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RESEARCH ARTICLE

Trade Balance, Real Exchange Rate and Trade Policy Uncertainty in Türkiye: Evidence from the SVAR Approach

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ABSTRACT
In recent years, the trade wars, the global economic crisis and protectionist policies have created a climate of trade policy uncertainty in the world economy. The increased uncertainty had important impacts on economic variables, in particular on foreign trade and exchange rates. As a result, the attention of researchers and policy makers has been focused on this area. Also, it is a well-known fact that uncertainties have a greater impact on developing countries with economies that are more vulnerable to shocks and risks. From all of these facts, the aim of this study is to investigate the relationships between exchange rate, trade balance and trade policy uncertainty by using structural VAR (SVAR) analysis for the 1960:Q1-2020:Q4 period in Türkiye. The results show that there exists a significant relationship between trade policy uncertainty, the trade balance and the exchange rate in the long term. The response of trade policy uncertainty to shocks to the trade balance and to the exchange rate is statistically significant and negative. The response of the exchange rate to trade balance shocks is statistically significant and positive. An increase in the trade balance increases the exchange rate and reduces trade policy uncertainty.

Keywords: Trade, exchange rate, trade policy uncertainty, structural VAR

Introduction

The world economy has been experiencing global trade wars for the past two decades. Tariff threats, tariff hikes, and retaliations have emerged as principal causes of economic and trade policy uncertainties (Baker et al., 2019). The increase in trade policy uncertainty in 2018 resulted in a decrease of approximately 0.08% in the global GDP in the first half of 2019 (Caldara et al., 2019). The US withdrawal from the Trans-Pacific Partnership Agreement in January 2017, the suspension of negotiations on the North American Free Trade Area Agreement in August 2017, tariff increases on US steel and aluminum imports, uncertainties in the Brexit process, and the trade war between the US and China since March 2018 are the main reasons for the increase in the global trade policy uncertainty (Baker et al., 2019; Huynh et al., 2023 and Yu et al., 2023). Additionally, the COVID-19 pandemic emerged in 2019, and the Ukrainian-Russian War started in 2022 also contributed to the process of uncertainty. On the other hand, it is useful not to ignore the direct and indirect effects of the protectionist policies implemented by countries after the 2008 Global Crisis. Policymakers, investors, and other economic agents have been engaged in trade negotiations to develop a new approach to trade policy (Borojo et al., 2023 and Wang and Wu, 2023). However, these negotiations have not been able to prevent an increase in uncertainties surrounding global trade.

The trade wars and other factors, particularly robust trade and financial ties between nations, have amplified the policy uncertainty pertaining to trade worldwide (Ahir et al., 2020). According to Gulen and Ion (2016), policy uncertainty denotes a circumstance wherein economic agents are unable to accurately anticipate whether, when, and how governments will modify their current policies. Trade policy uncertainty, a kind of economic policy uncertainty, is defined as unpredictable alterations in trade policy that are difficult for economic agents to forecast accurately. The effects of trade policy uncertainty on output (Linde and Pescatori, 2019; Furceri et al., 2020), income (Kempa and Khan, 2019), welfare (Johnston and Parajuli, 2017; Steinberg, 2019), employment (Pierce and Schott, 2016; Lin and Whalley, 2021), institutions (Marshall et al., 2015; Tian et al., 2020), immigration (Facchini et al., 2019), foreign trade investments (Bao et al., 2022), and financial markets (Handley and Limao, 2015; Crowley et al., 2018; Burggraf et al., 2020; He et al., 2021; Chen et al., 2022) have been frequently discussed by researchers recently.

International trade is susceptible and more responsive to economic shocks; therefore, companies tend to adopt a cautious attitude

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when trade policy uncertainty is high (Novy and Taylor, 2020). A high level of trade policy uncertainty results in a reduction in investment, exports, and international trade volume. Consequently, unexpected changes in trade policy uncertainty negatively affect exports and investments. More precisely, increased uncertainty causes firms to delay investment decisions and reduce hiring, which in turn lowers consumer confidence, expenditures and ultimately results in decreased economic activity. On the other side, the impact of trade policy uncertainty on trade performance is unclear (Caldara et al., 2019). While some studies confirm the strong and negative relationship between the two variables, others argue that uncertainty can enhance countries' trade performance by encouraging investment (Borojo et al., 2023). Handley (2014) contends that export enterprises are considerably responsive to tariff hikes. Additionally, Imbruno (2019) emphasizes the significance of trade policy uncertainty on firms' trade decisions. In terms of trade policy uncertainty, the potential for sudden tariff increases does not encourage firms to export. Furthermore, Handley and Limao (2015) claimed that policy uncertainty deters firms from entering foreign trade. Simultaneously, it also impacts firms' future expectations, resulting in a decrease in investments relating to trade. According to Handley and Limao (2017), trade policy uncertainty diminishes export-oriented investment as well as technology upgrades. This reduces trade flows and consumers' real income. Similarly, Crowley et al. (2018) investigated the impact of future tariff rate uncertainty on firms' market entry or exit decisions, and found evidence to suggest that such uncertainty has a negative effect on entry decisions. In sum, trade policy uncertainty negatively affects the expectations of economic agents and is considered a trade barrier as it is seen as an additional cost. It diminishes both the probability of exporting and the volume of trade (Osnago et al., 2015).

