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The J-Curve Hypothesis: An Analysis for Turkey

J-Eğrisi Hipotezi: Türkiye İçin Bir Analiz

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Abstract

J-curve which explains the possible effects of exchange rates on foreign trade states that the depreciation of national currency worsens the trade balance in the short-term and has an improvement effect in the long-term. The success of devaluation in affecting the trade balance positively depends on the fulfillment of Marshall-Lerner condition. Accordingly, when the sum of foreign demand elasticity of exported goods and domestic demand elasticity of imported goods is equal to or greater than one, the rise in the RER increases the country's foreign exchange earnings and improves the trade balance. In our study, it is investigated whether the J-curve hypothesis is valid or not in Turkey. For this purpose, the Toda-Yamamoto Causality Test and Hatemi-J (2012) Asymmetric Causality Test are applied using the 1996-2019 monthly data. The Toda-Yamamoto Causality Test results indicate that there is a unidirectional causality relationship from the real exchange rate to import. On the other hand, the results of the Hatemi-J (2012) Asymmetric Causality Test show that shocks in the real exchange rate do not affect export but decrease import. Thus, the J-curve hypothesis has been determined to be invalid for Turkey.

Keywords: *Real Exchange Rate, Trade Balance, J-Curve*

Öz

Döviz kurunun dış ticaret üzerindeki olası etkilerini açıklayan J-eğrisi, ulusal para birimindeki değer kaybının dış ticaret dengesini kısa dönemde kötüleştirici, uzun dönemde iyileştirici etki yaptığını ifade etmektedir. Devalüasyonun dış ticaret dengesini olumlu etkilemedeki başarısı, Marshall-Lerner koşulunun sağlanmasına bağlıdır. Buna göre, ihraç edilen ürünlerin dış talep esnekliği ile ithal edilen ürünlerin iç talep esnekliklerinin toplamı 1 ya da 1'den büyük olduğunda, reel döviz kurundaki yükselme ülkenin döviz gelirlerini artırmakta ve dış ticaret dengesini düzeltmektedir. Bu çalışmada, J-eğrisi hipotezinin Türkiye'de geçerli olup olmadığı sınanmaktadır. Bu amaçla, Türkiye için 1996-2019 dönemine ait aylık veriler kullanılarak Toda-Yamamoto Nedensellik Testi ve Hatemi-J (2012) Asimetrik Nedensellik Testi uygulanmıştır. Toda-Yamamoto Nedensellik Testinin sonuçları, reel döviz kurundan ithalata doğru tek yönlü bir nedenselliğin olduğunu ortaya çıkarmıştır. Hatemi-J (2012) Testinin sonuçları ise, reel kur şoklarının ihracatı etkilemezken, ithalatı azaltıcı bir etki meydana getirdiğini göstermiştir. Dolayısıyla J-eğrisi hipotezinin Türkiye için geçersiz olduğu belirlenmiştir.

Anahtar Kelimeler: *Reel Döviz Kuru, Dış Ticaret Dengesi, J-Eğrisi*

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Introduction

In economies where a fixed or stable exchange rate regime is applied, governments can adjust the exchange rates by intervening in the currency markets. But in the event of long term foreign deficits in developing countries, the country may devalue its domestic currency by stepping up the real exchange rate since the opportunities to sell foreign currency in the market are limited. Similar practices can be encountered in economic systems where there is no fixed exchange rate regime and exchange rates float freely in the market (Hepaktan, 2009, p. 41). With devaluations, it is aimed to increase foreign exchange earnings by promoting exports on the one hand, and to save foreign exchange by reducing domestic demand for imported goods on the other (Karagöz & Doğan, 2005, p. 220).

Devaluations made in cases where trade deficits reach unsustainable levels can lead to improvements in countries' trade balance in the short-term, depending on the price elasticities demand for imported and exported goods (Akkaya, 2018, p. 329). Countries determine their national exchange rate policies by prioritising their trade balances and their competitiveness in foreign trade (Eren, 2019, p. 1038). In underdeveloped countries where capital movements are very limited, exchange rate policies are generally established in order to increase international competition and eliminate trade imbalances (Vergil & Erdoğan, 2009, p. 36). Normally, there is an expectation that the increase in the RER (Real Exchange Rate) will increase the competitiveness of the country in foreign trade, increase its net EXPs (Exports) and improve the trade balance. However, the effects of the increases in exchange rates on trade balance may emerge in different ways by periods (Eren, 2019, p. 1040).

According to the M-L (Marshall-Lerner) condition which explains the effects of changes in the RER on foreign trade by taking into account the sum of IMP and EXP demand elasticities, decreases in the RER or devaluations in the fixed exchange rate system reduce the foreign trade deficit while the increases or revaluations in the exchange rate have the effect of eliminating the foreign trade surplus (Vergil & Erdoğan, 2009, p. 36; Kılıç et al., 2018, p. 113). Under the assumption that the elasticities of export and import supply in the country are infinite, this condition ($\mathrm{e_m} + \mathrm{e_x} \geq 1$) states that a devaluation in the exchange rate will effect the trade balance positively in the long-term when the sum of the domestic demand elasticity of imported goods (e_m) and the foreign demand elasticity of exported goods (e_x) is equal to or greater than one. The greater the sum of elasticities than one, the greater the effect of exchange rate regulations on maintaining the trade balance (Karagöz & Doğan, 2005, p. 220; Akkay, 2012, p. 174).

Magee (1973) explaines the effect of devaluations on trade balance in the context of delays in economics. Magee (1973) argues that due to delays like recognition, production, delivery, etc.; drops in exchange rates increase trade deficit initially and reduce it after a certain period. The fact that the decline in exchange rates worsens the trade balance at the beginning and improves after a certain period is due to the volume and price effect in foreign trade. Exchange rate differentials do not affect the volume of trade in the short-term since import-export orders and agreements are usually made a few months in advance and elasticities are low in the short-term. Changes in the exchange rate are reflected in purchasing decisions a few months later, when elasticities begin to rise. However, the price effect temporarily affects the trade balance with the change in the exchange rate although the delays in foreign trade volume. With the fall in the real exchange rate, domestic price of imported goods in national currency increases while the international price of exported goods decreases. Eventually, a slump in the exchange rate increases the foreign trade deficit more in the first phase. Foreign trade partners make new contracts in line with the changes in exchange rates after fulfilling their old contracts. As the national currency will depreciate as a result of these agreements, the demand for exported goods will increase, the demand for imported goods will decrease. This will create an improving effect on the trade balance. This effect is expressed as the J-Curve Effect Hypothesis in the international economics literature because the fact that the downfall in exchange rates initially disrupts the trade balance but improves it after a certain period of time is identified with the letter J (Kılıç et al., 2018, p. 113-114).

