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Short and Long Run Effects of Exchange Rate on Trade Balance: An Application of Bound Test

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Abstract: By using bounds test approach to cointegration and quarterly data during time period 2001q1-2011q4, the present paper has analyzed the short run and long run effects of exchange rate on trade balance between Iran and South Korea. The results obtained show that the hypothesis which is the devaluation positively affects on trade balance between Iran and the selected country is confirmed in the long run. Also, the hypothesis which is the devaluation negatively affects on trade balance in short run is verified. It's mentionable that regarding to *CUSUM* and *CUSUMSQ* tests, all coefficients are stable.

JEL Classification: F14 ‘ F17 ‘ F31 ‘ F32
Key words: Exchange rates · Bilateral trade balance · Bounds test · Trade balance · Iran · South korea

INTRODUCTION

Exchange rate devaluation is one of the adjustment and stabilization policies for improving trade balance and strengthening international competitiveness. Also, exchange rate is considered as one of the essential matters for developing countries, since it's linked these economies to the world.

One of the important reasons of being Iranian non oil trade balance deficit in recent years is due to its single-product and oil based economy and also some import favored policies. Regarding to the affecting of trade balance on economic growth and the role of the exchange rate policy in this relation, this study has examined a hypothesis which is the devaluation positively affects on trade balance between Iran and South Korea.

To test these hypotheses we've used an Auto Regressive Distribution Lags (ARDL). Data are collected through domestic and international organizations such as custom and central bank of Iran and international monetary fund (IMF).

By considering the empirical studies on the topic, we can find two important points. First, there is no certain result about the hypothesis.[1-10] provide no support for the existence of J curve. On the other hand, some studies such as [11-18] have justified the hypothesis). Second, recent empirical studies are differentiated by considering bilateral trade balance.

This paper is organized as follows. After the introduction, in the second section, literature review is presented. The third section is devoted to the methodology and econometric model. In the fourth Section, results are presented.

Literature Review: Despite of dollar devaluation in 1971, the US Trade balance was deteriorated which lead to do researches about why sometimes the devaluation policies don't work. Then, the researchers tried to separate short run effects of devaluation from its long run ones.

It is claimed that the devaluation may improve trade balance only after short run period. Furthermore, the relation between the devaluation and trade balance changes with passing time, so that short run and long run reactions of trade balance are different from each other ([19]).

To determine the long run and short run effects of the devaluation on trade balance, two approaches have been introduced namely Marshal-Lerner and J curve. In the framework of Marshal-Lerner approach, reaction of export and import expenditures to the devaluation depends on elasticity of import and export demand to exchange rate. Specifically, the current account shows normal reaction against the devaluation when we have:

$$\left[\frac{X}{M}\right]\sigma_x - \sigma_m > 1 \tag{1}$$

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where $X(M)$ is export (import). Also, $\sigma_x(\sigma_m)$ is elasticity of import (export) demand respect to exchange rate. By assuming balanced trade ($X = M$) and using absolute value terms, we can rewrite the relation (1) as follows:

$$|\sigma_x|+|\sigma_m|>1 \tag{2}$$

which is Marshal - Lerner condition and based on this condition, the devaluation can remove trade balance deficit if only the sum of export demand elasticity and of import demand elasticity both in absolute value will be larger than 1.

Marshal- Lerner condition has some important shortcomings. First, it's assumed that the price elasticity of both export and import supply is infinity. Also, it assumes balanced trade while authorities usually don't devaluate domestic currency in this condition.

The other approach is J curve. According to [1], in the beginning of the devaluation, current account deteriorates because in this time, amount of export doesn't change but import is more expensive than before. Over time both of producer and consumer react to the devaluation and amount of export and import start adjusting. So trade balance begins to improve. In other words, the devaluation affects on trade balance only with time lag. Figure 1 depicts trade balance reaction to the devaluation which is called J curve since it resembles the letter J.

Based on [20], existence of time lag in the impact of the devaluation policy on trade balance is due to some factors such as lags in recognition, decision, distribution, replacement and production.

