Theoretical and Applied Economics
Volume XXIV (2017), No. 2(611), Summer, pp. 221-236

An examination of bilateral J-curve: Evidence from Turkey and her 20 major trading partners

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Abstract. *There are two methods to determine the impact of real exchange rate on balance of foreign trade. While previous studies, which aim to uncover the nexus between foreign balance and real exchange rate, use foreign trade statistics to measure the volume of foreign trade, some other recent studies utilize bilateral trade statistics. By following current literature, this study draws from the model of Rose and Yellen (1989) and analyzes the relationship between the volume of bilateral foreign trade and bilateral real exchange rate in Turkey and her 20 major trading partners for the period from 1995 to 2015. To this purpose, the presence of cross-sectional dependence among the countries was investigated, and long-term coefficients for each country were obtained with the Mean Group Estimator (MG) method developed by Pesaran and Smith (1995). In conclusion, the findings revealed that bilateral real exchange rate has a statistically significant negative effect on the bilateral foreign trade balance in 10 out of 20 countries in the panel. This negative relationship means that depreciation of the Turkish Lira (TL) against the currency of trading partners improves bilateral foreign balance, and thus, the J-curve effect in these countries is verified. Moreover, Canning and Pedroni (2008) panel causality test results indicate that bilateral real exchange rates cause bilateral foreign trade balance in Turkey with her 14 trading partners.*

Keywords: bilateral J-curve, bilateral foreign trade, bilateral real exchange rate, panel co-integration, Canning and Pedroni (2008) panel causality test.

JEL Classification: F14, F31, C33, F41.

Introduction

The exchange rate system in a country informs us about the economic agents that determine the value of the national currency against foreign currencies. Exchange rates are determined by economic actors in flexible exchange rate system and determined by monetary authorities in fixed exchange rate system. However, despite the flexible exchange rate system, it is observed an intervention in the foreign exchange market to prevent fluctuations and to assure stability. The value of national currency affects many of the main economic variables such as income level, interest rate, unemployment rate and foreign trade balance. Especially, the response of foreign trade balance to exchange rates is one of the most researched economic relationships by both scholars and policy makers.

In outward-oriented economies, import and export potential of a country are among the indicative parameters of national income and domestic output level. In this respect, while setting targets for a country's national income and trade volume, it is of importance to analyze how the changes in exchange rates may respond to trade balance. However, it cannot be said that there is consensus on the long-term effects that the changes in exchange rates can create (Hacker and Hatemi-J, 2004: 778). Depreciation of the national currency against foreign currencies makes the imported goods more expensive and the domestically-produced goods cheaper for foreigners. As a result of depreciation, import decreases and export increases, and thus, a recovery in the foreign trade balance is expected. However, there are several factors prevent simultaneous effect of exchange rate change on the foreign trade balance. The reaction of economic actors to price changes, the exchange rate system in a country and foreign trade policy, the composition of the foreign trade, and the treaties among stakeholders may prevent the emergence of the expected improvement in the foreign trade balance in the short term (Lal and Lowinger, 2002: 400-401). Thus, depreciation or devaluation lead to a further deterioration in the foreign trade balance in the short term, and the expected recovery effect on foreign balance is to be observed in the long-run. In time, the balance of foreign trade follows a path that is similar to the letter J, so it is known as J curve effect (Krugman and Obstfeld, 2003: 464).

Two different methods have so far been used in the empirical studies that have been conducted to examine the validity of Marshall-Lerner condition and J-curve, which shed light on the relationship between real exchange rate and foreign trade balance. Although some of these studies make use of the aggregate data on foreign trade to measure foreign trade balance, more recent studies benefit from the international bilateral foreign trade data. This study followed the most current literature by using the Rose and Yellen (1989) model and conducted an econometric analysis of bilateral foreign trade and bilateral real exchange rate data of Turkey's 20 trading partners. The 20 countries in the study constitute 70% of total import and 60% of total export in Turkey since 2015. Total export and import figures of these countries are given in Table 1 to show their importance in Turkey's foreign trade:

Table 1. *Turkey's trade with major trading partners in 2015 (millions of US dollars)*

Trading partner	Imports	Exports	Trading partner	Imports	Exports
Austria	1,568	1,025	Japan	3,140	335
Belgium	3,147	2,558	Korea	7,058	569
China	24,874	2,415	Netherlands	2,915	3,155
Egypt	1,216	3,125	Poland	2,978	2,329
France	7,598	5,850	Russia	20,402	3,589
Germany	21,352	13,418	Spain	5,589	4,743
India	5,614	650	Switzerland	2,445	5,681
Iran	6,096	3,664	UAE	3,448	4,681
Israel	1,673	2,698	United Kingdom	5,541	10,556
Italy	10,642	6,888	United States	11,128	6,408

Source: Direction of Trade Statistics (DOTS) 2015, IMF; TURKSTAT Foreign Trade Statistics 2015.