Developing countries are more affected by an increase in trade policy uncertainty. As uncertainty increases, investments and funds flow towards developed countries and risk factors tend to increase in developing countries. Capital outflows from the country mean depreciation of the national currency. This increases the value of foreign currency-denominated debt, which in turn increases country risk. On the other hand, a country's trade flows are affected not only by its own trade policy uncertainty but also by the uncertainty of its trading partners. In other words, shocks caused by uncertainty in one country spill over to other countries. It affects foreign trade through the global value chain (Tam, 2018). According to Bartsch (2019), policy uncertainty affects prices via expectations. If policymakers communicate their future policy accurately and precisely, there is no uncertainty among economic actors and prices adjust precisely when information is communicated. Moreover, policy uncertainty increases exchange rate volatility. According to Hlatshwaya and Saxegard (2016), the uncertainties weaken export performance by limiting the pass-through effect of real exchange rates to exports.

Based on the theoretical and empirical literature, one might claim that there is a strong linkage between the exchange rate, foreign trade and trade policy. The theoretical relationship between the trade balance and the exchange rate is based on the J-curve hypothesis. According to the J-curve hypothesis, increases in the exchange rate worsen the trade balance in the short-term, while improving the balance in the long-term. According to the hypothesis, in the short-term, the foreign trade balance deteriorates as the response to price changes in the exchange rate is not immediate. However, in the long-term, the trade balance improves due to price adjustments. The reason for the improvement in the trade balance in the long-term is the fulfillment of the Marshall-Lerner condition. On the other hand, recent studies on the effects of trade policy uncertainty have mainly focused on the effects of trade policy uncertainty on foreign trade and the effects on exchange rates have been relatively neglected.

From this point of view, the main motivation of this study is that there is no study in the literature that investigates the relationship between these variables using the SVAR model in the case of Türkiye. From this point, the purpose of this study is to determine the relationships between exchange rate, trade balance and trade policy uncertainty by following structural the VAR (SVAR) analysis for the 1960: Q1-2020: Q4 period in Türkiye. The trade balance of merchandise and real exchange rate variables used in the analyses were obtained from the database of the Central Bank of the Republic of Türkiye (CBRT). The Trade Policy Uncertainty Index (TPU) indicator was also retrieved from the Federal Reserve Economic database (FRED).

This study is divided into five sections. The following section includes the literature review of the papers examining the relationships between exchange rate, trade balance and trade policy uncertainty. Section 3 describes data and econometric methodology. Section 4 contains the empirical findings of the econometric analyses. Eventually, the conclusion, including policy recommendations and implications, is presented in the last section.

Literature Review

The linkages between exchange rate and trade balance have usually been the focus of attention of researchers. Related studies in this field mainly investigate the relationships between trade balance and exchange rate under the J-curve hypothesis. Recently, the interest of researchers has focused on the effects of various variables such as trade policy uncertainty, risk and institutional factors affecting the relationship between exchange rate and trade balance. In this context, the literature review in this paper was based on two aspects. First of all, papers examining the linkage between exchange rate and trade balance are presented in Table 1, in terms of country, country groups or region, period, methodology and main results of the analysis. Then, the literature consisting of studies examining the role of trade policy uncertainty in the relationship between these two variables was reviewed.