It is worth mentioning that the J curve approach has an important advantage against Marshall - Lerner approach. Specifically, the J curve includes information about Marshall – Lerner elasticity as well as the depth of the effect of the devaluation on the trade balance [19].

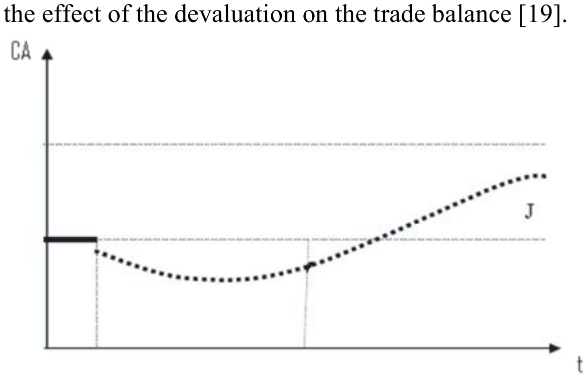

Fig. 1: J Curve

Empirical studies on the topic have analyzed in two ways. The first are those mostly the past years that have considered foreign trade data as a whole. And the second are papers mostly published recently have employed bilateral trade data. As [21] have pointed out, trade balance of a country may improve with one partner and worsen with another.

MATERIALS AND METHODS

We begin with a balance trade model for home country with import and export equations as follows:

$$M = M(E, P, Y) \tag{3}$$

$$X = X(E, P, Y^*) \tag{4}$$

$$TB = P\,X\,(E, P, Y^*) - \tag{5}$$

where import (M) depends on exchange rate (E), general price level (P) and domestic income (Y). Also, export (X) is a function of exchange rate, general price level, income of foreign country (Y^*).

Regarding to real exchange rate as $RE = E\frac{P^*}{P}$, the trade balance in domestic currency is rewritten as follows:

$$CA = P\,X(R\frac{P}{P^*}, P, Y^*) - P^* R\frac{P}{P^*} M(\,R\frac{P}{P^*}, P, Y) \tag{6}$$

Finally, the trade balance equation will be as follows:

$$CA = f(Y, Y^*, RE, P, P^*) \tag{7}$$

By increasing exchange rate or the devaluation, export value increases ($X_E < 0$), import value decreases ($M_E < 0$) and consequently trade balance improves (volume effect). On the other hand, the devaluation causes each unit of the imported goods being more expensive and deteriorates trade balance (value effect).

In these conditions, by currency devaluating, the trade balance decreases initially and then improves by bieng stronger the volume effect. However, this issue is complicated as a result of the slow exchange rate pass through [18].

Specifically, producers in response to the exchange rate may not be able to vary their foreign prices because they don't want to transfer the effect on their customers. In extreme case, it is possible neither $\frac{P}{E}$ nor P^*E varies by the currency devaluating. In other words, percentage increase in domestic prices, percentage decrease in foreign prices and percentage increase in exchange rate are equal. In this case, amount of export and import won't change and trade balance will even improve in short run.

However, we should not expect the extreme case in the short run as producers change the degree of transfer. So, in short run there are two opposing forces in response to the devaluation: more import value in domestic currency, in given P^*, which causes pressure on the trade balance, slow transfer of exchange rate and neutralize the effect. If at this stage, the value of imports is the dominant, trade balance will worsen in the short run. Over time, although export and import react to exchange rate, but low pass through may lead to weak adjustments.

Based on the relation 7, a model is specified as follows [21]:

$$LnTB_{j,t} = a + bLnY_{IR,t} + cLnY_{j,t} + dLnRE_{j,t} + \varepsilon \tag{8}$$

where $Y_{IR,t}$, $TB_{j,t}$, $Y_{j,t}$ and $RE_{j,t}$ are Iran's real income, the ratio of Iran's export to trading partner j to its import from this partner, real income of trading partner j and real exchange rate in relation to trading partner j in time t respectively. It is mentionable that recent studies have used the ratio export to import to measure trade balance since the logarithm of this variable implies trade balance.