This study examines the effect of bilateral foreign exchange rates on bilateral foreign trade balance of Turkey's most important 20 trading partners. In other words, the validity of J-curve effect is investigated focusing specifically on Turkey. To this end, first, the presence of cross-sectional dependence among the countries was investigated. As the findings showed cross-sectional independence, the presence of a long-term relationship was examined with the Pedroni (1999) and Kao (1999) first-generation co-integration tests, and long-term coefficients were obtained with Pesaran and Smith (1995) MG parameter estimator. Finally, causality relationships among the variables were determined using the Canning and Pedroni (2008) panel causality test.

1. Theoretical framework on the relationship between foreign trade balance and real exchange rate

Import and export are the most important commercial activities that provide the connection between country and the rest of the world. On the condition that domestic and foreign prices are fixed, a country's total import volume is positively correlated with country's income level, while it is negatively correlated with the real exchange rate. On the other hand, there is a positive relationship between a country's total export, and the income level of trading partners and real exchange rate. In this respect, the balance of foreign trade which emerges due to the difference between total export and import has a strong relationship with the real exchange rate. An upward movement in the real exchange rate, or in other words, depreciation of the national currency increases export and competitiveness of the country and import is affected negatively (Bocutoğlu, 2014: 421-428).

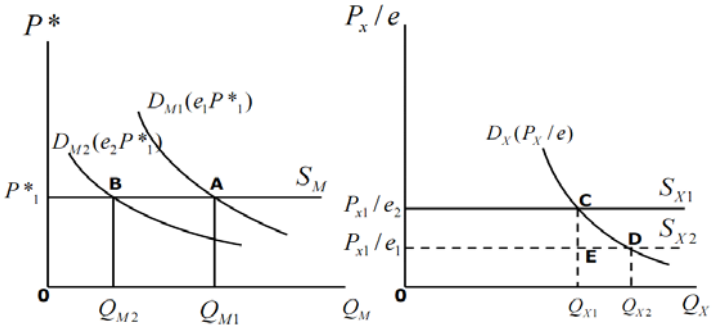
Increase or decrease in exchange rates may have different definitions based on the exchange rate system used in the country. In a country where the flexible exchange rate system is adopted, an increase in exchange rate is named as depreciation, while in country using the fixed exchange rate system, such an implementation by an administrative decision is named as devaluation. On the other hand, when exchange rates decrease in flexible exchange rate system, the situation is considered as appreciation. When fixed exchange rate system is adopted with the exchange rates declining, the situation is named as revaluation (Bekaert and Hodrick, 2012: 61-62). No matter which exchange rate system is used, the reaction of the balance of foreign trade to depreciation is investigated

within the framework of Marshall-Lerner analysis named after Alfred Marshall and Abba Lerner, who first revealed this interaction (Krugman and Obstfeld, 2003: 477).

Alfred Marshall and Abba Lerner based their explanations regarding how the increase and decrease in exchange rates can recreate foreign trade balance on the price elasticity of imported and exported goods. Graph 1 shows the effect of exchange rate changes on import supply and demand and tries to make the issue clearer.

The left and right sections of Graph 1 display drawings regarding import and export functions, respectively. (P^*) in the vertical axis of the first graph that shows import supply and demand represents the price of the imported good in terms of foreign currency, while (Q_M) in the horizontal axis represents the quantity of import. The reason why the S_M line, which shows import supply, is parallel to the horizontal axis is that in this model foreign countries' meeting of the demand constantly at a specified price $(P_1^* \, in \, the \, graph)$, in other words, supply elasticity is infinite. D_M curve, which is a negatively sloped curve, indicates that an increase in the price of foreign goods decreases import. An increase in exchange rate when the price of the imported goods in terms of foreign currency is fixed means that the relevant good will be more expensive in national currency; thus, import demand curve will shift to the left, and the quantity of import will decrease. When import demand decreases because of the increase in exchange rate, the amount of import will drop from Q_{M1} to Q_{M2}.

Graph 1. *The effect of real exchange rate movement on balance of foreign trade*



Source: Ünsal, 2005: 572.

(P_X/e) in the vertical axis of the graph on the right which displays export supply and demand functions show the price of the exported good in foreign currency, and (Q_X) in the horizontal axis illustrates the amount of export. Similar to import supply function, export supply function (S_X) has infinite elasticity as manufacturers continually meet foreign demand at a specified price. Negatively sloped export demand curve (D_X) indicates that a decrease in the price of the exported good in foreign currency increases the amount of export. Any incidence that leads to an increase in the exchange rate is to make the price of domestic goods cheaper compared to foreign competitors, and the price will drop to P_{X1}/e_1, while the amount of export will increase from Q_{X1} to Q_{X2} (Ünsal, 2005: 573-575).

