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Impact of Exchange Rate on Trade Balance in Bangladesh: Is there any Causal Relationship?

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Abstract: *The paper attempts to explore the effect of depreciation in real effective exchange rate on trade balance in Bangladesh. For the analysis, annual data from 1973 to 2013 have been used for Bangladesh and its major trading partners. The Engle-Granger two step procedure, Johansen Cointegration technique, Vector Error Correction Model (VECM) and Impulse Response Function are utilized to find out the short run and long run impact of real exchange rate on trade balance. The findings suggest that the real exchange rate has a positive influence on trade balance in Bangladesh in both short run and long run. The granger causality test reflects a unidirectional causal relationship from exchange rate to trade balance. The overall result confirms that there is no initial declining part in trade balance to currency devaluation or depreciation in Bangladesh, however, the upward sloping part of J-curve is present. The implication of the findings is that currency devaluation is a possible tool for the policymakers to improve the trade balance in Bangladesh and to reduce the trade deficit.*

Keywords: Depreciation, Johansen Cointegration, VECM, Impulse Response Function, J-curve.

Introduction

Over the years, Bangladesh has been successful in increasing its exports from a very lower base to about 35 billion in fiscal year 2016-17. However, the country has been maintaining a deficit in trade balance since import has been higher than exports. The issue of maintaining a balanced trade is important from policy perspective as it is linked to achieving balanced and inclusive growth as well as macroeconomic stability. Bangladesh pursued various exchange rate policies since independence to improve trade balance. Soon after its independence, Bangladesh introduced fixed exchange rate with British pound sterling. In 1983 exchange rate was changed as pegged to a basket of major partner country's currencies where US dollar was the intervening currency. Since then, multiple exchange rates were allowed to favor export and remittance. These policies finally created macroeconomic imbalances. Finally, Bangladesh formally stepped to market based exchange rate for Taka from 31 May 2003, where nominal exchange rate is set by the market forces, however, there is discretion for the central bank to intervene in the market for foreign exchange so that the exchange rate can be kept within a certain limit of appreciation or depreciation. The system is formally known as 'managed float'. Exchange rate policies in Bangladesh has taken, mainly, to accelerate exports, to reduce extra pressure of imports and thereby to improve the balance of trade. It is worthwhile to mention that Bangladesh devalued her currency (Taka) about 130 times from 1972 to 2002 to reduce deficit in the balance of payment (Younus and Chowdhury, 2006).

Objectives

The objective of the study is to investigate the impact of exchange rate depreciation on balance of trade in Bangladesh. Empirical evidence found that there is a J-shaped effect on trade balance due to depreciation in exchange rate which is formally known as J-curve effect. It is defined as the currency devaluation leads a country's trade balance to deteriorate in the short run but improves eventually (Magee, 1973). As a consequence of depreciation, imported goods become expansive but import volume does not fall immediately, resulting increase in import bill. On the other hand, with low export price, the export volume will not change substantially resulting unchanged or reduced export revenue. Trade balance deteriorates because of this inelasticity of import and export. This is attributed as the price effect of devaluation. Over the long run, quantity adjusts in response to changes in price. This is the volume effect of devaluation. Export and import elasticities increase as import volume falls and the export volume rises in response to changes in price. Trade balance improves eventually as long as the Marshall-Lerner condition is satisfied, which states that currency devaluation will only lead to an improvement in the balance of payments if the sum of the absolute value of demand elasticities for imports and exports is greater than unity (Bahmani-Oskooee and Ratha, 2004). The study is important both for policy purpose and for understanding the dynamics of trade balance in Bangladesh. It the evidence of a cointegrating relationship is found between these two variables, a more sustainable economic growth path can be achieved in the long-run by utilizing exchange rate as a tool of economic policies.

Literature Review

The general consensus among the professionals in international economics is that movements in real exchange rate have direct impacts on trade balance in the long run (Himarios, 1989). There have been a large number of economic literatures that examine the effect of currency devaluation or depreciation on trade balance. The available literature on this perspective shows inconclusive evidence concerning the impact of depreciation on trade balance.