Real exchange rate has been measured based on CPI and PPI indices as follows:

$$RE_{CPI} = E(CPI_F \,/\, CPI_i)$$
$$RE_{PPI} = E(PPI_F \,/\, PP_i) \tag{9}$$

It's expected a negative sign for b in the relation since import increases by $Y_{IR,t}$. On the other hand, if increasing national income means an increase in the production of commodities competing import, we will expect a negative relationship between national income and trade balance. The expected sign of c is positive. In other words, it's expected that an increasing of foreign country's income will increase Iran's export. On the other hand, if the increase in foreign country's income makes production of goods substituting for import to increase, the sign of c will be negative. The expected sign for d is positive since exchange rate will increase export and reduce import. Finally, the expected sign for e is negative cause of negative affecting the relative price on the trade balance.

In this study we use bounds test approach to level relationship developed by [25], which can be applied irrespective of whether the underlying regressors are I(1) or I(0) or fractionally integrated. Thus, the bounds test approach to level relationship eliminates the uncertainty associated with the order of integration. Since most of cointegration tests such as Engel-Grenger and Johansen and Joselius (1992), are confident when the series are in the same order of integration, these tests cannot be suitable for our study. Thus we use bounds test approach to level relationship developed by Pesaran et al. (2001), which can be applied irrespective of whether the underlying regressors are I(1) or I(0) or fractionally integrated. Thus, the Bounds test approach to level relationship eliminates the uncertainty associated with the order of integration.

In order to avoid uncertainty on the results of unit root tests and investigating a long run relationship between trade balance and domestic national income, South Korea's GDP and exchange rate, the bounds test for cointegration within ARDL (the autoregressive distributed lag) modeling approach was mainly adopted in this study. This method has definite advantages in comparison to other cointegration procedures. First, all other techniques require that the variables in the model are integrated of the same order, whereas the approach developed by [25] could be employed regardless of whether the underlying variables are I(0), I(1) or fractionally integrated. Second, it can be used in small sample sizes, whereas the Engle-Granger and the Johansen procedures are not reliable for relatively small samples. The ARDL approach involves estimating the following error correction models:

$$\Delta \ln Y_t = a_{0y} + \sum_{i=1}^{n} b_{iy} \Delta \ln Y_{t-i} + \sum_{i=1}^{n} c_{iy} \Delta \ln X_{t-i} + \sum_{i=1}^{n} d_{iy} \Delta \ln Z_{t-i} + \sigma_{1y} \ln Y_{t-1} + \sigma_{2y} \ln X_{t-1} + \sigma_{3y} \ln Z_{t-1} + \varepsilon_{1t} \tag{9}$$

$$\Delta \ln X_t = a_{0x} + \sum_{i=1}^{n} b_{ix} \Delta \ln X_{t-i} + \sum_{i=1}^{n} c_{ix} \Delta \ln Y_{t-i} + \sum_{i=1}^{n} d_{ix} \Delta \ln Z_{t-i} + \omega_{1x} \ln X_{t-1} + \omega_{2x} \ln Y_{t-1} + \omega_{3x} \ln Z_{t-1} + \varepsilon_{2t} \tag{10}$$

where Δ is the difference operator, $\ln Y_t$ is the natural log of the dependent variable, $\ln X_t$ and $\ln z_t$ are the natural logs of the independent variables and ε_{1t} and ε_{2t} are serially independent random errors with mean zero and finite covariance matrix.

In the second stage, Error Correction Model (ECM) for the long-run equilibrium relationship is estimated by using the *ARDL* method.[1]

RESULTS AND DISCUSSION

Table (1) presents the results of the bounds test for model of Iran's trade balance with the selected country during period time 2001q1-2011q4, under three different scenarios as suggested by [25], which are with restricted deterministic trend (F_{IV}), with unrestricted deterministic trend (F_V) and without deterministic trend (F_{III}). Intercept in these scenarios are all unrestricted.

As can be seen from this table, the F-statistic values are higher than the upper bound at all levels with deterministic trend. It means that the null hypothesis of being no long-run relationship between trade balance and domestic national income, South Korea's GDP and exchange rate can be rejected.