Experiences in some countries around the world have shown that while the demand elasticities of imported and exported goods are rigid in the short-term, they increase in the long-term. Reactions of producers and consumers to relative price changes arising due to changes in the exchange rate are not immediate, it takes time to adapt to devaluation (Vergil & Erdoğan, 2009, p. 36). After the devaluation, exports may not increase immediately and a temporary deterioration may occur in the trade balance in the short-term due to possible uncertainties in the market until economic units get used to the new rates of exchange, past and ongoing foreign trade agreements, changes in supply and demand structures require time. In the long-term, within the framework of the M-L condition, the trade balance is expected to improve by being positively affected via devaluation (Uslu, 2018, p. 552-553).

In the success of a devaluation; factors such as fixed domestic prices, stability of foreign market prices of imported goods, consumer behavior and habits are effective. Besides, if the trade deficit problem in the country's economy stems from structural reasons such as insufficient production, technological and administrative backwardness, the success of the devaluation in maintaining trade balance will be restricted. After devaluation, when the sum of short-term absolute elasticity values is less than one, the J-curve effect will occur (Karagöz & Doğan, 2005, p. 220).

Especially in the post-1970 period, the liberalisation of financial capital movements in the world, transition to the market economy, economic integrations and the changes in economies caused by the differentiation in the exchange rate systems of countries were effective in the emergence of the J-curve, which symbolises the transformation of trading equilibrium from negative level to positive level with the recovery processes in international trade (Akkaya, 2018, p. 329). After the Bretton Woods System came to an end, nominal exchange rates began to be determined by supply and demand conditions in the foreign exchange market with the transition of many countries to flexible exchange rate regime. Although flexible exchange rate regime paves the way for determination of the value of national currencies of countries within the framework of market dynamics, this system has generally been applied in the form of a managed floating exchange rate regime in which Central Banks intervene in exchange rates within certain limits. In parallel with these developments, discussions about the effects of exchange rates, which exhibit ups and downs in the face of different endogenous and exogenous shocks in the process of automatic determination of rates in the market, on trade balance have increased (Bal et al., 2017, p. 62). With the globalisation process, Turkey's come to position to a country open to foreign capital and determination of its foreign economic policies in this direction have created a strong link between changes in the RER and its foreign trade performance.

In this study, it is investigated whether there is a J-curve effect in Turkey. For this purpose, first, literature review is conducted and studies testing the validity of the J-curve hypothesis are included. Second, the econometric model used in the study is introduced and the real exchange rate-foreign trade relationship in Turkey is examined. Finally, in the conclusion part, the analysis results are interpreted and policy inferences are made in the light of the empirical findings.

1. Literature Review

Until today, the validity of the J-curve hypothesis has been tested by applying different empirical techniques for different countries by many authors. When the studies in this field are examined, it is seen that different results are obtained on whether the J-curve hypothesis is valid or not, and many indications are found that devaluation improves as well as worsens the balance of trade. Therefore, it should be said that there is no consensus in the literature in terms of the results of the studies on the J-curve theory. Although many studies have been conducted to test the validity of the J-curve hypothesis for Turkey and the world countries, it is striking that the Toda-Yamamoto Causality Test and the Hatemi-J (2012) Asymmetric Causality Test are not included in the existing studies in the literature. Thus, the contribution of this study to the literature on the RER-trade balance relationship will be in the context of the Toda-Yamamoto Causality Test and the Hatemi-J (2012) Asymmetric Causality Test. But before that, previous studies on this subject are given below.

Magee (1973) observes that devaluation policies implemented to eliminate the foreign trade deficit in USA do not improve the trade balance as expected, but rather worsen it. Magee conducts his analysis within the framework of the foreign exchange purchase and sale agreements before and after the devaluation and the stationary period in which the quantity adjustment takes place. He attributes the unexpected developments in trade balance following the devaluation to the price-quantity mismatch occurring in the mentioned processes.

Miles (1979), taking into account the effects of fiscal & monetary policies in the exchange rate-foreign trade relationship in his analysis for 14 countries on the basis of the period 1956-1972, determines that the essential effect of devaluation is on the balance of payments thanks to the surplus created in the capital account and it does not have an effect on improving the trade balance.

Bahmani-Oskooee (1985), in his study using Almon Delay Model for 4 economies for the period 1973-1980, obtaines evidence for the existence of the J-curve in Greece, India and Korea. In addition, he has encountered the existence of a long-term relationship between the exchange rates and trade balance only in Thailand.

Zhang (1996) determines that the J-curve hypothesis is not valid for China by applying Cointegration and Granger Causality Test with the data 1991 to 1996.

Lal & Lowinger (2002), using time series with data from 1980-1998, state that the relationship between RER and trade balance varies from country to country, and the J-curve effect is verified in some countries, but not in some countries.

Arora et al. (2003), using the ARDL technique for India and its seven largest trading partners with the data of 1977-1998, conclude that devaluation in the long-term improves the trade balance while there is no indication for validity of the J-curve in the short-term.

Akbostancı (2004) observes that devaluation does not reduce trade deficit in the long-term, that is, the M-L condition doesn't occur, and the J-curve hypothesis is not valid in the short-term in Turkey, in the study it conducts with the VAR Model for the years 1987-2000.

Kamoto (2006) concludes that the J-curve is not valid for Malawi by employing the Cointegration Test and VECM with the data 1974 to 2003.

Peker (2008), with the help of Cointegration and VECM on Turkey for the period of 1992-2006, finds that an increase in the RER negatively affects the trade balance in the short-term and long-term, so the J-curve hypothesis is not valid.

Yuen-Ling et al. (2008) argue that M-L condition is fulfilled, but the J-curve hypothesis is not supported in their research which they deal with for Malaysian economy for the period of 1955-2006.

Vergil & Erdoğan (2009) prove the existence of the J-curve in the study they deal with the help of Almon Multinomial Model for the period 1989-2005 in Turkey. They also state that M-L condition for Turkey is occurred in accordance with the ARDL Cointegration Test results.

Shahbaz et al. (2010), using the ARDL method for Pakistan economy over the period 1980-2006, submit that increases in the RER affect the trade balance negatively, hence the J-curve hypothesis is not valid.

Bal & Demiral (2012) study the short-term and long-term relationship between the RER and trade balance by time series for the bilateral trade of Turkey-Germany. They find that the real exhange rate elasticity of trade balance is negative in the short-term, and positive in the long-term. Thus, they demonstrate that the M-L condition doesn't occur in the short-term and the J-curve hypothesis is valid.

