional $ 60 billion customs tax on US imports in September 2018. In the continuous period, on September 1, 2019, the USA increased tariffs worth 300 billion dollars on Chinese goods and retaliated by applying tariffs on imports of US goods worth 75 billion dollars in China the same day.

Table 1. Tariff Practices in Trade Wars Between the US and China

No	Date started	Tariff and quota measures	Description
1	23-03-2018	US steel aluminium Tariffs	US tariff increase on steel and aluminium from China, Canada, Mexico, and the EU
2	02-04-2018	China $3Billion	China's tariff increase in the 3 billion round
3	06-07-2018	China's $50 billion wave 1	China's tariff increase (implemented) in the first wave of the 50 billion round
4	06-07-2018	US-China $50 billion wave 1	US tariff increase (implemented) in the first wave of the 50 billion round
5	08-08-2018	China's $50 billion wave 2	China's tariff increase (pending) in the second wave of the 50 billion round
6	08-08-2018	US-China $50 billion wave 2	US tariff increase (implemented) in the second wave of the 50 billion round
7	18-09-2018	China's $60 billion tariffs increase1	China's 60 billion tariffs on US imports (first increase)
8	18-09-2018	US $200 billion tariff increase	US 200 billion tariff increase on Chinese products (first increase)
9	13-05-2019	China's $60 billion tariffs increase	China's 60 billion tariffs on US imports (second increase)
10	01-09-2019	US $300 billion tariff increase1	US 300 billion tariff increase on Chinese products (first increase)
11	01-09-2019	China's $75 billion tariff increases1	China's retaliation for US 300 billion tariff

Source: *Li, M. (2018) CARD Trade War Tariffs Database (Citing article: Doifode ve Narayanan, (2020)*

The phase one trade deal signed between the US and China in January 2020 shows a compromise between the countries in the trade war. The USA has committed to reducing the tariff application from 15% to 7.5% in the previous period. (Chowdhry & Felbermayr, 2020). On the other hand, China has been importing an additional $200 billion worth of US goods for two years (Ciuriak, 2020).

With the first phase trade deal between the US and China, the trade wars look to calm down by 2020. The US's trade balance in 2018 was $419 billion. In 2019 $345 billion, and 2020 $223 billion. With the trade wars in the US economy, it is seen that the trade balance improved by 21% in 2019 and by 55% in 2020. It can be said that these improvements occurred due to the first phase trade agreement.

The EU's largest trading partner is China after the USA. China's trade volume with the USA is very close to the trade volume with EU countries (Jiang et al., 2019). In addition, the trade wars between China and the US are likely to affect both China's trade with EU countries and trade between the US and EU countries. In addition, it is thought that the trade war between China and the USA will adversely affect the economies of other countries. Therefore, this study aims to discuss the effects of trade wars on both the country and the global economy.

2. Literature Review

This study evaluates the possible effects of the trade war between the USA and China on the three principal actors of the world economy, the USA, China, and the EU. When the literature is examined, studies indicate a positive relationship between trade volumes and welfare levels. With the opening of countries with a closed economy to world markets, their economies caught a growth trend. In addition, there are studies indicating an improvement in the welfare level of the citizens of the country and economic growth. For example, with China's membership in the World Trade Organization, there has been a significant increase in the welfare level (Ianchovichina and Martin (2003); Wang (2003); Chen and Ravallion (2004)). Ballard and Cheong (1997) estimated that the establishment of the Pacific free zone, which includes China and the USA, would increase the prosperity of China and the USA by 1.4% and 0.13%, respectively. In the studies, it has been emphasized that the globalization of trade between countries and the elimination of trade-blocking factors such as tariffs will increase world welfare.

On the contrary, it has been stated that increasing the measures against the factors preventing trade will have a decreasing effect on world welfare. Balistreri et al. (2018) examined the effects of the trade wars between the USA and China on the country's economies. The results concluded that the trade wars had a negative effect of 1.02% on the US national income and 1.71% on China's income. They also stated that trade wars impacted other countries and regions. For example, they found that trade wars would increase EU-27 welfare by 0.49%, and non-EU-27 countries would increase by 0.35%. Bollen and Rojas-Romagosa (2018) found that the national income of the USA and China decreased by -0.4% and -1.2%, respectively, as a result of the tariff and retaliation wars that started on steel and aluminium. In their studies, Walmsley and Minor (2018) predicted that the trade wars between the USA and China had an impact of -1.78% on the US national income in 2019 and that it would have an effect of -1.25% in 2030. In addition, between 2018 and 2030, it is thought that there will be a loss of 2.8 trillion in the US national income. In addition, they emphasized that other countries other than the USA and China will benefit from the trade wars. Balistreri et al. (2018). Devarajan et al. (2018) stated in their studies that the trade wars would reduce the national income of the USA by 0.3% and China by 0.1%. They determined that the trade wars will adversely affect Mexico and Canada, but EU-28 and high-income Asian countries will be positively affected by this situation. They also predicted that the trade wars would increase US exports by 11% and reduce imports by 10.6%.

Noland (2018) stated in her study that the policies implemented by the USA would cause trade wars, and this situation would negatively affect the national income of both countries. Amiti et al. (2019) found that the trade war between the USA and China caused 1.4 billion dollars of welfare loss per month in the USA. Itakura (2020) found that the trade war between the USA and China reduced the national income in both countries by 1.41% and 1.35%, respectively. In addition, the study found that the trade war negatively affected almost all sectors of both countries. Carvalho M. et al. (2019) stated in their study that trade wars would cause a loss of welfare in the USA and China. They predicted that the wealth lost in the USA and China would be 23 and 43 billion dollars, respectively. They also stated that there would be an increase in welfare in other countries. Li, Balistreri and Zhang (2020) found in their study that the trade wars between the USA and China reduced the national income of both countries by 0.2% and 1.7%, respectively. In addition, the two trade negotiations stated that the US's additional customs tax threats and China's response to retaliation would worsen the welfare of both countries. Guo et al. (2018) predicted in their study that the trade war between the US and China would lead to the collapse of bilateral trade. They emphasized that this situation will cause a severe loss of social welfare in the USA. It will have positive and negative consequences in China, depending on its effect on the trade balance. In addition, they emphasized that the US-China trade war will affect some small economies positively, but other countries will suffer from this situation.

Studies in the literature show that countries' welfare, especially the USA and China, will decrease with trade wars. When the literature is examined, it has been observed that there has been a development both in the Chinese economy and in the regional and global economies with China's membership of the World Trade Organization. In this study, the relationship between the foreign trade volumes of the USA, China and EU (European Union) countries, which dominate the world national income and a large part of world trade, and world welfare will be examined.

With With the findings to be obtained, the effects of trade wars targeting sectors in case they target the whole economy are investigated. For this purpose, especially the trade wars between the USA and China were examined. We also included the EU, an essential economic power in the world economy in the study. Because we wanted to discuss the EU's involvement in trade wars, this approach distinguishes the study from the studies in the literature. It is thought that it will make an essential contribution to the literature. In this context, it is aimed to discuss the findings obtained by making analyzes under different hypotheses. Research hypotheses are presented below.

Hypothesis 1: There is a causality relationship between the total foreign trade volume between the EU and China and the world's national income.

Hypothesis 2: There is a causality relationship between the total foreign trade volume between the EU and the USA and the world's national income.

Hypothesis 3: There is a causality relationship between China's total foreign trade volume and world national income.

Hypothesis 4: There is a causality relationship between the total foreign trade of the USA and the world's national income.

Hypothesis 5: There is a causality relationship between the total foreign trade volume of the EU and the world's national income.

Hypothesis 6: There is a causality relationship between the total foreign trade volume between China and the USA and the world's national income.