Critical values for F-statistic are taken from [30] and presented in Table (2). The lag length (P) for this test is based on Schwarz Bayesian Criterion (SBC) and Akaike Information Criterion (AIC). The best choice of lag length is four.

Moreover, estimation results of ARDL (3, 3, 1, 3) model in Table 3 show that all of the coefficients are significant and have the expected signs except LGDPI that isn't significant. Based on this result, we may conclude that exchange rate and Korea's GDP have significant effects on Iran's trade balance in long run and Exchange rate is the most important variable that affects Iran's trade balance.

The coefficients of exchange rate variable are positive and significant. So, the hypothesis is confirmed in the long run. According to the long run model, the coefficient of national income variable is negative and insignificant. Also, the coefficient of foreign (South Korea) income is negative but significant. So, it is expected that the economic growth of the trade partner may disturb Iran's long run trade balance. Furthermore, the coefficient of the exchange rate has positive and significant effect on Iran's trade balance against South Korea in the long run. Thus, the hypothesis is confirmed in the long run.

The results of short run dynamic coefficient associated with the long run relationships obtained from ECM are given in Table 4.

All lagged changes in the trade balance coefficients are statistically significant. Also, the first and third lags of trade balance have positive and second lag have negative effects on trade balance in short long. This implies that trade balance are based on previous periods. The EC term has a statistically significant and an expected sign. The significance of the long-run causal effect implies that the series is non-explosive and the long-run equilibriums are attainable. Also, the estimated coefficient of the EC term (-0.38111) indicates that nearly 38 percent of the disequilibrium is corrected in any period.

The signs of the short-run coefficients are theoretically correct. All of the coefficients are statistically significant except South Korea's GDP. According to our results, the short-run coefficient of exchange rate is -0.069888 and less than the long-run coefficient (0.056229) and the short-run coefficient of the Iran's GDP is 0.254017 and more than their long-run coefficient (-0.045124).

Finally, presented in Figure (2), moving path of tests' statistic is in such a way that always lies between straight lines and this result shows stability

Table 1: Bounds test for cointegration

Variables	With deterministic trend		Without deterministic trend	
Fltb(ltb|lgdpi,lgdpg.exr)	F_{IV}	F_V	F_{III}	t_{III}
	9.15065*	10.3873*	8.4976*	-4.3571

Source: present study

Notes: Akaike Information Criterion (AIC) and Schwartz Criteria (SC) were used to select the number of lags required in the cointegration test. F_{IV} represents the F statistic of the model with unrestricted intercept and restricted trend. F_v represents the F statistic of the model with unrestricted intercept and trend and F_{III} represents the F statistic of the model with unrestricted intercept and no trend. Note: H0: No existences long run. * indicates that the statistic falls outside the upper bound at all levels

[1]In this model, there is no need to variables to be the same order in integration. For more detail, see Gujarati (2004)

Table 2: F-statistic critical values for ARDL approach:

	1%		5%		10%	
K=4	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F_{III}	4.428	6.250	3.202	4.544	2.66	3.838
F_{IV}	4.763	6.2	3.512	4.587	2.98	3.918
F_{V}	5.376	7.09	3.958	5.226	3.334	4.438

Note: Critical values are from [30]

k is the number of regressores for dependent variable in ARDL model, F_{IV}, represents the F statistic of the model with unrestricted intercept and restricted trend, F_{V}, represents the F statistic of the model with unrestricted intercept and trend and F_{III}, represents the F statistic of the model with unrestricted intercept and no trend

Table 3: The long-run static solution of the estimated ARDL (2,1,3,1,3) model is presented below

Variables	Coefficients	Standard Errors	T-Ratio	(Prob)
C	16.834270	4.777900	3.523305	(0.0012)
exr	0.056229	0.015259	3.685010	(0.0007)
LGDPI	-0.045124	0.054160	-0.833100	(0.4103)
LGDPk	-0.660067	0.193930	-3.403516	(0.0016)