Kemeç & Kösekahyaoğlu (2015) find that the M-L condition and J-curve hypothesis is not valid in their VAR analysis for Turkey for the period 1997-2013.

Pirimbaev & Oskonbaeva (2015) reach the conclusion that the J-curve is not valid in the short-term and Marshall-Lerner condition is realized in the long-term by applying the ARDL model with the data of 2000-2013 in Kyrgyzstan.

Karamelikli (2016a), using the ARDL model on the basis of the period 2000 to 2015, reveals that there is no J-curve effect for USA and France in the short-term, there is a symmetrical relation between the RER and foreign trade for Germany and an asymmetric relationship for UK. In the long-term, he finds an asymmetrical relationship for USA and a symmetrical relationship for Germany between the RER and trade balance. It states that there is no linkage between variables in the long-term for France and England.

In another study made by Karamelikli (2016b) by using symmetric and asymmetric models based on monthly and quarterly data for the period 2003-2015 for Turkey, different results are obtained depending on the data sets used. According to the model created with monthly data set, a symmetrical relation in the short-term and an asymmetrical relation in the long-term is detected. Pursuant to the results of the analysis made with quarterly data, no cointegration relationship is found between the parameters and no evidence is found for the existence of the J-curve. According to the estimation results made with both monthly and quarterly data, results supporting the J-curve hypothesis are obtained in Turkey.

Berke & Akarsu (2017), putting to use the Dynamic Least Squares Method for Turkey covering the period of 1998-2016, couldn't find an indication supporting the J-curve hypothesis.

Nusair (2017) applies the NARDL model to 16 Transition Economies and proves the existence of a nonlinear connection between the RER and foreign trade in 12 transition countries and validity of the J-curve.

Kılıç et al. (2018) find that the J-curve hypothesis is valid in Turkey for the period 1998-2016 using the ARDL method.

Uslu (2018), employing the Panel Data for 80 countries on the basis of the period 1960-2016, observes that the M-L condition is met in countries other than high-income countries, and the J-curve hypothesis is weakly valid only in high-income countries.

Küçüksoy & Akkoç (2020) have tested the impact of exchange rate on Turkey-China's bilateral trade by the NARDL model for 2013-2019. Test results reveal that the exchange rate creates negative asymmetric effects in the overall economy and in important sectors in the short-term. As of the period under consideration, the validity of the J- curve has not been proven in any of the sectors.

Kopuk & Beşer (2020) suggest that while J-curve hypothesis prevails in the short-term in the Turkey's manufacturing industry, it does not prevail in the long-term.

Ibrahim and Bashir (2020) examine the effect of changes in the RER on the trade balance in Sudan on the basis of the 1978-2017 period using the ARDL bound test approach. The empirical results reveal that exchange rate devaluations do not affect the trade balance, so the J-curve effect cannot be found.

Ramzan (2021) investigates the effect of RER on Turkey-USA bilateral trade balance at industry level. Linear ARDL results show that the J-curve hypothesis is not valid at aggregate level. However, linear ARDL results at disaggregate level confirm the J-curve hypothesis in Transportation, Textiles & Clothing and Mine & Metal industries.

Güler (2021) investigates the asymmetric effects of RER shocks on EXPs and trade balance for Turkey. According to the NARDL test results, negative RER shocks cause a gradual improvement in the trade balance. So, the J-curve effect is not confirmed.

Bahmani-Oskooee and Karamelikli (2021) investigate the symmetrical and asymmetrical effects of devaluation on the trade balance for Germany and UK. In the study, in which linear and nonlinear ARDL models are used for the period 1999-2019, the symmetrical J-curve effect is found in 12 industries and the asymmetric J-curve effect is found in 21 industries.

Bahmani-Oskooee and Nouira (2021) examine the existence of the asymmetric J-curve effect for 58 industries in trade between Italy and the USA with linear and nonlinear models. Econometric test results show that the J-curve effect has been confirmed in 12 countries. Nonlinear model estimations reveal that asymmetric effects are seen in 48 industries in the short-term, and 29 industries in the long-term.

Iqbal et al. (2021) find that there is a J-curve effect in Pakistan's trade with Malaysia, China and the USA in their bilateral trade analysis of Pakistan and its 8 trading partners with the nonlinear ARDL model for the period 1980-2017.

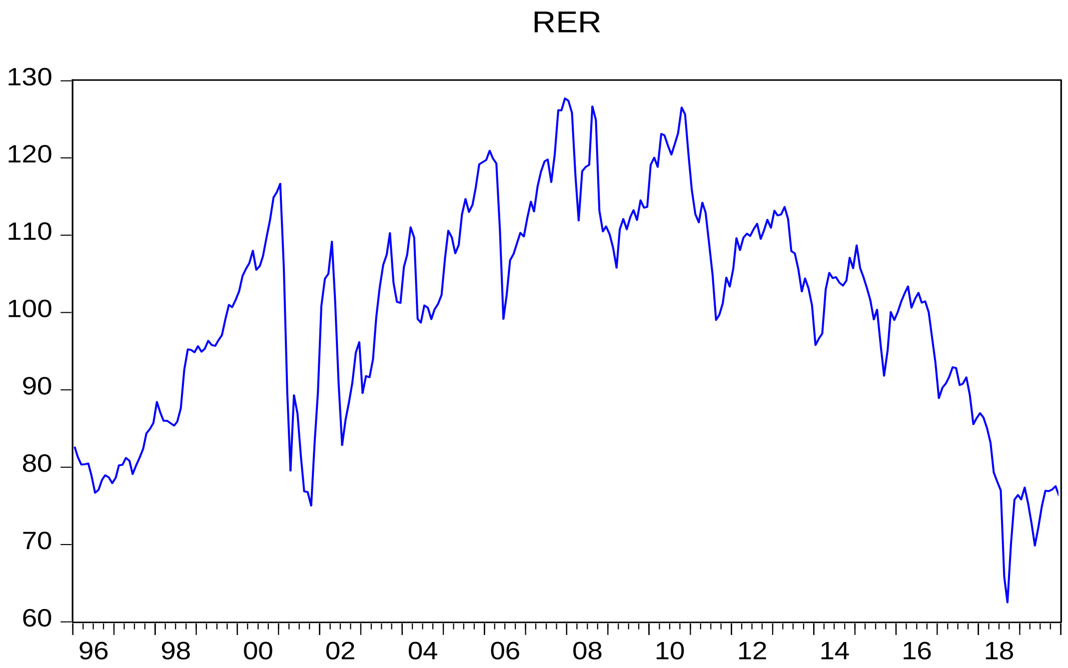
Mwito et al. (2021), in their studies with panel data analysis on the asymmetric effects of RER on trade balance for Kenya and its 30 trading partners for the period 2006-2018, determine that simultaneous bilateral decreases in RER boost the long-term trade balance. Thus, authors assert that devaluation policy will increase Kenya's competitiveness in international trade in the long-term.