Table 1. Literature Review

Author(s)	Country	Period	Methodology	Result
Bahmani-Oskooee (1985)	Greece, India, Korea and Thailand	1973:1980	OLS	J-curve hypothesis is confirmed.
Backus et al. (1994)	11 Developed Countries	1950:01-1990:02	General Equilibrium Model	J-curve hypothesis is confirmed.
Brada et al. (1997)	Türkiye	1969:Q1-1993:Q1	Cointegration analysis	There exists a cointegration between trade balance and exchange rate.
Durusoy and Tokatlıoğlu (1997)	Türkiye	1987-1995	OLS	J-curve hypothesis is confirmed.
Shirvani and Wilbratte (1997)	The US and G-7 Countries	1973:05-1990:08	Johansen-Juselius Cointegration Test	There is relationship between trade balance and exchange rate in the long-term.
Lal and Lowinger (2002)	Five South Asian Countries	1985:Q1-1998:Q4	VECM	There exists relationship between trade balance and exchange rate both in the short and long-term.
Rehman and Afzal (2003)	Pakistan	1974:Q3-2002:Q4	ARDL	J-curve hypothesis is confirmed.
Akbostanci (2004)	Türkiye	1987:Q1-2000:Q4	VAR	There exists a long-run linkage between exchange rate and trade balance but J-curve hypothesis is not valid for the short-run.
Hsing (2005)	Japan, Korea and Taiwan	1980:Q1-2001:Q1	VECM	J-curve hypothesis is confirmed only for Japan.
Karagöz and Doğan (2005)	Türkiye	1995:01-2004:06	Multiple Regression Analysis	There is no significant relationship between exchange rate, export and import.
Yamak and Korkmaz (2005)	Türkiye	1995:Q1-2004:Q4	VAR Analysis, Granger Causality Test	There doesn't exist relationship between reel exchange rate and trade balance in the long-run.
Ay and Özşahin (2007)	Türkiye	1995:01-2007:06	VAR Analysis, Granger Causality	J-curve hypothesis is confirmed.
Halicioglu (2008)	Türkiye	1980-2005	ARDL	J-curve hypothesis is confirmed only in the short-run.
Bahmani-Oskooee and Kutan (2009)	11 East European Emerging Economies	1990:01-2005:06	ARDL	J-curve hypothesis is confirmed for Bulgaria, Croatia and Russia.
Khatoon and Rahman (2009)	Bangladesh	1972-2006	VAR Analysis, Granger and Sims Causality Tests	J-curve hypothesis is not confirmed.
Vergil and Erdoğan (2009)	Türkiye	1989:Q1-2005:Q4	ARDL	J-curve hypothesis is confirmed.
Petrović and Gligorić (2010)	Serbia	2002:01-2007:09	ARDL	Exchange rate depreciation improves trade balance in the long run, but J-curve effect is supported in the short term.
Göçer and Elmas (2013)	Türkiye	1989:Q1-2012:Q2	Maki (2012) Cointegration Test, DOLS	The effects of the real exchange rate on exports and imports are positive.
Güneş et al. (2013)	Türkiye	1995:Q1-2010:Q2	Structural VAR	A shock in the terms of trade has a similar impact on the real exchange rate.
Demirtaş (2014)	Türkiye	2002:01-2012:08	ARDL	In both the short and the long term, the real exchange rate has a significant and positive impact on the trade balance.
Alege and Osabuohien (2015)	40 Sub-Saharan African Countries	1980-2008	Panel Cointegration, Pooled, Fixed and Random Effects Models	Export, import and exchange rate are cointegrated in the long-term but export and import are not elastic to changes in the exchange rate.
Kemeç and Kösekahyaoğlu (2015)	Türkiye	1997-2013	VAR Analysis, Granger Causality Test	J-curve hypothesis is not confirmed.
Albayrak and Korkmaz (2019)	Türkiye	1992:01-2015:12	ARDL, Granger Causality	J-curve hypothesis is confirmed. Also, there exists a bilateral causality trade between balance and real exchange rate.
Amusa and Fadiran (2019)	South Africa and the US	1991:Q4–2016:Q3	ARDL	J-curve hypothesis is confirmed.
Ari et al. (2019)	Türkiye	1990:Q1-2017:Q3	NARDL	J-curve hypothesis is valid.

Table 1. Continued

Arruda et al. (2019)	Brazil	1999:01-2013:07	VECM	J-curve hypothesis is not valid.
Bahmani-Oskooee and Arize (2019)	The US and 20 African Countries		ARDL, NARDL	There exists relationship between exchange rate and trade balance in the long-term.
Sivrikaya and Ongan (2019)	The UK and its 17 Trading Partners	1981:Q1-2015:Q1	NARDL	J-curve hypothesis is not confirmed.
Kopuk and Beşer (2020)	Türkiye	1998-2018	ARDL	J-curve hypothesis is confirmed only in the short-run.
Tuncay and Özkan (2020)	Nine Developing Countries	2009-2018	FGLS	Real effective exchange rates have positive effect on foreign trade balance.
Alessandria and Choi (2021)	US	1980-2015	Error Correction Model, Armington Elasticity	Exchange rate and trade balance are cointegrated in the long-term but elasticity is quite low in the short -term.
Bahmani-Oskooee et al. (2021)	Canada and Mexico	2000:01-2020:12	ARDL, NARDL	According to NARDL approach, there is a cointegration between exchange rate and trade balance in the long-term.
Bahmani-Oskooee and Karamelikli (2021)	Türkiye and the US	2003:01-2018:10	ARDL, NARDL	Asymmetric J-curve effect is valid some industries.
Bhat and Bhat (2021)	India	1996:02-2017:04	NARDL	J-curve hypothesis is not confirmed.
Ceyhan and Gürsoy (2021)	Türkiye	1996:2019	Toda-Yamamoto and Hatemi-J Asymmetric Causality	J-curve hypothesis is not confirmed.
Iqbal et al. (2018)	Pakistan and its eight trading partners	1980-2017	Asymmetric Cointegration, Non-linear ARDL	J-curve hypothesis is confirmed in the case of Malaysia, China, and the US.
Mwito et al. (2021)	Kenya and its 30 Trading Partners	2006:Q1-2018:Q4	PMG	J-curve hypothesis is supported for long-run and short-run asymmetries.
Arthur et al. (2022)	Gana, Switzerland and China	1995:Q1-2018:Q4	ARDL	J-curve hypothesis only is valid for China.
Mesagan et al. (2022)	Eight Largest African Countries	1970-2016	NARDL	There exists relationship between trade balance and exchange rate in the long-term.
Ojaghlou and Uğurlu (2023)	EU-27, China and the US	2008:Q2-2019:Q3; 2008:Q2-2020:Q4 and 2019:12–2021:12	ARDL, NARDL and Multiplier NARDL	Inverted J-curve is confirmed for all country groups.
Parray et al. (2023)	BRICS	2000:Q1-2020:Q2	PNARDL	J-curve hypothesis is not confirmed for both the symmetric and asymmetric model.
Truong and Vo (2023)	Vietnam	2010:01-2020:06	NARDL	The trade balance is impacted asymmetrically by the exchange rate in the short and long-term.