In the above six hypotheses, countries with the largest share of world trade are included. In this way, the effect of a trade war on welfare between the USA and China and between countries representing most of the world trade volume, including the EU, will be investigated. In the next part of the study, the data set used to test the hypotheses will be introduced. Then, the methodology and conclusion to be used in the study will be discussed.

3. Data and Methodology

The effects of trade wars between China, the USA and the EU on the world's national income are examined in the study. The study is carried out with annual data from 1980 – 2019. China's membership in the World Trade Organization as of December 11, 2001, has been included as a dummy variable in the analysis. The dummy variable (Dt) is created before and after 2002. The variables used in the analysis are world gross domestic product (GDPt) EU's total foreign trade volume with China (Trade1t), the EU's total foreign trade volume with the US (Trade2t), the total foreign trade volume of China (Trade3t), the total foreign trade volume of the USA (Trade4t), the total foreign trade volume of the EU (Trade5t) and USA' total foreign trade volume with China (Trade6t). Table 2 gives information about the variables used in the application.

Table 2. Tariff Practices in Trade Wars between the US and China

Variables	Abbreviation	Source
The world gross domestic product	GDP_t	IMF
EU' total foreign trade volume with China	$Trade_{1t}$	IMF
EU' total foreign trade volume with USA	$Trade_{2t}$	IMF
China's total foreign trade volume	$Trade_{3t}$	IMF
USA' total foreign trade volume	$Trade_{4t}$	IMF
EU' total foreign trade volume	$Trade_{5t}$	IMF
USA' total foreign trade volume with China	$Trade_{6t}$	IMF
Dummy (0, before 2002; 1, after 2002)	D_t	Authors' computation

Note: *Total foreign trade volumes are the sum of import and export values obtained from the IMF database.*

The relationship between the world gross domestic product and the foreign trade volume between China, the USA and the EU has been examined. The study investigates whether there is a relationship between the variables using Granger and Toda-Yamamoto causality analysis. In addition, the Johansen cointegration test was used to determine the long-term relationship. If there is a relationship between the variables shown in Table 2, it is tried to determine in which direction it is.

Augmented Dickey-Fuller (ADF) (1979, 1981) unit root test tests whether the series is stationary. Unit root tests should be done before testing causality between variables. The single constant term regression equation (1) and the constant term and trend term ADF regression equation (2) are shown below.

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \varepsilon_t \tag{1}$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 T + \sum_{j=1}^{p} \gamma_j \Delta Y_{t-j} + \varepsilon_t \tag{2}$$

Y_t is a time series, α is the constant parameter, t is the trend, α_1 is the autoregressive coefficient, ΔY_t is the first differentiated Y_t series, and ε_t is the White noise error term. The null hypothesis shows that the series has a unit root in the ADF unit root test. They are not stationary; the alternative hypothesis states that the series does not have a unit root. That is, they are stationary. Granger causality analysis can be performed after the series ensures to be stationary.

Vector Autoregressive (VAR) model is one of the highly preferred approaches in time series analysis. VAR models are known to explain the dynamic behaviour of economic series. VAR models can be used to investigate the relationships between variables. Sims (1980) suggested that the VAR model be used in stationary series. The interpretation of the coefficients estimated in VAR models is not essential. In this context, the dynamic properties of the VAR model are generally evaluated by three different methods. These are the Granger causality test, impulse–response functions and error variance decomposition approaches (Zivot and Wang, 2006).

Granger's (1969) causality analysis for two endogenous variables, such as X and Y, is performed using the following equation (3) and equation (4) VAR models. Different criteria are used to determine the lag length in Granger causality test (Bhattacharya ve Mukherjee, 2003). Schwarz Bayesian (BIC) information criteria are used for VAR models in lag length selection. The information criteria with a minimum value are preferred as the appropriate value (Mills, 2019). Consistent estimates are obtained using the Ordinary Least Squares (OLS) in VAR models (Farzanegan, Alaedini and Habibpour, 2021).

$$Y_t = \delta_0 + \sum_{i=1}^{n_1} \theta_i \Delta Y_{t-i} + \sum_{j=1}^{n_2} \beta_j X_{t-j} + \varepsilon_{1t}, \quad i = 1, \dots, n_1 \quad j = 1, \dots, n_2 \tag{3}$$

$$X_t = \mu_0 + \sum_{i=1}^{n_1} \emptyset_i \Delta Y_{t-i} + \sum_{j=1}^{n_2} \gamma_j X_{t-j} + \varepsilon_{2t} \quad i = 1, \dots, n_1 \quad j = 1, \dots, n_2 \tag{4}$$

In these equations, δ_0 and μ_0 are the constant, θ_i, β_j, $\emptyset_i$ and γ_j are slope coefficients, and ε_{1t} and ε_{2t} are the error terms. F test can be used in Granger causality analysis. Causality conditions can be more complex if there are more than two variables. In this context, Granger causality analysis is often used in applications with two variables (Lütkepohl, 2013; Forson et al., 2015). In Granger causality analysis, the null hypothesis means that while the lag lengths of the variable under investigation are equal to zero, this variable is not Granger cause. The alternative hypothesis is established that there is a Granger causation.

The bivariate VAR (p) model with a lag length of p is shown below:

$$\begin{pmatrix} Y_t \\ X_t \end{pmatrix} = \begin{pmatrix} \delta_0 \\ \mu_0 \end{pmatrix} + \begin{pmatrix} \theta_1 & \beta_1 \\ \emptyset_1 & \gamma_1 \end{pmatrix} \begin{pmatrix} Y_{t-1} \\ X_{t-1} \end{pmatrix} + \cdots + \begin{pmatrix} \theta_i & \beta_j \\ \emptyset_i & \gamma_j \end{pmatrix} \begin{pmatrix} Y_{t-p} \\ X_{t-p} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix} \tag{5}$$

The VAR (p) model can also be shown in the following:

$$y_t = c + \sum_{t=1}^{p} \phi_i y_{t-i} + \varepsilon_t, \quad i = 1,2, \dots, p \tag{6}$$

y_t is the nx1 vector of endogenous variables, c is the vector of constant terms, ε_t is the nx1 vector of error terms, and ϕ_i is the nxn matrix of autoregressive coefficients. The coefficients expressing the lags of X_t are zero in the equation Y_t. Similarly, the coefficients expressing the lags of Y_t are zero in the equation X_t. When evaluated in terms of Granger causality analysis, the coefficients of the Y_t in the X_t equation should be significant for Y_t to be the cause of X_t. Under the validity of these conditions, it is interpreted that Y_t is the Granger cause of X_t (Zivot and Wang, 2006; Pinzón, 2018).

VAR models reveal the effect of a shock on variables over time through impulse-response functions. Impulse-response functions indicate how shocks affect values (Box, Jenkins, Reinsel and Ljung, 2015).The impulse-response function provides information about the reaction of X_t, a period later when a standard deviation shock occurs at Y_t (Brahmasrene, Huang and Sissoko, 2014). In other words, impulse-response functions show the response of Y_t to a standard deviation shock in X_t (Konstantakis, Milioti and Michaelides, 2017).

Variance decomposition provides information about the extent of the impact of the shock of the variables on other variables in the VAR model. Variance decomposition gives the ratio of the changes that occur with the shocks of the dependent variables against the shock in other variables (Bayar and Kilic, 2014).

Hypothesis investigates whether changes in US, EU and China foreign trade volumes cause changes in world gross domestic product or whether changes in world gross domestic product cause changes in US, EU and China foreign trade volumes. Table 3 contains the equations created on the assumption of different research hypotheses. Analyzes are carried out according to the equations in Table 3. In the established hypotheses, the H0 hypothesis states no causality between the variables, and the H1 hypothesis states that there is causality between the variables.