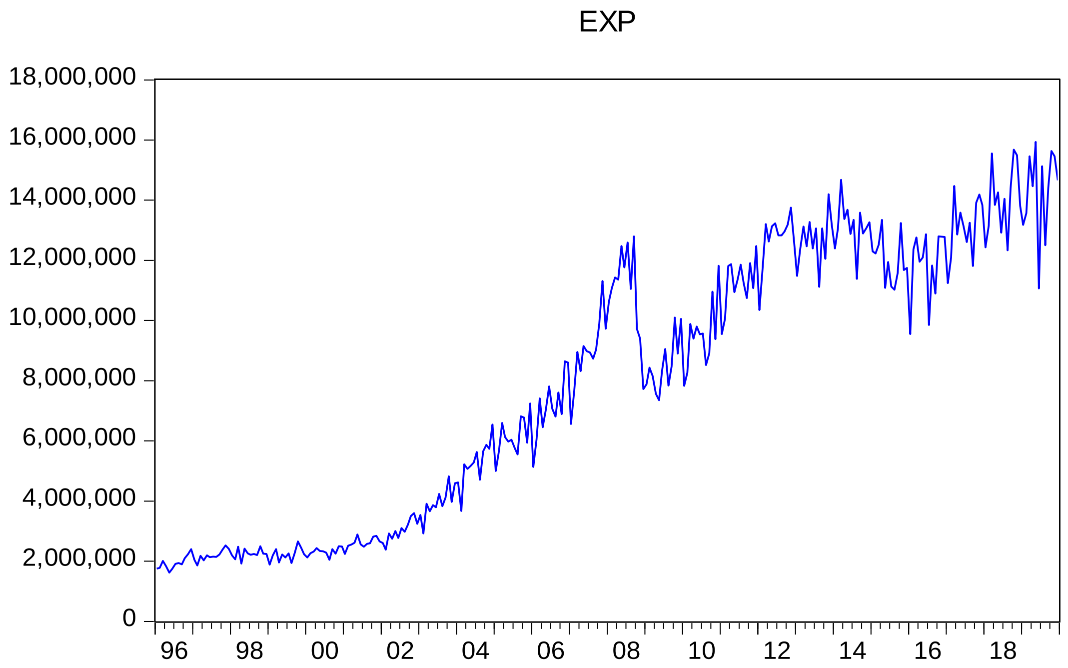
Ünal (2021) tests the validity of the M-L condition and J-curve hypothesis in the bilateral trade relationship between Turkey and Russia with the ARDL model for the 2000-2019 period. The findings of the study show that the M-L condition is met and the J-curve hypothesis is confirmed only in the long-term.

2. Methodology

2.1. The Aim of the Study and Method, Data

In this study, it is aimed to analyse the relationship between the Real Exchange Rate (RER) and Export Rate (EXP), Import Rate (IMP). EXP and IMP represent the totals of export and import exchanges. Accordingly, Hatemi-J (2012) Asymmetric Causality Test and Toda-Yamamoto Causality Test were conducted between 1996-2019 by using monthly data. All data were obtained from TCMB (2020). Firstly, Zivot-Andrews unit root test was used to ensure the stability of the obtained all data. The (ZA) test has advantages in terms of determining structural breaks on the dates and also is shared with the break dates in table. The abbreviated variables for the study are presented below.


RER
130
120
110
100
90
80
70
60
96
98
00
02
04
06
08
10
12
14
16
18


EXP
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
96
98
00
02
04
06
08
10
12
14
16
18

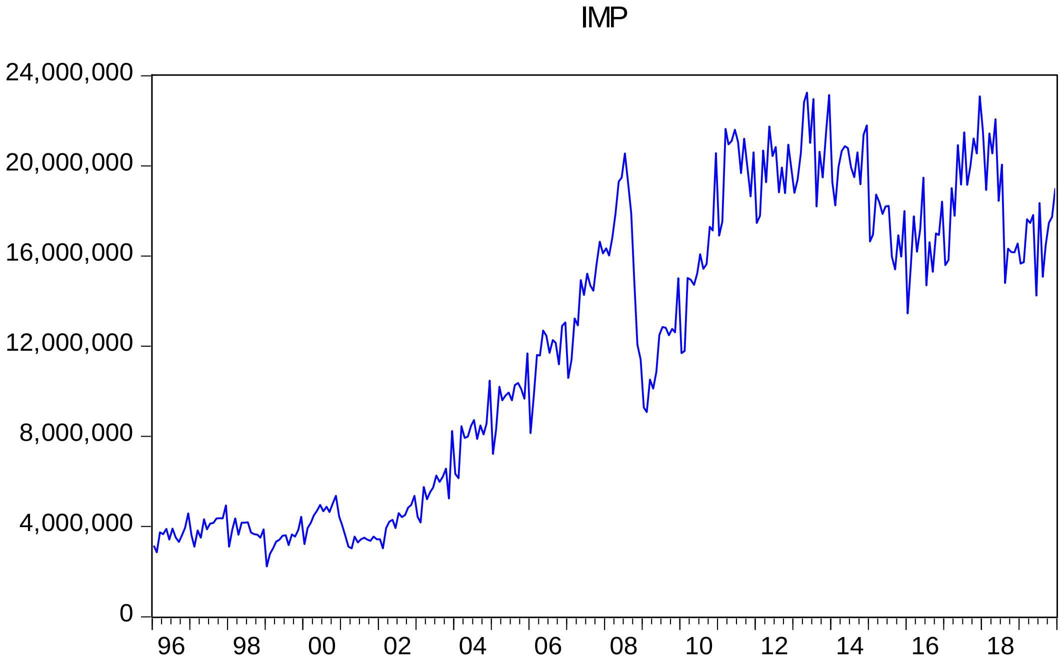


Figure 1. Charts of Series

2.2. The Research Hypotheses

In the study, two hypotheses have been established that question the existence of a causality relationship between the variables. These hypotheses established for study are as follows.

H_0: There is no causal relationship between RER variable and EXP, IMP variables.

H_1: There is causal relationship between RER variable and EXP, IMP variables.