In the first aspect of the literature review, the studies investigating the relationships between trade balance and exchange rate were evaluated. According to Table 1, the empirical studies within the scope of literature review can be classified into three groups in terms of the results obtained as follows: *The first group of studies* consists of studies investigating the validity of the J-curve hypothesis. Some studies (Bahmani-Oskooee, 1985; Backus et al., 1994; Durusoy and Tokatlıoğlu, 1997; Rehman and Afzal, 2003; Hsing, 2005; Bahmani-Oskooee and Kutan, 2009; Vergil and Erdoğan, 2009; Ari et al., 2019; Bahmani-Oskooee and Arize, 2019; Bahmani-Oskooee-Karamelikli, 2021; Iqbal et al., 2018; Arthur et al., 2022, etc.) have pointed out empirical findings that support the hypothesis, but Kemeç and Kösekahyaoğlu (2015), Sivrikaya and Ongan (2019), Bhat and Bhat (2021), Ceyhan and

Gürsoy (2021) and Parray et al. (2023) have reached the result that the J-curve hypothesis is not valid. *In the second group*, there are papers searching the relationship between trade balance and exchange rate. Except for the studies by Karagöz and Doğan (2005) and Yamak and Korkmaz (2005), the empirical results obtained from the studies in this group have confirmed the existence of a relationship between the two variables. *The third group of studies* includes papers that reach different results. For instance, Akbostanci (2004) claimed that the J-curve hypothesis is not valid in the short-term, but there exists substantial empirical evidence confirming that effect in the long-run. On the contrary, Halicioglu (2008) and Kopuk and Beşer (2020) have affirmed that the j-curve effect is valid in the short-term.

The second aspect of the literature review consists of the studies examining the relations between trade policy uncertainty, exchange rate and trade balance. For example, Çekin and Nuroğlu (2020) have examined the effects of trade policy uncertainties arising from trade wars on the trade balance and macroeconomic indicators for the period of 1987:01-2018:09 in BRICS-T countries. The main findings obtained from the analyses in which the econometric methodology of the panel VAR method was employed show that trade policy uncertainty stem from the US negatively affects China more in terms of trade balance. In the paper by Ongan and Gocer (2020), they investigated the effects of changing US trade policy uncertainty on the US bilateral trade balance with China for the period of 1993: Q1-2019: Q2 by employing the NARDL approach. The results indicate that there exists relationship between trade policy uncertainty and the US trade balance. Trade policy uncertainty improves trade balance in the short-run while trade policy uncertainty decreases or worsens trade balance in the short-run but improve in the long-run.

Özçelik (2022) has employed the Augmented ARDL approach in order to analyze the impacts of economic and trade policy uncertainties on the US's foreign trade balance with China by taking the data for 2000:Q1-2021:Q4. Findings from the empirical analysis show that the increases in trade policy uncertainty in the US do not have a significant effect on the US bilateral trade balance with China, but the increases in trade policy uncertainty in China have a negative impact on the US trade balance both in the short and long-run. In another study, Baek and Yoon (2023) have explored the relationship between trade policy uncertainty and trade balance of China and its trade partners (US, Japan and Korea) using structural VAR for the period of 2000:01-2021:12. They found that trade policy uncertainty has a significant negative effect on China's trade as a result. Borojo et al. (2023) have employed the two-step Heckman sample selection model and poisson pseudo-maximum likelihood in order to analyze the impact of trade policy uncertainty on trade flows between 2004 and 2019 for 113 emerging economies and low-income developing countries. Similar to the main findings of the studies by Özçelik (2022) and Baek and Yoon (2023), they detected that trade policy uncertainty has a negative effect on trade flows.

Yaman-Songur (2023) have analyzed the influence of the US trade policy uncertainty on the dollar-TL rate using data for 2002:01-2022:08. As a result of DOLS, FMOLS and CCR, she found that there exists cointegration between trade policy uncertainty and exchange rate. In addition, increases in trade policy uncertainty trigger exchange rate increases. According to the results of Breitung and Candelon (2006) causality test, trade policy uncertainty is the cause of the dollar-TL exchange rate in the long-run, but it is not in the short and medium-run.

Yu et al. (2023) have investigated the impact of the US trade policy uncertainty on Chinese agricultural export and import applying structural VAR analysis for the period between 2007:01 and 2019:05. The results of empirical analyses depict that as the US trade policy uncertainty increases, China's agricultural exports to the US and imports from the US.

By far, we have reviewed the empirical literature on exchange rate, trade balance, and trade policy uncertainty. Based on the relevant literature, one might say that there is a large number of studies in the literature investigating the relationships between trade balance and exchange rate by following different econometric procedures (ARDL, NARDL, PNARDL, VAR, OLS, VECM, FGLS, etc.) for different countries, country groups and regions. However, it can be observed that the number of studies investigating the effects of different variables like economic and trade policy uncertainty on the relationship between two variables has increased in recent years, but it is still limited. Within the scope of the reviewed literature, it has not found studies investigating the relationship between exchange rate, trade balance and trade policy uncertainty in Türkiye using the SVAR method.