These explanations indicate that in an economy with flexible exchange rate system, two effects, namely price effect and volume effect, emerge on export revenue as a result of depreciation of the national currency. As an increase in the exchange rate is to make the foreign goods cheaper for foreigners due to the new exchange rate, an increase in foreign demand is expected. Likewise, as increasing exchange rate is to make the foreign goods expensive keeping the initial prices fixed, foreign demand will decrease, and import volume will reduce. When the amount of import decreases and export volume increases, foreign trade balance is improved, and thus positive volume effect is observed (Krugman and Obstfeld, 2003: 436).

Despite this positive effect on the amount, the total export revenue of the country will decrease as the price of the exported goods becomes cheaper in terms of foreign currency as a result of the increase in exchange rates. In this case, the time path of foreign trade balance will depend on the reaction that foreigners will give to the increasing exchange rate, in other words, on the price elasticity of demand for exported goods. If the decrease in the price of the exported good in foreign currency due to the increasing exchange rate leads to a further amount increase in foreign demand, in other words, if the demand elasticity of the exported good is higher than 1, the depreciation is to affect foreign trade balance positively. When the demand elasticity of the exported good is low, foreign trade balance may again be affected positively if the price elasticity of the imported goods is higher than 1. In this case, an increase in the price of the imported goods reduces import more than export, and so, foreign trade balance will be improved (Ünsal, 2005: 575).

When the volume and price effects that yield contradictory results are examined together, it can be said that it is impossible to make a deduction about the effect of increasing exchange rates on a country's foreign exchange reserves. Although foreign exchange revenue of a country will decrease as a result of the positive volume effect created by the increasing exchange rate, it may be impossible to reach a definite conclusion about the country's foreign exchange revenue as the result of price effect is not known exactly (Seyidoğlu, 2015: 494). To improve foreign trade balance, the sum of coefficients of domestic demand elasticity of imported goods and foreign demand elasticity of exported goods must be higher than 1 with the assumption that supply elasticity of imported and exported goods is infinite:

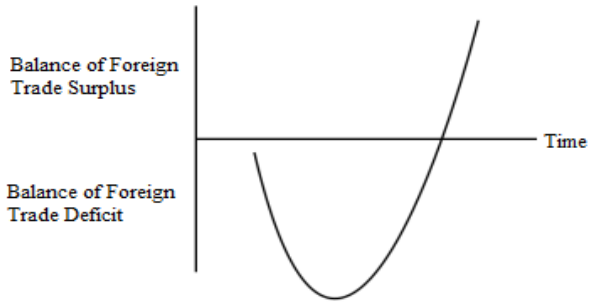
$$\eta_x + \eta_M > 1$$

In the equation, η_x represents foreign demand elasticity of exported goods, while η_M represents domestic demand elasticity of imported goods (Karluk, 2013: 662-663). According to this criterion known as Marshall-Lerner condition, the higher the sum of foreign demand elasticity of exported goods and domestic demand elasticity of imported goods is than 1, improvement of foreign trade balance will be. However, to maintain the validity of this condition, supply elasticity must be infinite; in other words, there must be no flaws in the production of imported and exported goods (Rose and Yellen, 1989: 67; Seyidoğlu, 2015: 488).

2. Foreign trade balance after the changes in exchange rates and the J-curve

When the findings of the empirical studies conducted to test the validity of Marshall-Lerner condition are examined, it is seen that foreign balance deteriorate following currency devaluation in the short term instead of getting better but improve only after a period. The graph of the foreign trade balance following the depreciation in the national currency resembles the letter J, and thus, it is known as J-curve (Krugman and Obstfeld, 2003: 464). According to J curve analysis, improvement in foreign trade balance after depreciation of national currency can only be observed after a certain delay (Gandolfo, 2002: 126-127).

Graph 2. *The effect of currency depreciation on the trade balance and J-curve effect*



Source: Ünsal, 2005: 577.

As opposed to the prediction that Marshall-Lerner made based on elasticity coefficients, the unexpected effect on foreign trade balance may be associated with the fact that short-term elasticity coefficients are generally smaller than the long-term ones (Bahmani-Oskooee and Ratha, 2004: 1377). The reason behind the deterioration in the foreign trade balance in a short-term following the depreciation of national currency was explored by Magee (1973), who mainly drew attention to the importance of delayed effects. In his study, Magee (1973) highlights that it takes a time to adjust import and export to the new exchange rate; and thus, foreign balance is initially affected negatively as producers and consumers react slowly to the changes in exchange rates.