2.3. The Zivot-Andrews Unit Root Test

Table 1. The Results of The Zivot-Andrews Unit Root Test

Zivot-Andrews (Model C)						
Variables	**Level Test Statistics**	**Level Breaking Date**	**Critical Value**	**1. Difference Test Statistics**	**1. Difference Breaking Date**	**Critical Value**
RER	-3.57	January 2010	-5.08	-7.74	August 2002	-5.08
EXP	-3.22	May 2015	-5.08	-6.09	October 2008	-5.08
IMP	-4.37	October 2008	-5.08	-6.15	September 2010	-5.08

**: It is significant at 5% level.

According to the findings of the unit root test, all variables are not stationary at the level means that I(0). The t statistic values of the RER, EXP and IMP variables are smaller than the Critical values. It has been observed that the variables become stable after taking the first difference.

2.4. Hatemi-J Asimetrik Nedensellik Analizi

The Asymmetric Causality Test, which was first introduced to the literature by Granger & Yoon (2002), was developed by Hatemi-J (2012), and causality is investigated by dividing variables into positive and negative components. In this asymmetric causality analysis, it is aimed to find hidden relationships that will help to understand the dynamics of the series and allow to develop possible predictions for the future (Yılancı & Bozoklu, 2014, p. 214).

In the case, we want to test the causality bond between two integrated variables y_{1t} and y_{2t} (Hatemi-J, 2012, p. 449-450);

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{10} + \sum_{i=1}^{t} \varepsilon_{1i} \qquad ve \qquad y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{20} + \sum_{i=1}^{t} \varepsilon_{2i} \tag{1}$$

Here, $t = 1, 2, \dots T$, denotes the constant terms, y_{1t} and y_{2t} denotes initial values, ε_{1i} and ε_{2i} error terms. Positive and negative shocks are expressed as in equation (2);

$$\varepsilon_{1i}^{+} = \max\ (\varepsilon_{1i}, 0)\,, \varepsilon_{2i}^{+} = \max\ (\varepsilon_{2i}, 0), \varepsilon_{1i}^{-} = \min\,(\varepsilon_{1i}, 0) \quad ve \quad \varepsilon_{2i}^{-} = \min\ (\varepsilon_{2i}, 0), \tag{2}$$

However, it is shown as $\varepsilon_{1i} = \varepsilon_{1i}^{+} + \varepsilon_{1i}^{-}$ ve $\varepsilon_{2i} = \varepsilon_{2i}^{+} + \varepsilon_{2i}^{-}$

Based on these, it is possible to rewrite equations (1) and (2) as follows:

$$y_{1t} = y_{1t-1} + \varepsilon_{1t} = y_{1,0} + \sum_{i=1}^{t} \varepsilon_{1i}^{+} + \sum_{i=1}^{t} \varepsilon_{1i}^{-}, \tag{3}$$

$$y_{2t} = y_{2t-1} + \varepsilon_{2t} = y_{2,0} + \sum_{i=1}^{t} \varepsilon_{2i}^{+} + \sum_{i=1}^{t} \varepsilon_{2i}^{-}. \tag{4}$$

Lastly, the pos and neg shocks in each variable are expressed in cumulative form as

$$y_{1t}^{+} = \sum_{i=1}^{t} \varepsilon_{1i}^{+}\,, \qquad y_{1t}^{-} = \sum_{i=1}^{t} \varepsilon_{1i}^{-}\,, \qquad y_{2t}^{+} = \sum_{i=1}^{t} \varepsilon_{2i}^{+}\,, \qquad y_{2t}^{-} = \sum_{i=1}^{t} \varepsilon_{2i}^{-}\,, \tag{5}$$

Then, assuming that is $y_t^{+} = y_{1t}^{+}, y_{2t}^{+}$, the causal link between the positive components is tested through the p delayed vector autoregressive model (VAR). VAR (p) model is expressed as in equation (6);

$$y_t^{+} = v + A_1 y_{t-1}^{+} + \cdots + A_p y_{t-1}^{+} + u_t^{+} \tag{6}$$

Here, y_t^{+} indicates a variable vector of size 2x1, v is constant variable vector of size 2x1, u_t^{+} is error term size of 2x1, and A_r is expressed as a parameter matrix of "r" order, which is determined using 2x2 size delay length information criteria. The following equation is used to determine the optimal lag lengt:

$$HJC = \ln(|\widehat{\Omega}_j|) + j\left(\frac{n^2 lnT + 2n^2 \ln(\ln T)}{2T}\right), \qquad j = 0, \dots, p \tag{7}$$

$(|\widehat{\Omega}_j|)$ shows j length. The estimated VAR model's error term is variance-covariance matrix, n is the number of equations in the VAR model, and T is the number of observations.

After the lag length is determined, the Wald statistic is used to test the H_0 fundamental hypothesis, which indicates the absence of Granger-causality between series. The VAR model equation created in order to obtain the Wald statistics is as follows:

$Y = DZ + \delta$ the equation is more clearly expressed;

$Y{:}\ = (y_1^{+}, y_2^{+}, \dots, y_T^{+})$

$D{:}\ = (v, A_1, A_2, \dots, A_p)$

$$Z_t: = \begin{bmatrix} 1 \\ y_t^{+} \\ y_{t-1}^{+} \\ \vdots \\ y_{t-p+1}^{+} \end{bmatrix} \tag{8}$$

$Z{:}\ = (Z_0, Z_1, \dots, Z_{T-1})$

$\delta{:}\ = (u_1^{+}, u_2^{+}, \dots, u_T^{+})$

According to equation (8): it refers to matrixes of different sizes $Y: (n\ x\ T)$, $D: \left(n\ x\ (1+np)\right)$, $Z_t: ((1+np)\ x\ 1)$, $Z: ((1+np)\ x\ T)$ and $\delta: (n\ x\ T)$.

The basic hypothesis ($H_0: C\beta = 0$) which states that there is no Granger causality, is tested with the Wald statistics. The Wald statistics can be calculated with the help of the following equation;

$$Wald = (C\beta)'[C((Z'Z)^{-1} \otimes S_U)C']^{-1}(C\beta) \qquad (9)$$

Equation (9) is in the form of $\beta = vec(D)$ and indicates the column clustering operator. $\otimes$ Kronecker, C represents the indicator function including constraints. The variance-covariance matrix calculated for the unconstrained VAR model is expressed as $S_U = \frac{\hat{\delta}'_U \hat{\delta}_U}{T-q}$. And here, the q h represents the number of lags in the VAR model.