Table 3. VAR Equations Created Based on Hypotheses

Hypothesis	Equations	Explanation
Hypothesis 1	$\Delta GDP_t = \delta_0 + \theta_1 \Delta GDP_{t-1} + \beta_1 \Delta Trade_{1t-1} + \varepsilon_{1t}$	$Trade_{1t} \rightarrow GDP_t$
	$\Delta Trade_{1t} = \delta_0 + \theta_1 \Delta Trade_{1t-1} + \beta_1 \Delta GDP_{t-1} + \varepsilon_{1t}$	$GDP_t \rightarrow Trade_{1t}$
Hypothesis 2	$\Delta GDP_t = \delta_0 + \theta_1 \Delta GDP_{t-1} + \beta_1 \Delta Trade_{2t-1} + \varepsilon_{1t}$	$Trade_{2t} \rightarrow GDP_t$
	$\Delta Trade_{2t} = \delta_0 + \theta_1 \Delta Trade_{2t-1} + \beta_1 \Delta GDP_{t-1} + \varepsilon_{1t}$	$GDP_t \rightarrow Trade_{2t}$
Hypothesis 3	$\Delta GDP_t = \delta_0 + \theta_1 \Delta GDP_{t-1} + \beta_1 \Delta Trade_{3t-1} + \varepsilon_{1t}$	$Trade_{3t} \rightarrow GDP_t$
	$\Delta Trade_{3t} = \delta_0 + \theta_1 \Delta Trade_{3t-1} + \theta_2 \Delta Trade_{3t-2} + \beta_1 \Delta GDP_{t-1} + \beta_2 \Delta GDP_{t-2} + \varepsilon_{1t}$	$GDP_t \rightarrow Trade_{3t}$
Hypothesis 4	$\Delta GDP_t = \delta_0 + \theta_1 \Delta GDP_{t-1} + \beta_1 \Delta Trade_{4t-1} + \varepsilon_{1t}$	$Trade_{4t} \rightarrow GDP_t$
	$\Delta Trade_{4t} = \delta_0 + \theta_1 \Delta Trade_{4t-1} + \beta_1 \Delta GDP_{t-1} + \varepsilon_{1t}$	$GDP_t \rightarrow Trade_{4t}$
Hypothesis 5	$\Delta GDP_t = \delta_0 + \theta_1 \Delta GDP_{t-1} + \beta_1 \Delta Trade_{5t-1} + \varepsilon_{1t}$	$Trade_{5t} \rightarrow GDP_t$
	$\Delta Trade_{5t} = \delta_0 + \theta_1 \Delta Trade_{5t-1} + \beta_1 \Delta GDP_{t-1} + \varepsilon_{1t}$	$GDP_t \rightarrow Trade_{5t}$
Hypothesis 6	$\Delta GDP_t = \delta_0 + \theta_1 \Delta GDP_{t-1} + \beta_1 \Delta Trade_{6t-1} + \varepsilon_{1t}$	$Trade_{6t} \rightarrow GDP_t$
	$\Delta Trade_{5t} = \delta_0 + \theta_1 \Delta Trade_{6t-1} + \beta_1 \Delta GDP_{t-1} + \varepsilon_{1t}$	$GDP_t \rightarrow Trade_{6t}$

Note: Total foreign trade volumes are the sum of import and export values obtained from the IMF database.

Toda – Yamamoto (1995) developed an approach based on the Granger test and tested it by applying the Wald criterion. In the Toda – Yamamoto test, the maximum integration (dmax) degree of the series in the model is determined. A calculation is made based on the modified Wald (MWald) test statistics by increasing the autoregressive coefficients in the VAR models with the optimal

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delay number (k) and dmax. Here, the VAR model is calculated in the degree of ($k+d_{max}$) (Payne, 2012). The test statistic calculated in this test approach has an asymptotic chi-square distribution (Singhal, Choudhary and Biswal, 2021). Model estimates were estimated using the seemingly unrelated regression (SUR) approach (Amiri and Ventelou, 2012).

According to the Toda – Yamamoto approach, the VAR models will be as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i}\, \Delta Y_{t-i} + \sum_{j=k+1}^{d_{max}} \alpha_{2j}\, Y_{t-j} + \sum_{i=1}^{k} \vartheta_{1i}\, \Delta X_{t-i} + \sum_{j=k+1}^{d_{max}} \vartheta_{2j}\, X_{t-j} + \lambda_{1t} \tag{7}$$

$$X_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i}\, \Delta X_{t-i} + \sum_{j=k+1}^{d_{max}} \beta_{2j}\, X_{t-j} + \sum_{i=1}^{k} \phi_{1i}\, \Delta Y_{t-i} + \sum_{j=k+1}^{d_{max}} \phi_{2j}\, Y_{t-j} + \lambda_{1t} \tag{8}$$

4. Findings

Descriptive Statistics

Descriptive statistics in the study are presented in Table 4. Whether the error term of each of the data is normally distributed was tested with the Jargqu-bera test. Accordingly, it is seen that the Jarque Bera probability value is greater than 10% for each data. Thus, the H0 hypothesis that the error terms of the data are normally distributed is accepted. When other descriptive statistics were examined, all series were slanted to the left due to the Skewness test. As a result of the Kurtosis test, it is understood that the series is less than 3. In other words, it is understood that the series are compressedly. Looking at the data average, trade5t has the largest average, and GDP data has the minor average. Finally, when looking at the distance of the data from the arithmetic mean values, it was determined that the most deviation was in the trade6t data with 1.706. It also has trade3t data with a minor deviation of 0.655.

Tablo 4. Descriptive Statistics

	GDP	Trade1t	Trade2t	Trade3t	Trade4t	Trade5t	Trade6t
Mean	10.762	11.265	12.494	13.128	14.296	15.279	11.365
Median	10.789	11.169	12.635	12.932	14.412	15.251	11.610
Maximum	11.809	13.350	13.445	15.349	15.252	16.278	13.399
Minimum	9.499	8.622	11.316	10.535	13.054	14.005	8.444
Std. Dev.	0.692	1.622	0.673	1.655	0.742	0.777	1.706
Skewness	-0.1842	-0.189	-0.345	-0.047	-0.292	-0.218	-0.381
Kurtosis	1.818	1.656	1.806	1.579	1.713	1.696	1.727
Jarque-Bera	2.552	3.249	3.166	3.376	3.329	3.149	3.671
Probability	0.279	0.196	0.205	0.184	0.189	0.207	0.159
Sum	430.498	450.629	499.771	525.157	571.863	611.162	454.637

Sum Sq. Dev.	18.702	102.691	17.673	106.912	21.506	23.602	113.591
Observations	40	40	40	40	40	40	40

Unit Root Test

The study aims to reveal the relationships of the world gross domestic product with total foreign trade volumes in the USA, the EU, and China triangle. First, the unit root test is performed for series. According to the unit root test results, it is seen that all variables are stationary at the first difference. Granger causality test is used to examine the relationship between stationary series. Table 5 shows the results of the ADF unit root test.