Data and Methodology

This study investigates the relations between exchange rate, trade balance and trade policy uncertainty employing a quarterly time series data for the period of 1960:Q1-2020:Q4 for Türkiye. For trade balance, we used trade balance of merchandise (the US Dollar) as indicator provided by the database of the Central Bank of the Republic of Türkiye (CBRT). The data for real exchange rate was obtained from the database of the CBRT. The Trade Policy Uncertainty Index (TPU) indicator as proxy for trade policy uncertainty was taken from the Federal Reserve Economic database (FRED). The natural logarithm forms of all variables were employed in order to reduce heteroscedasticity and to procure the growth rate of the variables by their differenced logarithms.

Table 2. Descriptive Statistics for Variables

	LNTRADE	*LNREER*	*LNTPU*
Mean	24.15836	-5.354409	3.500246
Median	24.30955	-5.968632	3.441654
Maximum	24.34942	1.976916	5.334841
Minimum	23.02585	-11.61662	2.616832
Std. Dev.	0.292128	5.151828	0.453686
Skewness	-1.914142	0.041151	1.404864
Kurtosis	5.999432	1.317919	6.603827
Observations	243	243	*243*

Table 2 shows descriptive statistics of the variables in the analysis in order to represent summary information. According to the table, while *LNTRADE* has the highest values in terms of mean (24.158), maximum (24.349) and minimum values (23.025), *LNREER* has the lowest values in terms of these statistics. The highest variable in terms of median value is *LNTRADE* (24.309), and other variables are *LNTPU* (3.441) and *LNREER* (-5.968), respectively. On the other side, while the variable with the highest standard deviation is *LNREER* (5.151), the variable with the lowest value is *LNTRADE* (0.292). Figure 1 depicts the change of the logarithmic values of the variables for the period of 1960:Q1-2020:Q4.

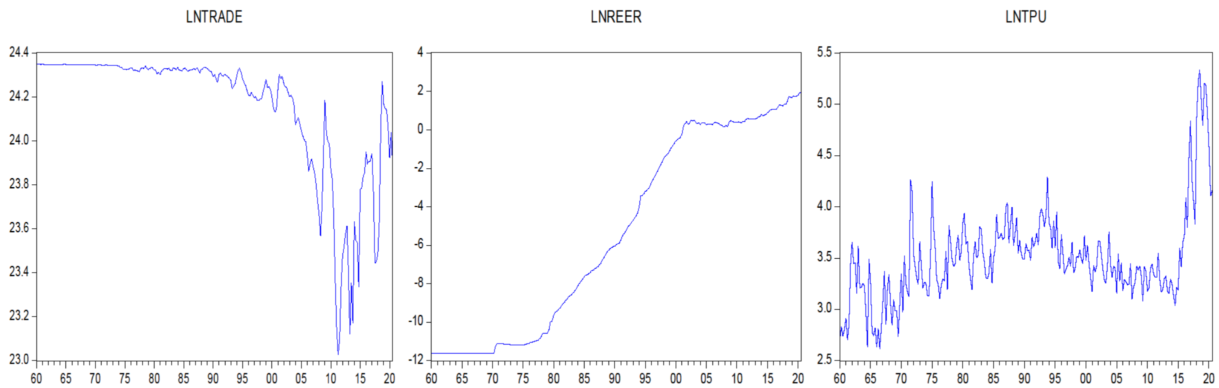

Figure 1. Time Series Graphs

In this study, we followed the econometric procedure of the structural VAR approach developed by Sims (1980;1986), Bernanke (1986), Shapiro and Watson (1988). Standard VAR models are based on simultaneous equation systems in which many endogenous variables are employed in the model at the same time. Although the impulse-response function is an important tool to uncover the linkages between variables in standard VAR models, there exist some obstacles in their interpretation (Lütkepohl, 2005). It is not suitable for policy reviews, as impulse-response functions and shock term are not descriptive enough in these models (Cooley and Leroy, 2005). The standard VAR model is written as follows:

$$Y_t = B * X_t' + u_t' \tag{1}$$

In Eq. (1), Y_t is a (3x1) vector of endogenous variables. X_t' refers to the lag of the endogenous variables. u_t' denote the residuals of (3x1) vectors. In the reduced VAR model, the residuals are often correlated and so, it does not clearly show the net effect of a specific shock on the residuals. The structural VAR model in which all variables are employed endogenously with their lagged values developed to overcome the lack of the standard VAR model is expressed as follows (Enders, 2010):

$$BY_t = \Gamma_0 + \Sigma_{i=1}^{n} \Gamma_i \gamma_{t-i} + \varepsilon_t \tag{2}$$

Where, B refers to (3x3) contemporaneous matrix and Y_t is a (3x1) vector of endogenous variables (trade balance, real exchange rate and trade policy uncertainty index). Γ_0 and Γ_i is constant term of the vector and (3x3) autoregressive coefficient matrix, respectively. ε_t denotes (3x1) structural shocks matrix. Finally, n depicts the optimal lag length. The matrix form of the SVAR model is as in Eq. (3)

$$e_t = \begin{bmatrix} e_t^{LNTRADE} \\ e_t^{LNREER} \\ e_t^{LNTPU} \end{bmatrix} = \begin{bmatrix} \alpha_{11} & 0 & 0 \\ \alpha_{21} & \alpha_{22} & 0 \\ \alpha_{31} & \alpha_{32} & \alpha_{33} \end{bmatrix} x \begin{bmatrix} e_t^{LNTRADEShock} \\ e_t^{LNREERShock} \\ e_t^{LNTPUShock} \end{bmatrix} \tag{3}$$

According to Eq. (3), the variable (*LNTRADE*) in the first row does not respond to other variables in the model but affects other variables (*LNREER* and *LNTPU*). The variable (*LNREER*) in the second row responds to the first variable (*LNTRADE*), but it does not respond to the other variable (LNTPU). The variable (LNTPU) in the third row responds to all variables (*LNTRADE, LNREER* and *LNTPU*) in the model.