As Magee (1973) states, this deterioration that is observed in the foreign balance in the short term can be explained regarding both demand and supply. Despite the changes in real exchange rates, purchase price, sale price and the payments will continue to be made according to the rates due to the contracts signed before the changes (Magee, 1973: 305-306). Economic actors have to consider possible future values of exchange rates or the increase or decrease in exchange rates in contracts in order not to lose income in foreign trade. The exporter chooses to receive payment when her currency gains value, while it is more advantageous for the importer to make payment when her currency loses value. Thus, based on the bargaining power of trading partners, the exchange rate is fixed through the contracts signed before the trade not to be affected by the changes in exchange rate. In this case, the changes in exchange rate, economic activities are maintained according to the ex-rate specified in the contract, and thus, in the short term the increase in the exchange rates deteriorate foreign trade balance rather than improve it

(Bahmani-Oskooee and Ratha, 2004: 1378). Over time, new contracts begin to dominate, and it can be seen an improvement in the balance of trade. In this situation which is called pass-through effect by Magee (1973), a devaluation of national currency increases the domestic prices of imported goods, while the demand is the same. Likewise, although this situation makes export even cheaper in the trading partner country, the amount of demand will not change, and inflow of foreign currency will reduce. This adverse effect observed in import and export prices because it takes time to make adjustments over import and export volumes due to the rigidities in short-term supply and demand is the second reason behind the deterioration in the foreign trade balance in the short term (Gandolfo, 2002: 126-127).

When the change in the prices of imported and exported goods is the same depreciation rate of the national currency, the pass-through effect will be full. On the other hand, when the change in prices is lower than exchange rate change, the pass-through effect will be partial (Seyidoğlu, 2015: 489). Following the short term pass-through effect in prices in which demand is inelastic, the elasticity condition of the Marshall-Lerner will be met, and foreign trade balance will be improved in time. There has not yet been consensus on how long it takes for the expected positive effect of depreciation of national currency on foreign balance to emerge. This period depends on the exchange rate system and foreign trade policy in the country, the reaction that economic actors will give to price changes, and the term of the contract (Lal and Lowinger, 2002: 411). However, empirical studies have shown that balance of foreign trade worsens almost two years after depreciation and the positive effect will be observed only after this period (Seyidoğlu, 2015: 490-491).

Junz and Rhomberg (1973) point to five possible lags in addition to those specified by Magee (1973). One of these, recognition lag, emerges when it takes time for buyers and sellers to realize the changing competition conditions. As dissemination of information changes based on language and distance, the delay time may be longer in international trade. Moreover, in connection with the establishment of new business networks and the placement of new orders, delivery lag is also expected in addition to the decision lag. Purchasing of new materials and equipment (replacement lag) and production lag are other delay types (Junz and Rhomberg, 1973: 413).

3. Literature review

Most of the empirical research in the past, the validity of Marshall-Lerner condition was tested by calculating the sum of price elasticities of import and export. When the literature is examined, it is seen that in addition to these studies based on elasticities, there is also a significant number of studies that deal with the real exchange rate and foreign trade balance. The table below provides a summary of studies that focused on the relationship between the volume of the bilateral foreign trade between Turkey and her trading partners and bilateral exchange rate.

Table 2. *Studies in the literature and the main findings*

Authors	Country group	Time period	Method	Findings
Kimbugwe (2006)	Turkey and her 9 trading partners	1960-2000	ARDL, Johansen Co-integration	Although the results obtained using aggregate data show that Marshall-Lerner condition is valid, the Bilateral J-curve hypothesis was not verified.
Neyaptı, Taşkın and Üngör (2007)	Turkey and her 150 trading partners	1980-2001	Panel regression	Following the Customs Union process, the effect of real exchange rate on Turkey's export volume has increased even further. Appreciation of Turkish Lira leads to increase in import particularly from EU countries.
Halıcıoğlu (2008)	Turkey and her 13 trading partners	1985.1-2005-4	ARDL	None of the trading partners experienced J-curve effect.
Uz (2010)	Turkey's most significant 13 trading partners	1982.2-2007.4	OLS, FMOLS, DOLS, ARDL, Johansen(1988) multivariate maximum-likelihood methods	Appreciation or depreciation of Turkish Lira has a limited effect on the trade balance. The Marshall-Lerner condition is valid for only Canada, South Korea and the UK among 13 countries.
Demirtaş (2014)	Bilateral trade between Turkey and Germany	2002M01-2012M08	ARDL	Depreciation of Turkish Lira affects trade with Germany positively in both the short and the long run. While these findings confirm that J-curve effect is valid in the long term, it is not compatible with the effect expected in the short-run.
Çulha and Kalafatçılar (2014)	81 countries (7 from the Eurozone, 17 from the Middle East Africa region, 16 developed and 31 developing countries)	2003.1-2013.2	VAR analysis	While the demand conditions are the determinant factors in Turkey's export with developed countries, mostly the changes in real exchange rates are influential on the export to the Middle East and Africa.
Aydın, Başkaya and Demiroğlu (2015)	Turkey and her 91 trading partners	1994-2012	Panel regression	1% of appreciation in the currencies of trading partners increases the rate of export to import from 0.94% to 1.45%.