Table 5. Results of ADF Unit Root Test

Variables	t-statistics		Variables	t-statistics	
	Constant	**Constant+Trend**		**Constant**	**Constant+Trend**
GDP_t	7.04 (1.00)	0.14 (0.99)	ΔGDP_t	-2.43 (0.14)	-4.62** (0.00)
$Trade_{1t}$	2.83 (1.00)	0.41 (0.99)	$\Delta Trade_{1t}$	-1.91 (0.32)	-4.14* (0.01)
$Trade_{2t}$	0.79 (0.99)	-3.35 (0.07)	$\Delta Trade_{2t}$	-6.22** (0.00)	-6.51** (0.00)
$Trade_{3t}$	1.34 (0.99)	-1.41 (0.84)	$\Delta Trade_{3t}$	-4.64** (0.00)	-5.02** (0.00)
$Trade_{4t}$	0.05 (0.96)	-3.08 (0.13)	$\Delta Trade_{4t}$	-6.87** (0.00)	-6.86** (0.00)
$Trade_{5t}$	-0.18 (0.93)	-2.62 (0.28)	$\Delta Trade_{5t}$	-6.19** (0.00)	-6.15** (0.00)
$Trade_{6t}$	0.29 (0.97)	-1.94 (0.61)	$\Delta Trade_{6t}$	-4.38** (0.00)	-4.27** (0.00)

***Note**: **,* denotes significance at 1%, 5% significance level. Values in parentheses are prob. values. Test critical values at 1% and 5% significance levels are -3.610 and -2.939 for constant, -4.212 and -3.529 for constant and trend, respectively.*

Granger Causality Test

Table 6 shows the results of the Granger causality analysis. Accordingly, it has been determined that the foreign trade volume of the EU and China is the cause of the GDP, while there is a bidirectional relationship between the foreign trade of the USA and the GDP. Besides, while trade between EU and China explains GDP, trade between EU and USA has a bidirectional causality relationship with GDP. However, it has been concluded that there is no causal relationship between the trade between the USA and China and the GDP.

The results in Table 6 provide strong evidence that the combined foreign trade volumes of China, the USA and the EU are the cause of GDP. In addition, the H0 hypothesis was rejected in hypotheses 2 and 4 in Table 3. While H0 was rejected in hypotheses 1, 3, and 5 as one-way, in hypothesis 6, H0 was accepted. Another significant result reveals that China's membership in the World Trade Organization affects the GDP. Finally, it has been concluded that the dummy variable created by China's membership in the World Trade Organization causes GDP at 1% significance level.

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Table 6. Results of Granger Causality Test

	Lags	Test Statistics	Prob.
$\Delta GDP_t - \Delta Trade_{1t}$	1	2.205	0.147
$\Delta Trade_{1t} - \Delta GDP_t$	1	2.942*	0.095
$\Delta GDP_t - \Delta Trade_{2t}$	1	3.455*	0.072
$\Delta Trade_{2t} - \Delta GDP_t$	1	14.861***	0.000
$\Delta GDP_t - \Delta Trade_{3t}$	1	1.544	0.222
$\Delta Trade_{3t} - \Delta GDP_t$	1	4.767**	0.036
$\Delta GDP_t - \Delta Trade_{4t}$	2	6.909***	0.003
$\Delta Trade_{4t} - \Delta GDP_t$	2	8.178***	0.001
$\Delta GDP_t - \Delta Trade_{5t}$	1	1.159	0.289
$\Delta Trade_{5t} - \Delta GDP_t$	1	11.963***	0.001
$\Delta GDP_t - \Delta Trade_{6t}$	1	0.383	0.540
$\Delta Trade_{6t} - \Delta GDP_t$	1	0.211	0.649
$\Delta GDP_t - D_t$	1	0.145	0.706
D_t - ΔGDP_t	1	12.790***	0.001

***Note**: ***, **, * denotes significance at 10%, 5%, 1% significance level. Lag length are determined by Bayesian Information Criteria (BIC) values.*

Toda – Yamamoto Causality Test

Test results of the Toda – Yamamoto causality approach are given in Table 7. Appropriate lag lengths were determined according to the BIC criterion to implement this approach. According to the analysis results, it has been determined that there is a bidirectional causality relationship between the EU and China trade volume and the EU and USA trade volumes with the GDP. Similar results were also obtained in the causal relationship between the total trade volumes of China and the USA and the GDP. It has also been determined that the trade volume between the EU and the USA is the cause of GDP. However, it has been determined that there is no relationship between the US and China's trade volume and the GDP. Similar results were obtained in the Granger causality test. Thus, it was concluded that hypothesis 1,2,3 and 5 were entirely rejected by H0, while in hypothesis 3, one-way H0 was rejected, while in hypothesis 6 H0 was accepted entirely.

Table 7. Results of Toda-Yamamoto Test

	VAR($k+d_{max}$)	Test Statistics	Prob.
$\Delta Gdp_t - \Delta Trade_{1t}$	2	4.819**	0.028
$\Delta Trade_{1t} - \Delta Gdp_t$	2	3.539*	0.059
$\Delta Gdp_t - \Delta Trade_{2t}$	2	10.945***	0.000
$\Delta Trade_{2t} - \Delta Gdp_t$	2	20.064***	0.000
$\Delta Gdp_t - \Delta Trade_{3t}$	2	2.693	0.101
$\Delta Trade_{3t} - \Delta Gdp_t$	2	5.357**	0.021
$\Delta Gdp_t - \Delta Trade_{4t}$	3	14.833***	0.001
$\Delta Trade_{4t} - \Delta Gdp_t$	3	18.996***	0.000
$\Delta Gdp_t - \Delta Trade_{5t}$	2	6.939***	0.008
$\Delta Trade_{5t} - \Delta Gdp_t$	2	15.966***	0.000
$\Delta GDP_t - \Delta Trade_{6t}$	2	0.986	0.611

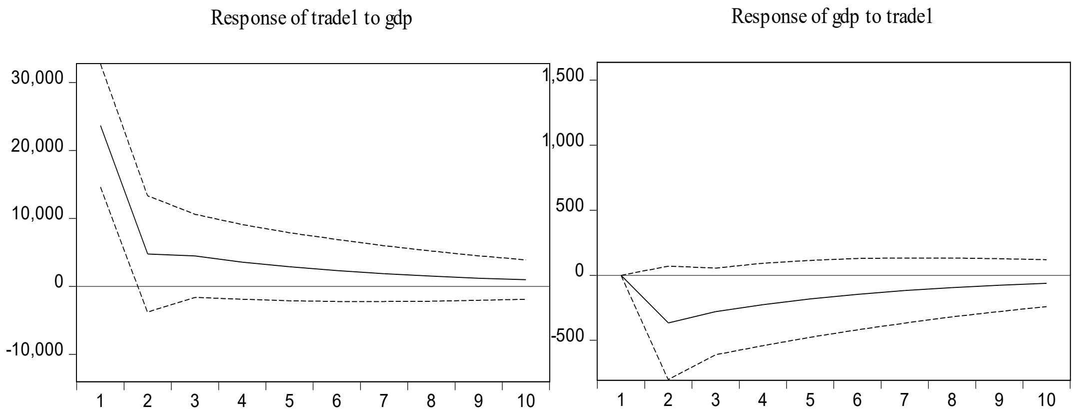
$\Delta Trade_{6t} - \Delta GDP_t$	2	0.786	0.675
$\Delta Gdp_t - D_t$	2	1.874	0.171
D_t - ΔGdp_t	2	19.377***	0.000

***Note**: ***, **, * denotes significance at 10%, 5%, 1% significance level. Lag length are determined by Bayesian Information Criteria (BIC) values.*

Impulse-Response Analysis

Different impulse-response functions are calculated since many bivariate VAR models are established in the analysis. Dotted lines in the figures indicate ∓2 standard error confidence intervals. Impulse-response analyses are given the variables examined within the scope of hypothesis 1 in figure 2. Accordingly, it gives the responses of GDP and Trade1 against shocks in GDP. The response of GDP to a one standard deviation shock on Trade1 is negative for two periods after the response seems to approach zero. The responses of GDP to a standard deviation shock on Trade1 are positive and have been in a decreasing direction for two years and then approached zero.