Empirical Results

Unit Root and Diagnostic Tests with Stability Condition

In the first stage, we performed the unit root tests to test the stationarity of the series in the model. The results of the Augmented Dickey-Fuller (ADF) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests calculated for the levels and first differences of the variables are reported in Table 3. The empirical findings derived from the ADF and KPSS unit root tests indicate that the null hypothesis of a unit root cannot be rejected at a 5 % significance for all variables have unit root at the levels in both constant and constant and trend models. Then, we take the first-order difference of all series and concluded that all series have become stationary. As a result, all series (*LNTRADE, LNREER* and *LNTPU*) are integrated of order 1, represented as I(1).

Table 3. Unit Root Test Results

Variables/	*ADF*		*KPSS*	
Unit Root Tests	*Constant*	*Constant+Trend*	*Constant*	*Constant+Trend*
LNTRADE	-1.891 (0.33)	-2.146 (0.51)	1.383	0.158
LNREER	-1.671 (0.44)	-1.500 (0.82)	0.309	0.299
LNTPU	-2.329 (0.16)	-2.856 (0.18)	0.423	0.230
ΔLNTRADE	-6.304 (0.00)*	-6.292 (0.00)*	0.036*	0.025*
ΔLNREER	-11.461 (0.00)*	-7.551 (0.00)*	0.400*	0.276*
ΔLNTPU	-8.446 (0.00)*	-8.543 (0.00)*	0.157*	0.102*

*Note: * is 1% of significant levels. The optimal lag length is determined automatically by using the SIC.*

Table 4 and Table 5 show the results of the diagnostics tests such as serial correlation Langrage Multiplier (LM) test, the White heteroskedasticity test and the Jarque-Bera normality test. According to Table 4, the evidence from the LM test indicates that the null hypothesis cannot be rejected, as there does not exist a serial correlation among the error terms.

Table 4. Serial Correlation LM Test

Lag	*LRE* stat*	*df*	*Prob*
1	13.65058	9	0.1353
2	23.61728	18	0.1680
3	32.92959	27	0.1994
4	40.58186	36	0.2754
5	50.01271	45	0.2811

Note: The optimal lag length is determined as five considering the AIC.

Table 5 shows that the evidence indicates no autoregressive conditional heteroskedasticity. More clearly, the null hypothesis which is the variance of the residuals is homoscedastic cannot be rejected for SVAR model. On the other hand, the residual term is normally distributed as regards the normality test. The results of the diagnostics test point out that the model specification is well-structured.

Table 5. Heteroskedasticity and Normality Tests

Joint Test			*Joint Test*		
Chi-sq	*df*	*Prob*	*Jarque-Bera*	*df*	*Prob*
200.9088	180	0.1364	1804.560	6	0.0000*

*Note: * is 1% of significant levels.*

Figure 2 indicates the inverse roots of the characteristic AR polynomial. The validity of the impulse-response analysis depends on the satisfaction of the VAR stability condition (Glaister, 1984). The estimated VAR is stable because of all roots lie inside the unit circle and all roots have a modulus of less than one, as shown in Figure 2.

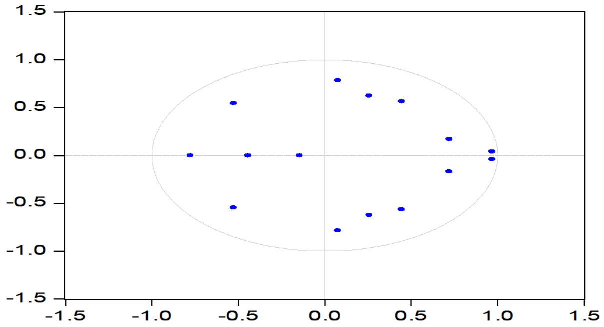

Figure 2. Inverse Roots of AR Characteristic Polynomial

Long-Run Structural VAR Analysis

Table 6 shows the estimation results of the long-term structural VAR model. The coefficients in the multiplier matrix cannot be interpreted, but preliminary information can be obtained for impulse-response analysis by looking at the signs of the coefficients and their statistical significance levels. According to Table 6, the response of LNTPU to shocks of LNTRADE and LNREER is statistically significant and negative. Also, the response of LNREER to LNTRADE shock is statistically significant and positive. While an increase LNTRADE leads to an increase in LNREER, an increase LNTRADE leads to a decrease in LNTPU over the sample period in Türkiye.