Several studies in the literature found the evidence of J-curve effect in the exchange rate and trade balance relationship (Abd-El-kader, 2013; Stucka, 2004), whereas others observed no such evidence (Baek, Mulik & Koo, 2006; Ziwei, 2008; Rose & Yellen,1989; Bahmani-Oskooee & Brooks, 1999). The study of Baek, Mulik and Koo (2006) examines the J-curve effect for the U.S. agricultural goods and non-agricultural goods with three major trading partners ? Japan, Canada and Mexico. Using quarterly data from 1989 to 2004 and employing autoregressive distributed lag (ARDL) model, they demonstrated no existence of J-curve for agricultural good. However, for non-agricultural good, J-curve exists while traded with industrialized nations -Japan, Canada but not with developing countries such as Mexico. Bahmani-Oskooee and Alse (1994) examined cointegration between real exchange rate and trade balance for 41 economics (developing and less developed) and found that for only 14 countries these two variables are cointegrated. They ended up with cointegration relationship for only few countries.

Stucka (2004) investigated the J-curve effect for Croatia, using two country- imperfect substitution model. Applying ARDL methodology, this study found the evidence of J-curve in Croatia. Lai and Lowinger (2002) investigated the determinants of trade balances of seven East Asian countries, namely Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, and Thailand, using cointegration technique, error correction model, and impulse response function, that confirmed the existence of the J-curve phenomenon except for Japan.

Empirical research shows a controversial result for the existence of J-curve effect in Bangladesh. Islam (2010) estimated export and import elasticity with respect to exchange rate using Johansen cointegration method. He found that the estimated elasticities imply the fulfillment of Marshall-Learner condition. Aziz (2008) estimated the effect of exchange rate on trade balance in Bangladesh using Engle-Granger and Johansen conitegration techniques and found the presence of J-shaped effect. The later study of Aziz (2012) using annual data from 1976 to 2009, error correction model, multivariate cointegration tests, and impulse response functions also support the existence of J-curve effect in Bangladesh. Younus and Chowdhury (2014) using monthly data for the sample period from June 2003 to June, 2014, examine the impact of Real Exchange Rate (RER) and Real Effective Exchange Rate (REER) on exports, imports and trade balance of Bangladesh with 8 major trading partners. They employed cointegration test, Vector Error Correction model (VECM), and Impulse Response Functions (IRFs) and found that there is reverse L-shaped effect of real exchange rate on trade balance. The study did not find any significant effect of REER either on the trade balance or exports and imports. Khatoon and Rahman (2009) utilized Johansen cointegration technique and VECM to capture the short run and long run dynamics of trade balance with respect to real exchange rate. The study does not support the existence of J-curve effect but confirms a positive impact of currency depreciation on trade balance in both short and long run. It is however not clear from the literature whether there is a causal relationship between real exchange rate and trade balance in Bangladesh and the direction of this relationship. In this backdrop, the current study is an attempt to investigate the causality between these two variable and the short and long run dynamics on this regard.

Methodology

Theoretical model:

The theoretical background of the paper is based on the famous Marshall-Lerner condition which refers to the condition that the exchange rate devaluation leads to the improvement in the balance of trade if the absolute sum of the long run export and import elasticities is greater than unity. Trade in goods tends to be inelastic in the short run due to trade contracts and sluggish adjustment in consumption patterns. Therefore, price effect dominates the volume effect in the short run. In the long run, consumer will adjust to price changes and trade balance will improve. Thus the effect of currency devaluation is supposed to have a "J-curve" pattern on the trade balance.

This study has followed the similar approach used by Khatoon and Rahman (2009) and Stucka (2004). In their studies trade balance is shown as a function of real exchange rate and the domestic and foreign real income. 'Two-country', imperfect substitution is used to model the trade balance.