Figure 2. Impulse-Response Functions Graphs for Hypothesis 1



As seen in Figure 3, the responses of Trade2 against a one standard deviation shock on GDP increase after one year, and the reaction decreases and approaches zero as of the second year. When the responses of Trade2 to a standard deviation shock on GDP ∓2 standard error confidence intervals are considered, the negative reaction seems to be quite significant until the fifth period. The responses of GDP to a one standard deviation shock on GDP start positively and then fluctuate, and the responses approach zero.

Figure 3. Impulse-Response Functions Graphs for Hypothesis 2

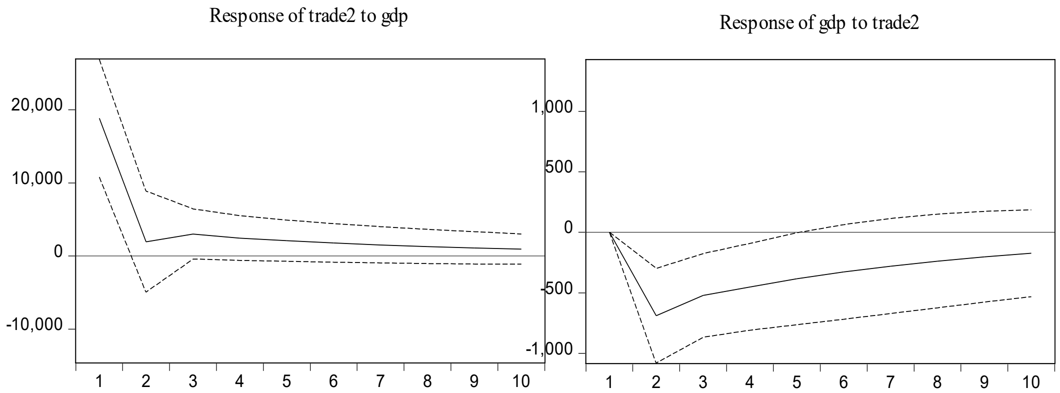


Figure 4 shows the graphs of the variables' responses to the shocks for hypothesis 3. When a standard deviation shock in GDP occurs, the responses of Trade$_3$ are negative until the third period, considering the ∓ 2 standard error confidence intervals. The responses of GDP, a one standard deviation shock on Trade$_3$, are initially positive and then decrease and eventually stabilize. The responses of GDP show a significant decrease significantly in the second year and approach zero in the following periods.

Figure 4. Impulse-Response Functions Graphs for Hypothesis 3

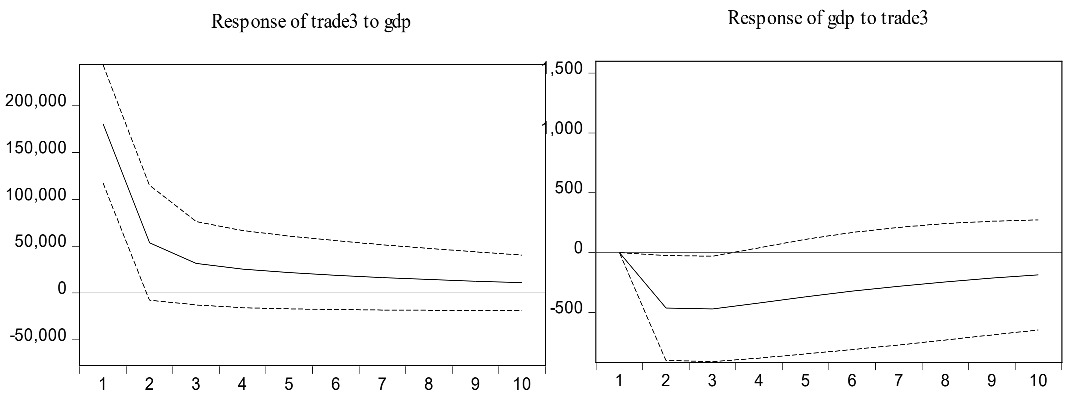


Figure 5 shows that while the response of Trade$_4$ to a one standard deviation shock on GDP is positive for the first two years, it turns negative in the following two years. Then, the responses of Trade$_4$ decrease in magnitude and reach zero in the eighth year. The responses of Trade$_4$ to a one standard deviation shock on Trade$_4$ start positively, then fluctuate for six periods, and then the effect ends in the tenth period. When one standard deviation occurs at Trade$_4$, the response of GDP is negative. The reaction shows a bottom level in the second period, and then the responses remain almost the same, eventually reaching the equilibrium level. The responses of $Trade_4$ to a one standard deviation shock on GDP seem to be negatively quite significant until the third period at the ∓2 standard error confidence intervals.

Figure 5. Impulse-Response Functions Graphs for Hypothesis 4

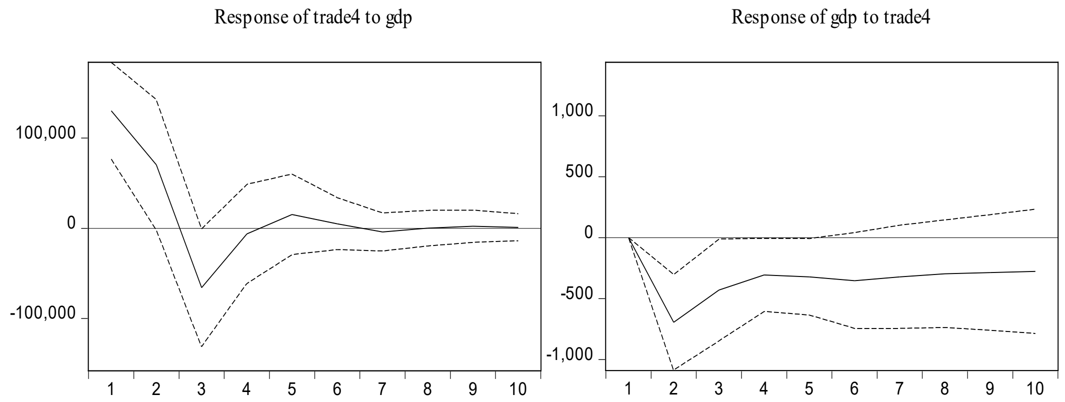


Figure 6 shows the impulse-response results of the variables examined for hypothesis 5. The responses of $Trade_5$ to a standard deviation shock on GDP are high in the first year, and the magnitude of these responses is gradually decreasing in the following. When a standard deviation shock occurs in $Trade_5$, the response of GDP is negative, and these responses are at a high level in the second year. The responses of GDP decreased in the following years and finally approached zero. The responses of $Trade_5$ to a standard deviation shock on GDP seem negative until the fifth period at the ∓2 standard error confidence intervals.