Table 6. Long-Run Multiplier Matrix for SVAR Model

	LNTRADE	*LNREER*	*LNTPU*
LNTRADE	1.5293	0.0000	0.0000
	(0.00)*		
LNREER	2.9310	2.0117	0.000
	(0.00)*	(0.00)*	
LNTPU	-1.2970	-0.6269	0.3199
	(0.00)*	(0.00)*	(0.00)*

*Note: * is 1% of significant levels.*

As mentioned earlier, the purpose of this study is to investigate the linkages trade balance, reel exchange rate and trade policy uncertainty in Türkiye. To achieve this aim, the impulse-response functions obtained from structural VAR analysis are quite helpful tools. Figure 3 shows impulse-response functions for LNTRADE, LNREER and LNTPU.

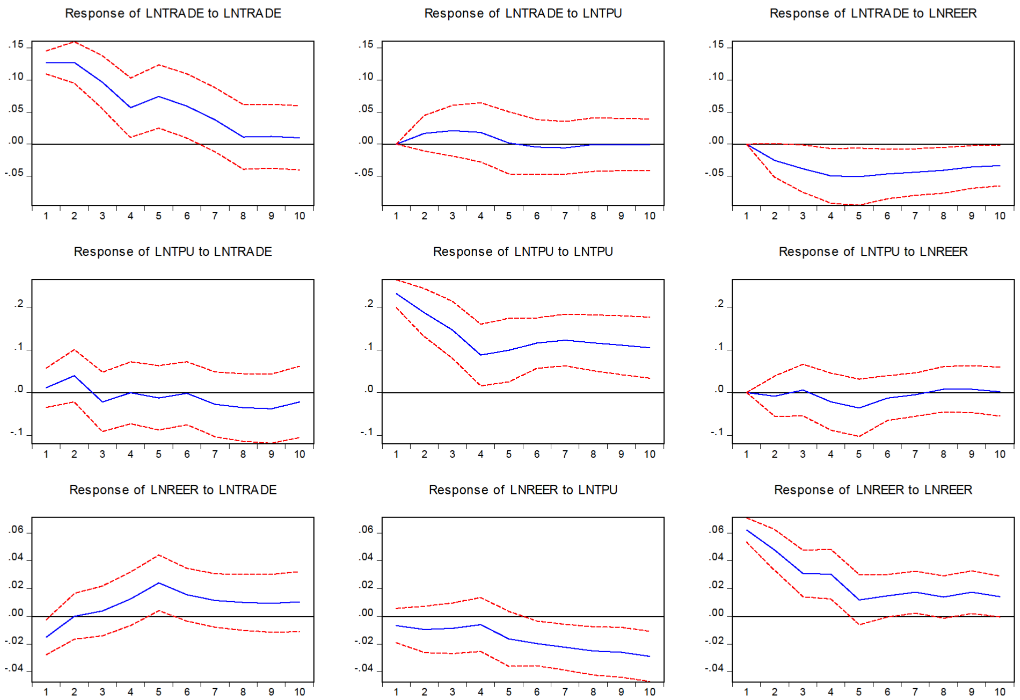

Figure 3. Impulse-Response Functions for Long-Run Structural VAR Analysis

The response of LNTRADE to the shock of LNTPU is zero in the first period and, after it is positive from the second period until the 6th period, it revolves negative. As from the 8th period, it reaches zero. The response of LNTRADE to the shock of LNREER is initially zero, but it is negative throughout the following periods. Also, the response of LNTRADE to its own shock remains positive in all the periods and it is at the minimum level by the 4th period.

The graphs in the second row of Figure 3 show the response of LNTPU to the shocks of other variables. The LNTPU's response to the shock of LNTRADE is zero in the first two periods and it turns negative afterwards. The response of LNTPU to its own shock remain positive in all the periods and it is at the minimum by 4th period. The last graph depicts the response of LNTPU to the shock of LNREER over the periods. While the response of LNTPU to the shock of LNTRADE is zero in the first period, it is negative between the 4th and 7th periods. In the remaining periods, it continued to be positive.

The three graphs in the last row of Figure 3 present the response of LNREER to the shocks of other variables with its own shock. Accordingly, the response of LNREER to the shocks of LNTRADE reaches the maximum level of 0.02% by the 5th period and it shows a decreasing trend in the 6th period, and eventually remains stable in the following periods. The LNREER's response to LNTPU shock has a negative trend. It is at the maximum level by the 4th period and gradually diminishes until the last period. Lastly, the LNREER's response to its own shock is positive during the periods. While the effect reaches the maximum in the first period, it is the minimum level in the 5th period.

Table 7. Variance Decomposition Results

For LNTRADE:				
Period	***S.E.***	***Shock 1***	***Shock 2***	***Shock 3***
1	0.127640	2.675185	29.49590	67.82891
2	0.183090	7.123827	35.05606	57.82011
3	0.211572	10.21520	38.88406	50.90074
4	0.225461	12.32473	42.11412	45.56115
5	0.242869	12.00762	46.92240	41.06997
6	0.254422	11.49249	50.30619	38.20133
7	0.261012	11.18064	52.46200	36.35736
8	0.264439	11.13330	53.15939	35.70731
9	0.267128	11.10426	53.75608	35.13966
10	0.269417	11.06228	54.22491	34.71281
For LNREER:				
1	0.232039	90.29407	9.209948	0.495977
2	0.300683	91.75454	6.740686	1.504769
3	0.335176	89.53908	9.151384	1.309538
4	0.347124	90.03089	8.665228	1.303886
5	0.363054	90.20196	8.026838	1.771202
6	0.381278	90.51751	7.856827	1.625665
7	0.401592	89.49353	8.745697	1.760773
8	0.419621	87.83420	10.29450	1.871299
9	0.435713	86.32359	11.65456	2.021853
10	0.448795	85.85966	12.14007	2.000270
For LNTPU:				
1	0.064336	17.25225	70.43273	12.31502
2	0.080674	18.89567	62.30812	18.79621
3	0.086881	19.84621	58.42520	21.72859
4	0.093048	19.04761	53.39020	27.56220
5	0.098198	19.37842	48.83113	31.79045
6	0.102397	21.70533	45.02690	33.26777
7	0.106827	25.06351	41.36988	33.56661
8	0.111023	28.65419	38.37251	32.97329
9	0.115691	32.21219	35.33890	32.44892
10	0.120525	35.70407	32.68351	31.61242