4. Variables and data sources used in econometric applications

This study analyzes how the foreign trade balance between Turkey and her most important 20 trading partners changes with the exchange rate movements. To this end, econometric analyses were conducted with Eviews 8 and Gauss 10 software programs using data for the period between 1995 and 2015. The study sample is composed of Austria, Belgium, China, Egypt, France, Germany, India, Iran, Israel, Italy, Japan, South Korea, the Netherlands, Poland, Russia, Spain, Switzerland, United Arab Emirates, the United Kingdom and the USA. To determine the bilateral exchange rate changes on bilateral trade of Turkey with her 20 trading partners, empirical model was followed in the studies of Rose and Yellen (1989: 55), Lal and Lowinger (2002: 402), Bahmani-Oskooee, Economidou and Goswami (2006), and Bahmani-Oskooee and Wang (2006: 326). The model to be estimated is given in Equation 1:

$$logTB_{j,t} = \alpha_0 + \alpha_1 logY_{t,t} + \alpha_2 logYF_{j,t} + \alpha_3 logRER_{j,t} + u_t \quad (1)$$

In this equation, α_0 represents the constant term, $\alpha_1, \alpha_2, \alpha_3$, indicate long-term coefficient for each variable and u_t shows the error term. All the variables were subjected to logarithmic transformation and estimations were done with the logarithmic model.

Although foreign trade balance is the difference between export and import volumes of the country, another calculation is used to make unit-free measure bilateral trade balance and to make a logarithmic transformation. As in the studies of Rose and Yellen (1989), Lal and Lowinger (2002), Bahmani-Oskooee, Economidou and Goswami (2006) Bahmani-Oskooee and Wang (2006), Bahmani-Oskooee and Goswami (2003), Halıcıoğlu (2008) and Kimbugwe (2006), this variable which is often used in the recent literature represents the ratio of the import from country j to country t to the export to country j from country t.

$logTB_{j,t}$ variable in Eq. (1) represents bilateral trade balance between Turkey and her foreign trade partner country j. To calculate this variable, the volume of import from country j to Turkey was proportioned to the volume of export from Turkey to country j. In addition to trade balance variable, $logY_{t,t}$ in Eq. (1) represents Turkey's real GDP level and $logYF_{j,t}$ show the real GDP level of foreign trade partner country j.

Table 3. *Definition of the variables and data sources*

Variable	Definition of the Variables	Data Source
$logTB_{j,t}$	Balance of bilateral foreign trade: the ratio of the import from country j to Turkey to the export to country j from Turkey $(M/X)_{j,t}$	The Direction of Trade Statistics (DOTS), International Monetary Fund.
$logY_{t,t}$	GDP in Turkey (constant 2010 US$)	World Bank, WDI.
$logYF_{j,t}$	GDP level of trading partner country j (constant 2010 US$)	World Bank, Global Economic Monitor (GEM) and IMF, International Financial Statistics.
$logRER_{j,t}$	Bilateral Real Effective Exchange Rate between Turkey and trading partner's currency: $logRER_{j,t}$ was calculated as $[(P_t * NER)/P_j]$ where P_t is CPI in Turkey, $P_j$is CPI in country j and NER bilateral nominal exchange rate of Turkey with trading partner j)	This variable was constructed by using World Bank Global Economic Monitor (GEM) and CBRT (The Central Bank of the Republic of Turkey) exchange rate statistics.

As import of the country is to rise with the increase in income level, α_1 coefficient of $logY_{t,t}$ is expected to be positive. However, GDP level of the country may have negative effect on import, if it supports import substitution industrialization and thus imported goods start to be produced at home. Likewise, α_2 coefficient of $logY_{j,t}$, which represents the GDP level of the trading partner can also be negative or positive (Bahmani- Oskooee and Wang, 2006: 326). $logRER_{j,t}$ represents bilateral real exchange rate between Turkish Lira and foreign currency of trading partner country j. Since $logTB_{j,t}$ is calculated by the ratio of import from trading partner country j to Turkey and export to the same country from Turkey, negative coefficient of α_3 indicates that the increase in the bilateral real exchange rate improves the bilateral foreign balance (Lal and Lowinger, 2002: 408).

5. Methodology and empirical findings

The presence of cross-sectional dependence among the countries in the panel has great importance in choosing the methods to be used in an econometric analysis. The findings that do not into consideration presence of cross-sectional dependence will be spurious regressions. Another pre-test that needs to be carried out in addition to cross-sectional dependence in panel data analysis is homogeneity test. To this end, Pesaran, Ullah and Yamagata (2008) bias-adjusted CD test was used to determine the presence of

cross-sectional dependence among 20 countries for the period between 1995 and 2015, and Pesaran and Yamagata (2008) Delta test ($\tilde{\Delta}$) was used to check the homogeneity structure of the panel.