Table 2. The Results of the Hatemi-J Asymmetric Causality Analysis

Direction of causality	**Wald statistic**	**Bootstrap Critical Values**		
		%1	**%5**	**%10**
RER (+)> EXP(+)	2.496	14.917	10.053	8.092
RER (+)> EXP(-)	6.902	14.435	9.984	8.126
RER (-)> EXP(+)	2.511	14.767	10.118	8.161
RER (-)> EXP(-)	2.380	14.150	9.788	7.975
RER (+)> IMP (+)	7.438	12.031	8.035	6.499
RER (+)> IMP (-)	8.176**	11.697	8.102	6.390
RER (-)> IMP (+)	7.908	12.243	8.301	6.580
RER (-)> IMP (-)	7.334	12.456	8.269	6.520

Note: *It is significant at 5% level.

According to the results of the Hatemi-J Asymmetric Causality Test, which investigates the relationships from RER to EXP and IMP, it is found that there are partial causality relationships between variables at the 5% significance level. According to findings of the equation in which positive causality relationship from the RER towards the EXP variable is tested, the wald statistic values of the variables are less than the bootstrap critical values. Then H_0 hypothesis is accepted, H_1 hypothesis is not accepted. From RER to EXP, the wald statistics value (2.380), bootstrap critical value (9.788), and it is not significant because wald statistic value is less than the bootstrap critical value. However, it is found that there is no negative causality relationship from RER to EXP. Then H_0 hypothesis is accepted, H_1 hypothesis is not accepted.

Looking at the causality effects on IMP from RER, it is found that positive causality relationship from the RER to IMP variable, the wald statistics value (8.176) is found, and it is significant because it is more than the bootstrap critical value (8.102). H_0 hypothesis is not accepted, H_1 hypothesis is accepted. Shortly, an asymmetric causality relationship from the RER variable to the IMP variable is determined. It has been observed that positive shocks in the RER variable are effective on negative shocks on IMP.

2.5. Toda-Yamamoto Causality Test

This method, developed by Toda & Yamamoto (1995), was created to take the Granger causality test to a higher level. In addition, the model tries to enhance some of the problems that occur in the Granger Causality Test. To be able to test Granger causality for time series, the series must first become stationary and stabilize at the same level. However, once this condition has been met, cointegration must also occur to demonstrate a long-term relationship between stationary series at the same level. In other words, the Granger Causality Test can be performed only between the series that are stable at the same level and have a cointegration relationship between them. However, the Toda-Yamamoto Test reveals that time series which are at different levels of stability may have causality between them, and even causality testing can be done without the need for a stationary test (Toda & Yamamoto, 1995, p. 246).

In the case of the performing the Toda & Yamamoto (1995) Test, the appropriate lag length *(k)* is determined by the VAR model. In the second stage of the analysis, the degree of integration (d_{max}) of the variable, which has the highest degree of integration, is added to the lag length *(k)* of the model. In the last stage, the VAR model is estimated according to the lags with level values of the series (k + d_{max}). The VAR model is applied with the help of the following equations (Toda & Yamamoto, 1995, p. 230);

$$Y_t = a_0 + \sum_{i=1}^{k+d_{max}} a_{1i} Y_{t-i} + \sum_{i=1}^{k+d_{max}} a_{2i} X_{t-i} + u_t \tag{10}$$

$$X_t = \beta_0 + \sum_{i=1}^{k+d_{max}} \beta_{1i} X_{t-i} + \sum_{i=1}^{k+d_{max}} \beta_{2i} Y_{t-i} + v_t \tag{11}$$

In the Toda-Yamamoto Test, the basic hypothesis and alternative hypothesis can be discussed as follows:

H_0: The X is not the Granger cause of the Y.

H_1: The X is the Granger cause of the Y.

The success of the Toda-Yamamoto Causality Test is directly related to the correct determination of the value of the series (d_{max}) and *(k)* in the model.

Table 3. Toda-Yamamoto Causality Test Results

Dependent Variable	Independent Variable	dmax	k	Chi-Square Test Statistics	Probability	Significant Relationship
EXP	RER	1	1	2.027811	0.3628	RER => EXP
IMP		1	2	6.333402	0.0421	RER => IMP

*: It is significant at 5% level.

The optimal lag length is determined according to the criterion SC, dmax = the maximum stationarity level according to the unit root test of Lee Strazicich, k = VAR denotes the lag length.

At the end of the analysis, it is obtained partial meaningful relations in all. The causality relationship with a 5% significance level is realized from the RER to the IMP in one way. It is seen that H_0 hypothesis is rejected, H_1 hypothesis is accepted. However, there is no causality relationship between RER and EXP at a 5% significance level. It is seen that the established H_1 hypothesis is accepted. The H_0 hypothesis is rejected. These results were obtained from probability values. In the equations established between EXP and RER variables, the probability value is 0.3628. Therefore, there is no significant relationship. In addition, it is understood from the 0.0421 probability value that there is a causality from the RER variable to the IMP variable.

Conclusion

J-curve, reflecting the reaction of the country's trade balance to devaluation, states that the decline in the RER will increase trade deficit first, and then decrease it after a certain period of time. J-curve hypothesis is related to import and export demand elasticities explained under the M-L condition. The fact that importers and exporters do not react immediately to changes in exchange rates causes elasticities to be rigid in the short-term and exports may not increase immediately. In the long-term, elasticities increase and the trade balance is positively affected with the adaptation to relative price changes arising as a result of devaluation. The higher the long-term price elasticity values of a country's exports and imports, the greater the effect of exchange rate adjustments on the improvement of trade balance.

In this study, the validity of the J-curve hypothesis in Turkey is analyzed with monthly data of the period 1996-2019 by applying Hatemi-J (2012) Asymmetric Causality Test and Toda-Yamamoto Causality Test. According to the outcomes of causality between variables, it is determined that similar results are obtained from both analysis. Apart from this, in both of the test results, it is found that the exchange rate is not the cause of a change in exports. Toda-Yamamoto Causality Test results show that there is a unidirectional causality from the RER to IMP. The results of the Hatemi-J (2012) Asymmetric Causality Test, on the other hand, reveal that the shocks in the real exchange rate do not affect export, but decrease import.

The fact that devaluation could not affect export positively in the short-term and long-term is a proof that the exchange rate adjustments in the country do not succeed in increasing export or improving trade balance. Analysis results of the study show that the J-curve hypothesis is not confirmed in Turkey.

The fact that the export in Turkey is largely based on the import of intermediate goods limits the success of devaluations. The increases in imported input prices after devaluations cause the goods produced to be supplied to the market at high prices, so exports may not increase at the desired level. For this reason, policies that reduce dependency on imported inputs and stimulate the production of domestic goods should be implemented. Attracting foreign direct investments to our country is of great importance in closing the foreign exchange gap and improving the trade balance. Through these investments; employment will be increased, high-tech products will be produced, thus the export volume will expand. Besides, for export growth, the country must have sufficient capital accumulation. For this, national income and domestic savings should be increased. Thus, it will be easier to make new investments and produce new capital goods for export.