Figure 6. Impulse-Response Functions Graphs for Hypothesis 5

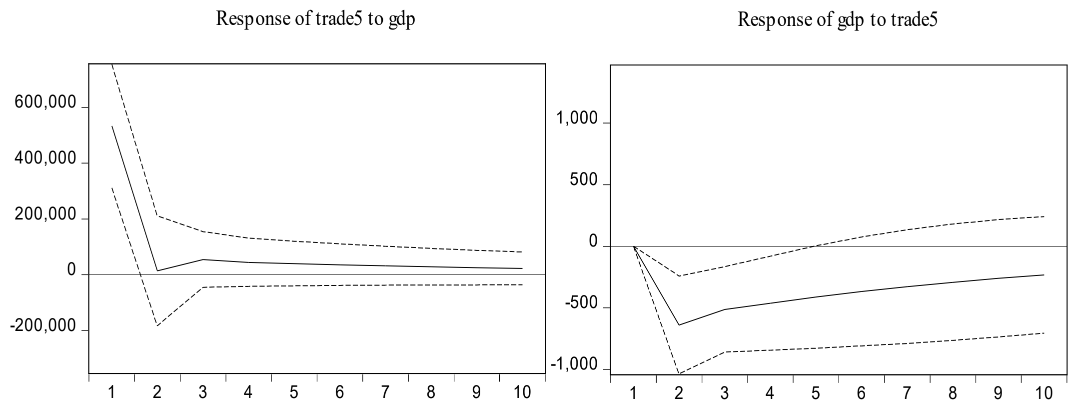


Figure 7 shows the impulse-response results of the variables examined for hypothesis 6. Accordingly, it gives the responses of GDP and $Trade_6$ against shocks in GDP. The response of GDP to a one standard deviation shock on $Trade_6$ is negative for two periods after the response seems to approach zero. The responses of GDP to a standard deviation shock on $Trade_6$ are favourable and have been in a decreasing direction for two years and then approached zero. $Trade_6$'s responses to

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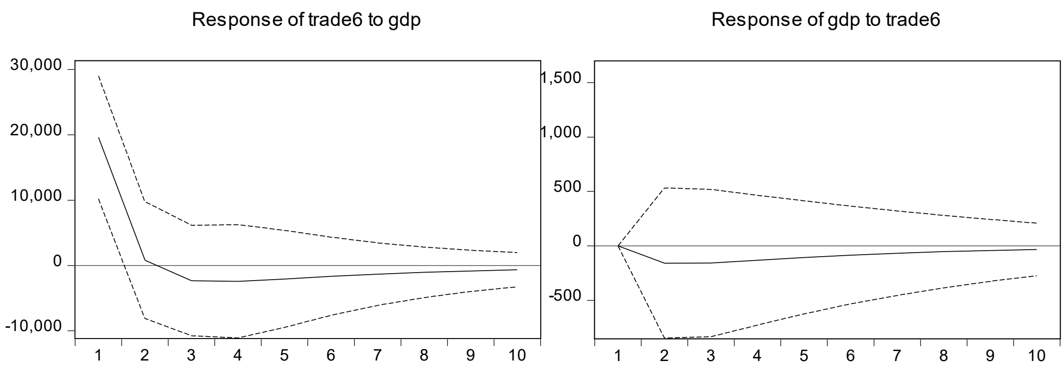
the standard deviation shock on GDP appear negative up to the second period at the ∓2 standard error confidence interval.

Figure 7. Impulse-Response Functions Graphs for Hypothesis 6



Variance Decompositions

The variance decomposition results are observed to increase the effect of $Trade_{1t}$ as of the second year in explaining shocks in GDP. At the end of the decade, approximately 9% of shocks are explained by trade and 91% by GDP. In the first year, approximately 53% of the shocks in $Trade_1$ are explained by itself and 47% by GDP. The rate of explanation for the changes in variance for $Trade_1$ indicates that the rate of explanation decreased with the second year; on the other hand, it is concluded that the rate of GDP increased.

Table 8. Variance Decompositions for Hypothesis 1

Period	**GDP shock** VD of GDP	**GDP shock** VD of $Trade_1$	**$Trade_1$ shock** VD of GDP	**$Trade_1$ shock** VD of $Trade_1$
1	100	0	52.85	47.151
2	94.786	5.214	53.258	46.742
3	93.185	6.815	53.945	46.055
4	92.4	7.6	54.361	45.639
5	91.971	8.029	54.626	45.374
6	91.719	8.281	54.795	45.205
7	91.565	8.435	54.904	45.096
8	91.47	8.53	54.974	45.026
9	91.409	8.591	55.019	44.981
10	91.371	8.629	55.049	44.951

Note: VD is the variance decomposition. VD analysis for ten years.

Table 9 contains the variance decomposition results considered within the scope of hypothesis 2. Accordingly, 55% of the $Trade_2$ shocks in the first year are explained by $Trade_2$. Although there are minor changes for other periods in explaining shocks for $Trade_2$, at the end of the decade, $Trade_2$ has 56% of explanation rate and 44% of GDP.

Table 9. Variance Decompositions for Hypothesis 2

Period	**GDP shock** VD of GDP	**GDP shock** VD of $Trade_2$	**$Trade_1$ shock** VD of GDP	**$Trade_1$ shock** VD of $Trade_2$
1	100	0	44.797	55.203
2	77.902	22.098	43.264	56.736
3	72.345	27.655	43.508	56.492
4	69.390	30.610	43.586	56.414
5	67.695	32.305	43.649	56.351
6	66.636	33.364	43.693	56.307
7	65.941	34.069	43.725	56.275
8	65.471	34.529	43.747	56.253
9	65.146	34.854	43.764	56.236
10	64.918	35.082	43.776	56.224

***Note**: VD is the variance decomposition. VD analysis for ten years.*

In Table 10, an analysis of variance decomposition is made within the scope of the hypothesis. According to the results, 100% of the first year GDP shocks are explained by GDP. The share of GDP in the explanation of shocks reached approximately 81% at the end of five years, and the remaining 19% belongs to $Trade_3$. GDP has a higher rate of explanation in $Trade_3$ shocks. Analysis results show that the share of GDP, 60.37% in the first year, increased in the following years and reached 62.50% at the end of the decade. Moreover, the explanation rate for $Trade_3$ shocks by itself is 37.50% at the end of the decade.

Table 10. Variance Decompositions for Hypothesis 3

Period	**GDP shock** VD of GDP	**GDP shock** VD of $Trade_3$	**$Trade_1$ shock** VD of GDP	**$Trade_1$ shock** VD of $Trade_3$
1	100	0	60.371	39.629
2	91.322	8.678	62.373	37.627
3	85.735	14.265	62.611	37.389
4	82.509	17.491	62.604	37.396
5	80.531	19.469	62.576	37.424
6	79.243	20.757	62.553	37.447
7	78.366	21.634	62.535	37.465
8	77.751	22.249	62.521	37.479
9	77.311	22.689	62.511	37.489
10	76.99	23.01	62.503	37.497

***Note**: VD is the variance decomposition. VD analysis for ten years.*

Table 11 gives the results of the analysis of variance decomposition. According to the results, GDP shocks are announced by GDP in the first year. While the share of GDP shocks explained by GDP at the end of five years decreased to 73.89%, the share of $Trade_4$ is 26.11%. In the following years, it is seen that the share of $Trade_4$ in the explanation of GDP shocks increased. There is an almost equal distribution for all years in general in explaining $Trade_4$ shocks. In the first year, the explanation rate of $Trade_4$ shocks by itself is 51.51%, while it is 48.49% by GDP.

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Table 11. Variance Decompositions for Hypothesis 4

Period	**GDP shock** VD of GDP	**GDP shock** VD of $Trade_4$	**$Trade_1$ shock** VD of GDP	**$Trade_1$ shock** VD of $Trade_4$
1	100	0	48.49	51.51
2	80.348	19.652	44.57	55.43
3	75.304	24.696	49.064	50.936
4	74.271	25.729	49.002	50.998
5	73.892	26.108	49.197	50.803
6	72.737	27.263	49.178	50.822
7	71.817	28.183	49.192	50.808
8	71.254	28.746	49.192	50.808
9	70.811	29.189	49.196	50.804
10	70.397	29.603	49.196	50.804

Note: *VD is the variance decomposition. VD analysis for ten years.*

The variance decomposition results analyzed within hypothesis 5 show that GDP explains 100% of the GDP shocks in the first year. In the second year explaining GDP shocks, the share of $Trade_5$ increased to approximately 19%, and its share increased continuously in the following years. $Trade_5$ shocks are explained by about 47% GDP in the first year and 53% by $Trade_5$. The share of GDP in the rate of $Trade_5$ shocks shows different fluctuations in the following periods.