Pesaran, Ullah and Yamagata (2008) developed the bias-adjusted CD test to determine whether a shock in a country will affect other countries. This method can be used in large panels where there is no limitation on time dimension and cross-sectional dimension and where both take high values. The calculation regarding this method is made through the equation given in Eq. (2) (Pesaran et al., 2008: 108).

$$LM_{adj} = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \frac{(T-k)\hat{\rho}_{ij}^2 - \mu_{Tij}}{\vartheta_{Tij}} \quad (2)$$

Another pre-test that needs to be conducted before the panel data analysis, Pesaran and Yamagata (2008) delta test ($\tilde{\Delta}$), determines whether the panel has a homogeneous or a heterogeneous structure. When the number of countries in the panel is high, $\tilde{\Delta}$ statistics, and when the number is few, $\tilde{\Delta}_{adj.}$ statistics yield more meaningful results. When the probability value of $\tilde{\Delta}$, which is calculated with Eq. (3) or $\tilde{\Delta}_{adj.}$ calculated with Eq. (4) is at 95% significance level and higher than 0.05, it means that slope coefficients of the panel are homogeneous; in other words, the countries in the panel have similar structures.

$$\hat{\Delta} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - k}{\sqrt{2k}}\right) \quad (3)$$

$$\tilde{\Delta}_{adj.} = \sqrt{N}\left(\frac{N^{-1}\tilde{S} - E(\tilde{Z}_{iT})}{\sqrt{var\tilde{Z}_{iT}}}\right) \quad (4)$$

Table 4 shows the homogeneity and cross-sectional dependence test results of the sample in this study. Probability statistics must be higher than 0.05 at 95% significance level to be able to accept the null hypothesis in the bias-adjusted CD test and to determine that there is no cross-sectional dependence among the countries in the panel. The findings in Table 4 indicate that the null hypothesis is accepted and there is cross-sectional independence among the countries in this study. Pesaran and Yamagata (2008) $\tilde{\Delta}$ and $\tilde{\Delta}_{adj.}$ statistics have shown that the null hypothesis will be accepted and the panel has a similar structure. According to these results, in the following stages of the study, analyses continued with first generation methods, which take homogeneous structure into account and which function under cross-sectional independence.

Table 4. *Cross-sectional dependency test results*

	Statistics	**Probability**
Bias-adjusted CD test (Pesaran, Ullah and Yamagata , 2008)	-1.202	0.88
$\tilde{\Delta}$ (Pesaran and Yamagata, 2008)	-3.724	0.99
$\tilde{\Delta}_{adj.}$ (Pesaran and Yamagata, 2008)	-4.236	0.99

While some of the first generation panel unit root methods take homogeneity of coefficients of countries, some yield results for the panel with a heterogeneous structure.

As the Pesaran and Yamagata (2008) Delta test results of this study indicated that the countries in the panel have homogeneous structure, unit root test for the variables was done with Levin, Lin and Chu (2002), Breitung (2000) and Hadri (2000) tests, which propose a hypothesis on homogeneity. Levin, Lin and Chu (2002) and Breitung (2000) unit root tests suggest that in the null hypothesis series include unit root, while Hadri (2000) unit root test puts forward that in the null hypothesis the series is stationary. Thus, to determine that a series is stationary according to Levin, Lin and Chu (2002) and Breitung (2000) methods, the probability value of the variable must be lower than 0.01 at 99% significance level. According to Hadri (2000) method, on the other hand, this value must be higher than 0.01.

Table 5. *Unit root tests results*

Variable	Levin, Lin and Chu (2002)		Breitung (2000)		Hadri (2000)	
	Level	First Diff.	Level	First Diff.	Level	First Diff.
$logTB$	-1.12 (0.12)	-5.27 (0.00)	-2.56 (0.01)	-4.43(0.00)	6.48 (0.00)	0.27 (0.39)
$logY$	1.80 (0.96)	-4.82 (0.00)	-9.47 (0.00)	-8.59 (0.00)	13.96 (0.00)	-3.31 (0.99)
$logYF$	-2.95 (0.01)	-7.54 (0.00)	0.82 (0.79)	-6.56 (0.00)	8.63 (0.00)	3.48 (0.01)
$logRER$	-9.92 (0.00)	-5.26 (0.00)	-1.14 (0.12)	-8.33 (0.00)	10.31 (0.00)	1.01 (0.15)

Note: The values in parentheses show probability values. Estimations are made with the inclusion of constant and trend.

Unit root test results for the variables in the long-term equation in Eq. (1) are given in Table 5. According to these results, while bilateral foreign balance $logTB$ and $logYF$ which represents the GDP of trading partner country have unit root at a level value at 99% significance level according to all three methods, they are stationary when the first difference is taken. Although $logY$ which represents the GDP level of Turkey, has unit root at a level according to Levin, Lin and Chu (2002) and Hadri (2000) methods, it is stationary at a level according to Breitung (2000) method. Although $logRER$ which represents bilateral real exchange rate, has unit root at a level according to Breitung (2000) and Hadri (2000) methods, it is stationary at a level according to Levin, Lin and Chu (2002) method. Based on these results it was determined that although each variable has unit root at a level according to at least two of the three methods, they are stationary when the first difference is taken.