Implementing policies that emphasize non-price competition rather than policies based on price competition will be effective in increasing export. In this regard, Turkey's foreign trade policy should be designed by considering non-price competitive factors such as creating widespread communication and transportation networks, having the capacity to produce, distribute and market new commodities, developing modern and flexible production technologies, increasing the quality of export goods, product differentiation, on-time delivery, and after-sell service. In addition, it is very important for domestic firms to make investments to increase total factor productivity, to renew and improve their production factors at times and to adapt swiftly to technological innovations in order to increase the variety of merchandises to be exported. Acting within these strategies will be effective in increasing Turkey's market share compared to foreign firms and increasing its competitiveness in international trade.

References

Akbostancı, E. (2004). Dynamics of the trade balance: The Turkish J-curve. *Emerging Markets Finance and Trade, 40*(5), 57-73. doi:10.1080/1540496X.2004.11052584

Akkay, R.C. (2012). Reel kur değişimlerinin dış ticaret dengesine olan etkisini değerlendirmede güncel bir yaklaşım: S-eğrisi hipotezi [A current approach to evaluate the effect of real exchange rate changes on trade balance: S-curve hypothesis]. *İstanbul Üniversitesi İktisat Fakültesi Mecmuası, 62*(1), 173-190. Access address: https://dergipark.org.tr/tr/download/article-file/8826

Akkaya, O. (2018). Türkiye ve Türkiye'nin dış ticaret partnerleri arasındaki iki yanlı J-eğrisi: 1996-2006 dönemi incelemesi [Bilateral J-curve between Turkey and Turkey's trading partners: An analysis of the period 1990-2006]. *Finans Ekonomi ve Sosyal Araştırmalar Dergisi, 3*(1), 328-338. doi:10.29106/fesa.390783

Arora, S., Bahmani-Oskooee, M. & Goswami, G. (2003). Bilateral J-curve between India and her trading partners. *Applied Economics, 35*(9), 1037-1041. doi:10.1080/0003684032000102172

Bahmani-Oskooee, M. (1985). Devaluation and the J-curve: Some evidence from LDCs. *The Review of Economics and Statistics, 67*(3), 500-504. doi:10.2307/1925980

Bahmani-Oskooee, M. & Karamelikli, H. (2021). Asymmetric J-curve: Evidence from UK-German commodity trade. *Empirica,* 1-53. doi: 10.1007/s10663-021-09502-z

Bahmani-Oskooee, M. & Nouira, R. (2021). U.S.-Italy commodity trade and the J-curve: New evidence from asymmetry analysis. *International Economics and Economic Policy,* (18), 73-103. doi: 10.1007/s10368-020-00472-4

Bal, H. & Demiral, M. (2012). Reel döviz kuru ve ticaret dengesi: Türkiye'nin Almanya ile ticareti örneği (2002.01-2012.09) [Real exchange rate and trade balance: The case of Turkey's trade with Germany (2002.01-2012.09)]. *Çukurova Üniversitesi İİBF Dergisi, 16*(2), 45-64. Access address: https://dergipark.org.tr/tr/pub/cuiibfd/issue/4146/54439

Bal, H., Akça, E. & Demiral, M. (2017). Döviz kuru değişmelerinin Türkiye'nin Avrupa Birliği ticareti üzerine etkileri [The effects of exchange rate changes on Turkey's trade with the European Union]. *Kahramanmaraş Sütçü İmam Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 7*(2), 61-82. Access address: http://iibfdergisi.ksu.edu.tr/tr/pub/issue/33603/372999

Berke, B. & Akarsu, G. (2017). Türkiye için "J eğrisi" analizi ["J curve" analysis for Turkey]. D.K. Dimitrov et al. (Ed.) *III. International Balkan and Near Eastern Social Sciences Congress Series, March 04-05, 2017, Edirne, Turkey, in Proceedings* (p.187-194). Access address: http://www.ibaness.org/conferences/edirne/IBANESS_Edirne_Proceedings_10_01_2018.pdf

Eren, O. (2019). Reel döviz kurunun ikili dış ticarete etkileri: Türkiye örneği [Effects of real exchange rate on bilateral foreign trade: The case of Turkey]. *Uluslararası Sosyal Araştırmalar Dergisi, 12*(63), 1038-1056. doi:10.17719/jisr.2019.3296

Granger, C.W.J. & Yoon, G. (2002). Hidden cointegration. *University of California, Economics Working Paper,* No: 2002-02. doi:10.2139/ssrn.313831

Güler, A. (2021). Reel döviz kuru şoklarının ihracat ve dış ticaret dengesi üzerindeki asimetrik etkileri: Türkiye için NARDL Yaklaşımından Kanıtlar [Asymmetric effects of real exchange rate shocks on export and trade balance: Evidence from the NARDL Approach for Turkey]. *MANAS Sosyal Araştırmalar Dergisi, 10*(2), 950-970. doi:10.33206/mjss.869125

Hatemi-J, A. (2012). Asymmetric causality tests with an application. *Empirical Economics, 43*(1), 447-456. doi:10.1007/s00181-011-0484-x

Hepaktan, C.E. (2009). Türkiye'nin Marshall-Lerner koşuluna ilişkin parçalı eşbütünleşme analizi [The analysis of fractional cointegration related to Marshall-Lerner condition of Turkey]. *Yönetim ve Ekonomi: Celal Bayar Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 16*(1), 39-55. Access address: https://dergipark.org.tr/tr/pub/yonveek/issue/13690/165686

Ibrahim, A.A.A. & Bashir, M.S. (2020). The effect of real exchange rate changes on external trade balance in Sudan: Testing J-curve hypothesis. *Nile Journal of Business and Economics, 6*(16), 3-23. doi:10.20321/%25nilejbe.616

Iqbal, J., Nosheen, M., Panezai, G.R. & Salahuddin (2021). Asymmetric cointegration, non-linear ARDL, and the J-curve: A bilateral analysis of Pakistan and its trading partners. *International Journal of Finance and Economics, 26*(2), 2263-2278. doi: 10.1002/ijfe.1905

Kamoto, E.B. (2006). *The J-curve effect on the trade balance in Malawi and South Africa (*Master of Arts in Economics). The University of Texas, Arlington, Access address: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.559.7455&rep=rep1&type=pdf

Karagöz, M. & Doğan, Ç. (2005). Döviz kuru dış ticaret ilişkisi: Türkiye örneği [Exchange rate-foreign trade relationship: The case of Turkey]. *Fırat Üniversitesi Sosyal Bilimler Dergisi, 15*(2), 219-228. Access address: http://web.firat.edu.tr/sosyalbil/dergi/arsiv/cilt15/sayi2/219-228.pdf