Table 12. Variance Decompositions for Hypothesis 5

Period	**GDP shock** VD of GDP	**GDP shock** VD of $Trade_5$	**$Trade_5$ shock** VD of GDP	**$Trade_5$ shock** VD of $Trade_5$
1	100	0	46.642	53.358
2	81.243	18.757	45.767	54.233
3	75.713	24.287	45.898	54.102
4	72.599	27.401	45.942	54.058
5	70.708	29.292	45.981	54.019
6	69.46	30.54	46.011	53.989
7	68.594	31.406	46.035	53.965
8	67.973	32.027	46.054	53.946
9	67.516	32.484	46.069	53.931
10	67.173	32.827	46.081	53.919

Note: *VD is the variance decomposition. VD analysis for ten years.*

The variance decomposition results analyzed within hypothesis 6 show that GDP explains 100% of the GDP shocks in the first year. In the second year explaining GDP shocks, the share of $Trade_6$ increased to approximately 1%, and its share increased continuously in the following years. $Trade_6$ shocks are explained by about 37% GDP in the first year and 62% by $Trade_6$. The share of GDP in the rate of $Trade_6$ shocks shows different fluctuations in the following periods.

Table 13. Variance Decompositions for Hypothesis 6

Period	**GDP shock** VD of GDP	**GDP shock** VD of $Trade_6$	**$Trade_1$ shock** VD of GDP	**$Trade_1$ shock** VD of $Trade_6$
1	100.0000	0.000000	37.21501	62.78499
2	99.10325	0.896754	36.04423	63.95577
3	98.49697	1.503030	36.25859	63.74141
4	98.15644	1.843558	36.58677	63.41323
5	97.96392	2.036076	36.82418	63.17582
6	97.85163	2.148371	36.97793	63.02207
7	97.78437	2.215626	37.07516	62.92484
8	97.74335	2.256647	37.13633	62.86367
9	97.71804	2.281962	37.17481	62.82519
10	97.70230	2.297702	37.19900	62.80100

Note: *VD is the variance decomposition. VD analysis for ten years.*

Johansen Cointegration Test

Table 14 presents the results of cointegration analysis among the variables used in the study. According to these results, it was determined that there is a cointegrated relationship between the data. In addition, it was reported that there was no causal relationship between the foreign trade volume between the USA and China and GDP in both causality analyzes. However, according to the Johansen cointegration test, it was determined that both variables act together in the long run. In addition, a long-term relationship has been determined between the USA, EU, China and GDP. Finally, it has been concluded that the US and EU trade volume and China and EU trade volumes move together with GDP in the long run.

Table 14. Johansen Cointegration Test

Hypothesized	**Trace Test**	**Maximum Eigenvalue Test**
$GDP_t \longleftrightarrow Trade_{1t}$ / Hypothesis 1		
None At most 1	0.043** 0.051*	0.106 0.051*
$GDP_t \longleftrightarrow Trade_{2t}$ / Hypothesis 2		
None At most 1	**0.004***** **0.081***	0.008*** 0.081*
$GDP_t \longleftrightarrow Trade_{3t}$ / Hypothesis 3		
None At most 1	**0.042**** **0.061***	0.094* 0.061*
$GDP_t \longleftrightarrow Trade_{4t}$ / Hypothesis 4		
None At most 1	**0.002***** **0.041****	0.008*** 0.041**
$GDP_t \longleftrightarrow Trade_{5t}$ / Hypothesis 5		
None At most 1	**0.002***** **0.054***	0.006*** 0.054*
$GDP_t \longleftrightarrow Trade_{6t}$ / Hypothesis 6		

None	0.088*	0.064*
At most 1	0.62	0.61

***Note**: ***, **, * denotes significance at 10%, 5%, 1% significance level.*

5. Conclusions

This study examines the effects of trade wars between global economies on both national and world welfare. For this purpose, the EU was included in the study with the USA and China. Thus, the effects of trade wars on the welfare of the country or countries were examined by developing six different models. These models were investigated by Granger causality test, Toda-Yamamoto causality test and Johansen cointegration test. According to Granger causality results, a bidirectional causality relationship was found between trade2 and trade4 with GDP. In addition, a unidirectional causality relationship from GDP to trade1, trade3, trade5 and Dt2 has been determined. In the Toda-Yamamoto test, a bidirectional relationship was determined between trade1, trade2, trade4 and trade5 and GDP, while a unidirectional causality relationship was found from GDP to trade3 and Dt. Another important result of the study is no causal relationship between trade6 and GDP. However, when the long-term relationship between the data is examined, it has been determined that there is a long-term relationship between trade6 and GDP. In addition, a dummy variable was used in the study to examine the impact of China's integration with the global economy and subsequent membership in the world trade organization on GDP. Accordingly, evidence has been obtained that the foreign trade volume positively affects the global economy after China accedes to the World Trade Organization. Similar results have been reported by Li and Zhai (2000), Lanchovichina and Martin (2003), Wang (2003) and Chen and Ravallion (2004).

Considering the results obtained from the study, the presence of trade between the USA, China and the EU positively affects both these countries and the global economy (Ballard and Cheong, 1997). This result means that removing barriers to global trade will increase the welfare level of countries. Another necessary consequence of trade wars is the negative impact on welfare. Itakurat (2020), Li, et al. (2019), Bollen and Rojas-Romagosa (2018), Balistreri, et al. (2018), Ciuriak and Xiao (2018), Devarajan, et al. (2018) found similar results. As a result of the trade barrier policy implemented by the USA during President Trump's term, global welfare was adversely affected as consumer goods were produced more expensively (Tsutsumi, 2018). This situation has been discussed in the literature, especially in the trade barrier policies against Mexico and China. One of the most important ways to increase the welfare level of countries is to have access to cheaper and higher quality consumer goods. For this, countries need to implement alternative policies instead of policies to prevent foreign trade from increasing their domestic production or improving their foreign trade deficits.

The importance of the US, China and EU economies on the global economy were determined in the Granger and Toda-Yamamoto causality tests. In addition, the Johansen cointegration test has proven the long-term relationship between these countries and world GDP. These results show that the trade wars between the USA and China negatively affect both countries and the world economy. We have determined that if the trade war spreads to the EU, its negative impact on economic growth will increase. For this reason, we would like to emphasize that the increase and spread of trade wars pose significant risks to the world economy. In such a case, countries will inevitably experience a loss of welfare, and people's quality of life will be adversely affected (Carvalho et al., 2019; Guo et al., 2018; Noland, 2018). For this reason, we need to emphasize that the World Trade Organization and other fundamental institutions should develop policies that will prevent the reflection of political crises between world economies on trade.

REFERENCES

Amiri, A. and Ventelou, B. (2012). Granger causality between total expenditure on health and GDP in OECD: Evidence from the Toda–Yamamoto approach. *Economics Letters*, *116*(3), 541-544.

Amiti, M., Redding, S.J. and Weinstein, D. (2019). The Impact of The 2018 Trade War on U.S. Prices and Welfare, CEP Discussion Paper (1603): pp. 1–37. http://eprints.lse.ac.uk/id/eprint/102619. (last accessed: 21.10.2021).

Balistreri, Edward J., Böhringer, Christoph and Rutherford, Thomas F. (2018). Quantifying Disruptive Trade Policies, Cesifo Working Papers, 7382 (8), pp. 1–53.

Ballard, C. and Cheong, I. (1997). The Effects of Economic Integration in The Pacific Rim: A Computational General Equilibrium Analysis. Journal of Asian Economics, 8(4), pp. 505–524.

Bayar, Y. and Kilic, C. (2014). Effects of sovereign credit ratings on foreign direct investment inflows: evidence from Turkey. *Journal of Applied Finance and Banking*, *4*(2), 91.