Note: Shock 1, Shock 2 and Shock 3 refer LNTRADE, LNTPU and LNREER, respectively. Also, S.E. is standard error.

Table 7 shows the variance decomposition results of the SVAR model. The empirical findings in Table 7 depict that 2.67% of the change in LNTRADE is explained by its own shock in the initial period. It reaches 12.00 % by increasing until the 5th period and remains at the level of approximately 11% in the subsequent periods. While 29.49 % of the fluctuations in LNTRADE is explained by LNTPU shocks in the first period, this rate is 67.82 % for LNREER shocks. The effects of LNTPU shocks on LNTRADE increasingly have continued throughout the years and reaches 54.22 % at the end of the 10th period. On the other side, the ratio explained by LNREER shocks have showed a decreasing trend and it is 34.71% in the last period. While most of the changes in LNTRADE are explained by the LNREER shock at the beginning, LNTPU is the determinant of the changes in LNTRADE at the end of the period. According to Table 7, while the effect of LNTPU shocks on changes in LNREER is more limited (9.20 %), the ratio explained by LNTRADE shocks is higher (90.29 %) in the first period. Also, 0.49 % of the change in LNREER is explained by its own shock. The effects of LNTRADE shock on change in LNREER decreased over time and it has a value of 85 % as of the last period. The effects of LNTPU shock and LNREER's own shock have an increasing trend. The effect of both shocks tends to increase regularly from the 7th period. Considering the first period, the changes in LNTPU are affected by its own shock (70.43 %), LNTRADE (17.25 %) and LNREER (12.31 %) shocks, respectively. The effects of LNTRADE shocks on LNTPU have increased throughout the period and eventually it reached 35.70 % in the 10th period. Likewise, the ratio of LNREER shocks explaining the changes in LNTPU has gone up to 31.61% at the last period. On the other side, the impacts of the LNTPU's own shock have decreased by more than about half over time.

Conclusion

Since the 2008 Global Crisis, there has been a deepening of the environment of economic and trade uncertainty, which had its origins in the spread of protectionist policies and the increase in US import tariffs. In this uncertain climate, what economic agents expect to happen in the current and future periods, and how they act according to these expectations, has a significant impact on the global economy. Trade policy uncertainty postpones or discourages business investment decisions in relation to exports. The reason for this is that companies that perceive uncertainty as a high risk have a high-cost avoidance bias. The volume of global trade is also affected by trade policy uncertainty. On the other hand, the situation is similar for the financial markets, which are affected to a large extent by uncertainty and risk. In other words, trade policy uncertainty has a negative impact on financial markets. For example, as uncertainty increases, the volatility of exchange rates also increases.

As seen, trade policy uncertainty has significant effects on key economic variables. It is important to study the impact of trade policy uncertainty, especially for developing countries that are vulnerable to economic shocks, risks and uncertainties. Therefore, the aim of this study is to analyze the relationship between trade policy uncertainty, trade balance and exchange rate in Türkiye with the help of the SVAR model. The results show that there is a significant relationship between trade policy uncertainty, the trade balance and the exchange rate in the long term. The response of trade policy uncertainty to shocks to the trade balance and to the exchange rate is statistically significant and negative. The response of the exchange rate to trade balance shocks is statistically significant and positive. An increase in the trade balance increases the exchange rate and reduces trade policy uncertainty. The exchange rate appreciation effect of the improvement in the trade balance can be explained by Türkiye's high dependence on imports of inputs. When exports increase, the demand for raw materials and intermediate goods needed in the production process increases. This increase in demand increases the demand for foreign exchange, thereby pushing up the exchange rate. While the findings of studies conducted by Durusoy and Tokatlıoğlu (1997), Ay and Özşahin (2007), Vergil and Erdoğan (2009) and Ari et al. (2019) Türkiye confirm the J-curve hypothesis, Kemeç and Kösekahyaoğlu (2015), Kopuk and Beşer (2020) and Ceyhan and Gürsoy (2021) claimed that the hypothesis is not valid. On the other hand, there is a negative relationship between worsening trade balance and trade uncertainty in Türkiye. In other words, an increase in uncertainty leads to a deterioration in the trade balance. The empirical evidence is broadly consistent with the theoretical and empirical literature.

In the light of the empirical findings of the study, it might be said that there is an important relationship between trade policy uncertainty, trade balance and exchange rate in Türkiye. It can be a recommendation for policy makers to design economic policies in such a way that the effects of trade policy uncertainty are taken into account.

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