Source: present study

Table 4: Error Correction Representation for the Selected ARDL Model

ARDL (3, 3, 1, 3) selected based on SBC, dependent variable is DLTB			
Regressors	Coefficient	Standard error	T-ratio(prob)
DLTB(-1)	0.705884	0.090569	7.793892(0.000)
DLTB(-2)	-0.538397	0.099537	-5.409006(0.000)
DLTB(-3)	0.407356	0.080174	5.08093(0.000)
DLGDPI	0.254017	0.037756	6.727884(0.000)
DLGDPI(-1)	-0.210256	0.049844	-4.218279(0.000)
DLGDPI(-2)	0.291924	0.077984	3.743356(0.0011)
DLGDPI(-3)	-0.146122	0.062028	-2.355741(0.0274)
DLGDPK	-0.04978	0.034237	-1.453978(0.1595)*
DEXR	-0.069888	0.014549	-4.803653(0.0001)
DEXR(-1)	0.001848	0.01763	0.104851(0.9174)*
DEXR(-2)	-0.073784	0.015325	-4.814588(0.0001)
Ecm(-1)	-0.381110	0.047677	-7.993626(0.000)
R-Squared= 0.94	R-Bar-Squared= 0.91	F-stat= 34.36184(0.0000)	
SER= 0.00228	RSS= 0.9196	DW= 1.9292	
AIC= -9.052791	SBC= -8.48096		

Source: present study

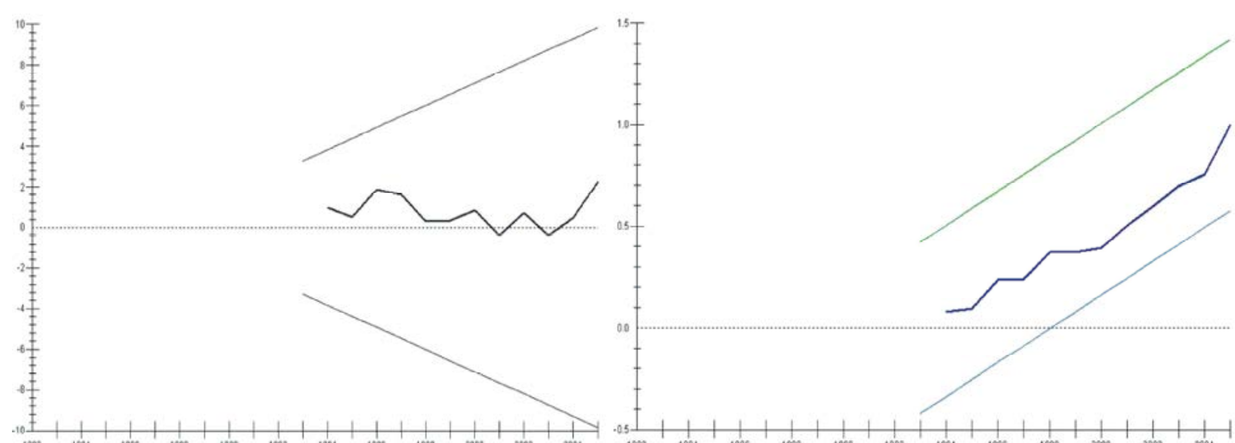

Fig. 2: CUSUM and CUSUMSQ for trade balance of Iran and South Korea

Source: present study

of estimated coefficients. Based on these tests, the hypothesis of coefficients stability cannot be rejected at the 5% significance level.

Finally, on the basis of error correction model, the error correction coefficient is greater than 1 and significant which probably means long run disequilibrium.

CONCLUSION

After the collapse of the Bretton Woods system in 1973 and establishing a floating exchange rate system, analysis the issue of the impact of the devaluation on the trade balance was alive. Since then, Exchange rate as one of the most important open macroeconomic variables and one of the affecting key elements on the trade balance has been paid attention by economic policy makers.

The present study has tested the hypothesis which is the devaluation positively affects on trade balance between Iran and South Korea by using bounds test approach to cointegration during seasonally time period 2001q1-2011q4.

The results confirm the hypothesis in both long run and short run. So, the hypothesis is fully confirmed for the selected country. *CUSUM* and *CUSUMSQ* tests show all coefficients are stable.

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