Bhattacharya, B. and Mukherjee, J. (2003). Causal Relationship Between Stock Market and Exchange Rate, Foreign Exchange Reserves and Value of Trade Balance: A Case Study for India. In Fifth Annual Conference on Money and Finance in the Indian Economy, 2014, pp. 1-24. http://eprints.lse.ac.uk/102619/1/dp1603.pdf (last accessed: 21.10. 2021).

Bollen, J. and Rojas-Romagosa, H. (2018). Trade Wars: Economic Impacts of US Tariff Increases and Retaliations- An International Perspective. CPB Background Document, pp. 1–43. https://www.researchgate.net/publication/328761235. (last accessed: 21.10.2021).

Bown, C., Jung, E. and Lu, Z. (2018). Trump and China Formalize Tariffs on $260 Billion of Imports and Look Ahead to Next Phase. Peterson Institute for International Economics, https://piie.com/blogs/trade-investment-policy-watch/trump-and-china-formalize-tariffs-260-billion-imports-and-look. (last accessed: 18.10.2021).

Box, G.E., Jenkins, G.M., Reinsel, G.C. and Ljung, G.M. (2015). Time Series Analysis: Forecasting And Control, 5. Edition, Hoboken, New jersey.

Brahmasrene, T., Huang, J. C., & Sissoko, Y. (2014). Crude oil prices and exchange rates: Causality, variance decomposition and impulse response. *Energy Economics*, *44*, 407-412.

Carvalho, M., Azevedo, A. and Massuquetti, A. (2019). Emerging Countries and the Effects of the Trade War between US and China, Economies, 7(2), pp. 45.

Chen, S. and Ravallion, M. (2004). Welfare Impacts of China's Accession to the World Trade Organization, The World Bank Economic Review, 8 (1), pp. 29–57. http://hdl.handle.net/10986/17153. (last accessed: 21.10.2021).

Chowdhry, S. and Felbermayr, G. (2020). The US-China Trade Deal: How the EU and WTO Lose From Managed Trade. Kiel Policy Brief, 132. https://www.ifw-kiel.de/ publications/kiel-policy-briefs/2020/the-us-china-trade-deal-how-the-eu-and-wto-lose-from-managed-trade-13679/ (last accessed: 18.10.2021).

Ciuriak, D. (2020). The US-China Trade Deal: Back of the Envelope Estimate of the Economic Impact, Available at SSRN 3521738, pp. 1-5. DOI: 0.2139/ssrn.3521738. Electronic copy available at: https://ssrn.com/abstract= 3521738. (last accessed: 21.10.2021).

Devarajan, S., Go, D.S., Lakatos, C., Robinson, S. and Thierfelder, K. (2018). Traders' Dilemma - Developing Countries' Response to Trade Disputes, The World Bank Policy Research Working Paper 8640: pp. 1–18. DOI: 10.1111/twec.13062.

Dickey, D. A. and Fuller, W.A. (1979). Distribution of The Estimators For Autoregressive Time Series With A Unit Root, Journal of the American Statistical Association, 74(366a), pp. 427-431.

Dickey, D. A. and Fuller, W.A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series With a Unit Root. Econometrica: Journal of the Econometric Society, 49 (4), pp. 1057-1072.

Doifode, A. and Narayanan, G.B. (2020). Trade Effects of US China Trade War: An Econometric Analysis. Available at SSRN, DOI: 10.2139/ssrn.3609033. https://ssrn.com/abstract=3609033. (last accessed: 21.10.2021)

Farzanegan, M.R., Alaedini, P. Azizimehr, K. and Habibpour, M.M. (2021). Effect of Oil Revenues on Size And Income Of Iranian Middle Class. Middle East Development Journal, 13 (1), pp. 27-58.

Forson, J. A., Buracom, P., Baah-Ennumh, T., Chen, G. and Carsamer, E. (2015). Corruption, EU aid inflows and economic growth in Ghana: Cointegration and causality analysis. *Contemporary Economics*, *9*(3), 299-318.

Granger, C.W. (1969). Investigating Causal Relations by Econometric Models And Cross-Spectral Methods. Econometrica, Journal of the Econometric Society, 37 (3), pp. 424-438.

Guo, M., Lu, L. Sheng, L. and Yu, M. (2018). The Day After Tomorrow: Evaluating The Burden Of Trump's Trade War. Asian Economic Papers, 17 (1), pp. 101–120.

https://www.census.gov/foreign-trade/balance/c5700.html (Date of access 24.11.2020).

Ianchovichina, E. and Matin, W. (2003). Economic Impacts of China's Accession to The World Trade Organization. World Bank Publications, (3053).

Itakura, K. (2020). Evaluating the Impact of the US–China Trade War. Asian Economic Policy Review, 15 (1), pp. 77-93.

Jiang, X., Kong, Y., Li, X., Yang, C. and Chen, X. (2019). Re-estimation of China-EU trade balance. China Economic Review, 54, 350-366.

Konstantakis, K. N., Milioti, C. and Michaelides, P. G. (2017). Modeling the dynamic response of automobile sales in troubled times: A real-time Vector Autoregressive analysis with causality testing for Greece. *Transport Policy*, *59*, 75-81.

Li, M. 2018. CARD Trade War Tariffs Database.https://www.card.iastate.edu/china/trade-war-data/ (last accessed: 18-10-2021).

Li, M., Balistreri, E.J. and Zhang, W. (2020). The US–China Trade War: Tariff Data and General Equilibrium Analysis, Journal of Asian Economics, 101216, 69, pp. 1-13.

Lütkepohl, H. (2013). Vector autoregressive models, in: Hashimzade, N., Thornton, M.A. (Eds.), Handbook of Research Methods and Applications in Empirical Macroeconomics. Edward Elgar Publishing, Massachusetts, pp. 139-165.

Mills, T.C. (2019). Applied Time Series Analysis: A Practical Guide to Modeling and Forecasting. Academic Press, Elsevier.

Noland, M. (2018). US Trade Policy in The Trump Administration. Asian Economic Policy Review, 13 (2), pp. 262–278.

Payne, J. E. (2012). The causal dynamics between US renewable energy consumption, output, emissions, and oil prices. *Energy Sources, Part B: Economics, Planning, and Policy*, *7*(4), 323-330.

Pinzón, K. (2018). Dynamics between energy consumption and economic growth in Ecuador: A granger causality analysis. *Economic Analysis and Policy*, *57*, 88-101.

Sims, C.A. (1980). Macroeconomics and Reality. Econometrica 48(1), pp. 1-48.

Singhal, S., Choudhary, S. and Biswal, P. C. (2021). Dynamic linkages among international crude oil, exchange rate and Norwegian stock market: evidence from ARDL bound testing approach. *International Journal of Energy Sector Management*.

Toda, H. Y. and Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of econometrics*, *66*(1-2), 225-250.

Walmsley, T. and Minor, P. (2018). Estimated Impacts of US Sections 232 and 301 Trade Actions on the US and Global Economies: A Supply Chain Prospective 2018-2030. ImpactEcon Report, pp. 1–73.

Wang, Z. (2003). The Impact of China's WTO Accession on Patterns of World Trade, Journal of Policy Modeling, 25 (1), pp. 1–41.

Xu, Y. and Lien, D. (2020). Dynamic Exchange Rate Dependences: The Effect of the US-China Trade War, Journal of International Financial Markets, Institutions and Money 101238 68, pp. 1-37.

Zivot, E. and Wang, J. (2006). Vector Autoregressive Models for Multivariate Time Series. Modeling Financial Time Series with S-Plus®, 2rd ed. USA. DOI: 10.1007/978-0-387-32348-0_11