Karamelikli, H. (2016a). Linear and nonlinear dynamics of the Turkish trade balance. *International Journal of Economics and Finance, 8*(2), 70-80. doi:10.5539/ijef.v8n2p70

Karamelikli, H. (2016b). Türkiye'nin dış ticaret dengesinde J-eğrisi etkisi [J-curve effect on Turkey's foreign trade balance]. *İnsan ve Toplum Bilimleri Araştırmaları Dergisi, 5*(3), 389-402. doi:10.15869/itobiad.16089

Kemeç, A. & Kösekahyaoğlu, L. (2015). J eğrisi analizi ve Türkiye üzerine bir uygulama [J curve analysis and an application on Turkey]. *Uluslararası İktisadi ve İdari Bilimler Dergisi, 1*(2), 1-29. doi: https://dergipark.org.tr/tr/pub/uiibd/issue/21612/232120

Kılıç, R., Özbek, R. & Çifçi, İ. (2018). Türkiye için J-eğrisi hipotezinin geçerliliği: ARDL sınır testi yaklaşımı [Validity of the J-curve hypothesis for Turkey: ARDL bound test approach]. *International Journal of Disciplines in Economics and Administrative Sciences Studies, 4*(7), 112-128. doi:10.26728/ideas.81

Kopuk, E. & Beşer, M.K. (2020, September). *Is J-curve hypothesis valid in the Turkey manufacturing industry? Bound test approach [Abstract].* Paper Presented at the International Conference on Economics, Eskisehir Osmangazi University, Eskisehir. Access address: https://2020.econtr.org/

Küçüksoy, N. & Akkoç, U. (2020). Türkiye ile Çin ikili ticaretinde J eğrisi: NARDL yaklaşımı [J-curve in bilateral trade between Turkey and China: NARDL approach]. *Ekonomi, Politika ve Finans Araştırmaları Dergisi, 5*(2), 190-209. doi:10.30784/epfad.732614

Lal, A.K. & Lowinger, T.C. (2002). The J-curve: Evidence from East Asia. *Journal of Economic Integration, 17*(2), 397-415. doi:10.11130/jei.2002.17.2.397

Magee, S.P. (1973). Currency contracts, pass-through, and devaluation. *Brookings Papers on Economic Activity, 4*(1), 303-325. doi:10.2307/2534091

Miles, M.A. (1979). The effects of devaluation on the trade balance and the balance of payments: Some new results. *Journal of Political Economy, 87*(3), 600-620. Access address: https://www.jstor.org/stable/1832025

Mwito, M.M., Mkenda, B.K. & Luvanda, E. (2021). The asymmetric J-curve phenomenon: Kenya versus her trading partners. *Central Bank Review, 21*(1), 25-34. doi:10.1016/j.cbrev.2020.09.001

Nusair, S.A. (2017). The J-curve phenomenon in European transition economies: A nonlinear ARDL approach. *International Review of Applied Economics, 31*(1), 1-27. doi:10.1080/02692171.2016.1214109

Peker, O. (2008). Reel döviz kurunun ticaret dengesi üzerindeki etkileri: Türkiye örneği [Effects of real exchange rate on trade balance: The case of Turkey]. *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 22*(2), 33-43. Access address: https://dergipark.org.tr/tr/pub/atauniiibd/issue/2694/35458

Pirimbaev, J. & Oskonbaeva, Z. (2015). Kırgızistan dış ticaret dengesinin belirleyicileri [Determinants of Kyrgyzstan's trade balance]. *Sosyoekonomi, 23*(25), 79-92. doi:10.17233/se.14363

Ramzan, I. (2021). U.S.-Turkey commodity trade and J-curve phenomenon: Evidence from 23 industries. *Journal of Emerging Economies and Policy, 6*(2), 15-23. Access address: https://dergipark.org.tr/en/pub/joeep/issue/60720/851736

Shahbaz, M., Jalil, A. & Islam, F. (2010). Real exchange rate changes and trade balance in Pakistan: A revisit. *Munich Personal RePEc Archive (MPRA),* No: 27631. Access address: https://mpra.ub.uni-muenchen.de/27631/

TCMB (2020). Elektronik Veri Dağıtım Sistemi. Access address: https://evds2.tcmb.gov.tr

Toda, H.Y. & Yamamoto, T. (1995). Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics, 66* (1-2), 225-250. doi:10.1016/0304-4076(94)01616-8

Uslu, H. (2018). Marshall-Lerner koşulu ve J eğrisi hipotezinin geçerliliği: Farklı gelir grubu ülkeleri için karşılaştırmalı bir analiz [Validity of Marshall-Lerner condition and J-curve hypothesis: A comparative analysis for countries in different income groups]. *International Journal of Academic Value Studies, 4*(20), 550-561. doi:10.23929/javs.787

Ünal, A. (2021). İkili dış ticaret dengesi ve reel döviz kuru ilişkisi: Türkiye-Rusya örneği [Bilateral trade balance and real exchange rate relationship: The Case of Turkey-Russia]. *Ömer Halisdemir Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 14*(2), 542-558. doi:10.25287/ohuiibf.736785

Vergil, H. & Erdoğan, S. (2009). Döviz kuru-ticaret dengesi ilişkisi: Türkiye örneği [Exchange rate-trade balance relationship: The case of Turkey]. *Uluslararası Yönetim İktisat ve İşletme Dergisi, 5*(9), 35-57. Access address: https://hdl.handle.net/20.500.12628/1025

Yılancı, V. & Bozoklu, Ş. (2014). Türk sermaye piyasasında fiyat ve işlem hacmi ilişkisi: Zamanla değişen asimetrik nedensellik analizi [Price and trade volume relationship in Turkish stock market: A time-varying asymmetric causality analysis]. *Ege Akademik Bakış, 14*(2), 211-220. doi:10.21121/eab.2014218052

Yuen-Ling, N., Wai-Mun, H. & Geoi-Mei, T. (2008). Real exchange rate and trade balance relationship: An empirical study on Malaysia. *International Journal of Business and Management, 3*(8), 130-137. doi:10.5539/ijbm.v3n8p130

Zhang, Z. (1996). The exchange value of the renminbi and China's balance of trade: An empirical study. *NBER Working Paper,* No: 5771. Access address: https://www.nber.org/system/files/working_papers/w5771/w5771.pdf

Zivot, E. & Andrews, D.W.K. (1992). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business and Economic Statistics, 10*(3), 251-270. Access address: https://www.jstor.org/stable/1391541