To test the presence of a long-term relationship among the variables, Pedroni (1999) and Kao (1999) co-integration methods under cross-sectional independence were used. In Pedroni method, the pre-condition is that each variable must be stationary at first difference; in other words, they must be I(1). The unit root tests revealed that all the variables in the study are stationary at first difference according to at least two of the three methods. This method checks that according to the null hypothesis, there is not a long-term relationship between variables, while the alternative hypothesis suggests the opposite. Pedroni (1999) calculates seven statistics with standard normal distribution, four of which are within dimension (panel v, panel p, panel PP and panel ADF-statistic) and three of which are between dimension (Group rho, Group PP and Group ADF).

Table 6. *Pedroni and Kao co-integration tests results*

	Constant		Constant and trend	
	Statistics	**Probability**	**Statistics**	**Probability**
Pedroni(1999)				
Panel v	3.64	0.00	1.98	0.02
Panel rho	-0.00	0.49	2.30	0.98
Panel pp	-3.68	0.00	-2.73	0.00
Panel adf	-4.26	0.00	-4.37	0.00
Group rho	0.23	0.59	2.77	0.99
Group pp	-9.43	0.00	-7.31	0.00
Group adf	-4.54	0.00	-3.34	0.00
Kao (1999)				
ADF Statistics	-3.13	0.00		

Table 6 presents the Pedroni (1999) and Kao (1999) co-integration test results of the constant and constant-trend model. The findings from Pedroni (1999) co-integration analysis show that both constant and constant-trend model rejects the null hypothesis compared to five statistics except for panel-rho and group-rho statistics. The rejection of the null hypothesis suggesting that there is no long-term relationship among the variables verifies that the variables in the long-term equation are co-integrated. Similarly, Kao (1999) co-integration test also shows that the null hypothesis which suggests that no co-integration relationship exists among $logTB, logY, logYF$ ve $logRER$ variables at 99% significance level is rejected.

Long-term coefficients of variables in Eq. (1) are obtained with Mean Group Estimator (MG) developed by Pesaran and Smith (1995). According to the results of the whole panel and achieved through this model, bilateral real exchange rates affect bilateral foreign trade balance negatively at 1% significance level. This result indicates that depreciation of Turkish Lira has negative effect on the bilateral foreign trade balance, which is calculated as the ratio between import and export (M/X). The negative coefficient of $logTB$ can be interpreted that depreciation in Turkish Lira affects import negatively; export and foreign balance are influenced positively. When coefficients for each country are examined, it is seen that while the bilateral real exchange rate is negative for 16 countries among the 20 countries in the panel, the results are statistically significant for ten countries. The appreciation of currencies of Belgium, Egypt, Germany, India, Israel, Italy, Japan, Russia, Switzerland and the United Kingdom compared to Turkish Lira reflects positively to Turkey's foreign trade balance with these countries in a statistically significant. Only in the bilateral foreign trade with China, appreciation of Turkish Lira has a positive and meaningful effect.

Table 7. *Panel mean group estimation results for 20 countries*

Country	$\boldsymbol{logY}$	$\boldsymbol{logYF}$	$\boldsymbol{logRER}$
Austria	0.787	-3.326*	-0.029
Belgium	-0.823**	2.179	-0.276***
China	11.62***	-5.435***	0.436**
Egypt	1.589	-2.278	-0.561***
France	0.678*	-4.523**	-0.113
Germany	1.275***	-2.600***	-0.111***
India	-4.517**	2.553**	-0.644***
Iran	-1.777	0.521	-0.072
Israel	-3.101***	5.178***	-0.365***
Italy	-0.104	-5.064***	-0.221***

Country	$logY$	$logYF$	$logRER$
Japan	0.039*	-3.248	-0.167*
Korea	3.104	-5.499**	0.084
Netherlands	-0.138	0.742	-0.145
Poland	-0.835	1.780	-0.085
Russia	-4.533***	3.918***	-0.810***
Spain	0.779**	-2.700***	-0.157
Switzerland	-1.508	-2.354	-0.756**
UAE	4.759	-2.557	0.092
United Kingdom	0.142	-3.053**	-0.185***
USA	4.461***	-7.471	0.078
PANEL	*0.594*	*-1.662***	*-0.200****

Note: *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

The effect of Turkey's income level on bilateral foreign balance, which is calculated as the import-export ratio is given in the second column of Table 7. The increase in Turkey's income level affects bilateral foreign balance negatively in 4 of the 20 countries in the sample, while it affects the bilateral foreign balance positively in 5 countries in a statistically significant. The positive results mean that the increase in GDP of Turkey enhances the import from the other country, and foreign balance calculated as import-export ratio increases as well. Thus, the positive relationship between $logY$ and $logTB$ variables indicates that the growth in Turkey's income level worsens the bilateral foreign balance between Turkey and her trading partners. The results in Table 7 reveals that the increase in Turkey's income level leads to more import from China, France, Germany, Japan, Spain and the USA than export to them.

The third column in Table 7 displays coefficients of the relationship between the $logYF$ representing the income level of Turkey's trading partners and the bilateral trade balance. According to these results, the income level of trading partners has a significant negative effect on foreign balance variable in 8 of the 20 countries in the sample, while it has a significant positive effect on three countries. The negative relationship indicates that the increase in the income level of trading partners also increases Turkey's export and bilateral foreign balance calculated as import-export ratio worsens.

After obtaining the long-term parameter coefficients for each country, causality analysis was conducted to search for the presence of causality relationship among the variables. Possible causality relationships from bilateral real exchange rate to bilateral foreign balance and from bilateral foreign balance to bilateral real exchange rate were investigated using Canning and Pedroni (2008) causality test. Results for each country are given in Table 8.

Table 8. *Canning and Pedroni (2008) causality test results*

Country	$logRER \rightarrow logTB$	Probability	$logTB \rightarrow logRER$	Probability
Austria	-1.89**	0.03	2.40*	0.09
Belgium	-1.39*	0.07	0.77	0.34
China	-1.39**	0.01	0.48*	0.10
Egypt	-1.36**	0.01	0.40**	0.05
France	-1.48***	0.00	1.01	0.14
Germany	-0.90**	0.01	1.30**	0.04
India	-1.01**	0.05	0.05	0.73
Iran	-0.61	0.22	0.32	0.57
Israel	-0.52	0.26	0.13	0.73

Country	$logRER \rightarrow logTB$	Probability	$logTB \rightarrow logRER$	Probability
Italy	-0.57**	0.05	0.16	0.49
Japan	-0.66	0.13	0.36	0.43
Korea	-0.46	0.19	0.05	0.78
Netherlands	-0.58**	0.03	0.12	0.66
Poland	-1.52***	0.00	070**	0.04
Russia	-0.89	0.03	0.17	0.58
Spain	-0.60**	0.04	0.31	0.16
Switzerland	-0.67*	0.10	-0.08	0.41
UAE	-0.34	0.23	0.11	0.28
United Kingdom	-1.02*	0.09	-0.33	0.62
USA	-0.24**	0.05	0.18*	0.10

Note: ***, ** and * determine significance at 1%, 5% and 10% level respectively.

According to the Lambda-Pearson statistics obtained from the Canning and Pedroni (2008) causality test, to reach causality from the independent variable to the dependent variable, probability values must be lower than 0.01, 0.05 and 0.10 at 99, 95 and 90% significance level, respectively. In this respect, based on the results in Table 8, it can be stated that bilateral real exchange rate cause bilateral foreign trade balance in 14 of 20 trading partners of Turkey. It is seen that causality relationship is at 99% significance level in France and Poland; at 95% significance level in Austria, China, Egypt, Germany, India, Italy, the Netherlands, Spain, and the USA; and at 90% significance level in Belgium, Switzerland, and the United Kingdom.

When the results obtained based on the hypothesis that the causality relationship is from bilateral foreign balance to bilateral real exchange rate are evaluated, it was observed that there is causality relationship in 5 of the 20 countries in the sample. Bilateral foreign trade causes bilateral real exchange rate in Germany, Egypt and Poland at 95% significance level, and in Austria, the USA and China at 90% significance level.

Conclusion

The exchange rate system in a country informs us about the economic actors that will determine the value of a national currency against other foreign currencies. While governments make this task in the fixed rate system, exchange rates are determined by the market forces in the presence of a floating exchange rate system. However, despite the floating exchange rate system, it is observed that in practice there are occasional interventions in the foreign exchange market to ensure stability. Moreover, excessive depreciation or appreciation of the national currency against foreign currencies affects country's foreign trade balance as well.

This study examines the validity of J-curve by searching for the relationship between bilateral foreign trade balance and bilateral real exchange rates within the context of Turkey and her 20 trading partners. In this respect, it was first investigated whether a shock in one country in the panel affects the other countries via the cross-sectional dependence test. Accordingly, based on the results obtained, unit root, co-integration, coefficient estimator and causality methods were determined. As the cross-sectional dependence test results show that there is cross-sectional independence among the countries in the panel, the presence of a long-term relationship among the variables was

investigated through the first generation Pedroni and Kao co-integration methods. All the results obtained from these methods revealed that there is a long-term relationship among the variables, and long-term coefficients for each country were obtained with the Mean Group Estimator (MG) method developed by Pesaran and Smith (1995). The results from the Mean Group Estimator method indicate that bilateral real exchange rate has a statistically significant negative effect on 10 of the 20 countries in the panel. This negative interaction means that the depreciation of Turkish Lira against the currency of the trading partner affects bilateral foreign balance calculated as import-export ratio positively, and thus, J-curve hypothesis is accepted in these countries. On the other hand, the results of the Canning and Pedroni (2008) causality test, which is conducted to determine the causality relationship among the variables, show that one-way causality exists from bilateral real exchange rate to bilateral foreign trade balance in 14 trading partners of Turkey.

Acknowledgements

This study benefited from a research project supported by Necmettin Erbakan University, BAP Coordination Office with 141221002 project number.

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