The quantity of imports demanded domestically, M_d , and the quantity of imports demanded by the rest of the world, M_d^* , are given by following equations.

$$M_d=M_d\,(Y_r,RP_m)\ ;\ RP_m= P_m/P \qquad (1)$$

$$M_d^*=M_d^*(Y_r^*,RP_m^*);\ RP_m^*= P_m^*/P \qquad (2)$$

Where Y_r is domestic real income and RP_m is the relative price of imports to the domestic overall price level. In equation 2 Y_r^* is foreign real income and RP_m^* is the relative price of imports in foreign country. It is assumed that the degree of homogeneity of demand function is zero and no money illusion for the consumers.

The supply of exports in each country depends only positively on the relative price of exports:

$$X_s= X_s\,(RP_x) \qquad (3)$$

$$X_s^*= X_s^*(RP_x) \qquad (4)$$

Where RP_x is domestic country's relative price of exported goods defined as the ratio of the domestic currency price of exported goods, P_x, to the overall domestic price level, P. Therefore, RP_x can be defined as foreign currency price of exports.

Domestic price of import is simply the foreign currency price of exports adjusted for exchange rate.

$$RP_m= P_m/P=eP_x^*/P= eP^*P_x^*/PP^*= e(P^*/P)(P_x^*/P^*) =QRP_x^* \qquad (5)$$

Where Q is defined as the bilateral real exchange rate, $Q= e(P^*/P)$, in such a way that an increase in Q refers to a depreciation of the domestic currency. The market equilibrium conditions for exports and imports are:

$M_d=eX_s^*$ and $M_d^*=X_s$

The trade balance equation is defined as equation 6.

$$TB=P_xM_d^*-QP_x^*M_d \qquad (6)$$

Therefore, the trade balance equation can be written in functional form as:

$$TB=f(Y_r,Y_r^*,Q) \qquad (7)$$

An increase in real domestic income implies a larger capability of domestic imports and a rise in foreign real income implies an increase in foreign import demand. Y_r is expected to be negatively related to trade balance and Y_r^* to be positively related to trade balance. It is anticipated that currency devaluation have a positive impact on trade balance in the long run and thus Q is positively related to trade balance.

Data and variables:

Annual data for the periods between 1973 and 2013 are used for analysis. Although monthly or quarterly data is best suited to capture the short run and long run dynamics, annual data have been utilized as information on GDP is unavailable for monthly or quarterly basis. The data used for Bangladesh and its major 21 trading partners namely

Australia, Belgium, Brazil, Canada, China, Hong Kong, Denmark, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Kuwait, Malaysia, Netherlands, Singapore, Spain, UK and USA, are taken from the International Financial Statistics (IFS) and the Direction of Trade Statistics (DOTS), published by the International Monetary Fund (IMF). The countries are chosen on the basis of their importance as a trading partner of Bangladesh. All of these countries cover about close to 80 percent of total trade of Bangladesh.

The real Gross Domestic Product (GDPD) is used as a proxy for the real income. The variable GDPD is defined as the index of Bangladesh's GDP (2010=100). The foreign Gross Domestic Product (FGDP) is estimated as the weighted average of GDP of major partner countries. Then it is converted as an index with 2010 as the base year.

The trade balance (TB) is defined as ratio of exports to imports with the trading partners. Thus an increase in the trade balance variable implies improvement of current account. Ratio is used to avoid the problems with nominal and real quantities. The variable real exchange rate (RER) is estimated as used by Khatoon and Rahman (2009). The only difference is that this paper uses different weight to calculate real exchange rate which varies from time to time where the formar used constant weight. The reason of this consideration is that a country's share in total trade of Bangladesh varies from time to time. This specialty makes the study unique. Data for nominal exchange rate is taken from IMF is defined as domestic currency per US dollar and an increase in exchange rate implies the devaluation of domestic currency. All the variables are converted into log form for estimation.

The real exchange rate is defined as in equation 8.

$$RER=E_t[\{\sum\alpha_{it}(CPI_{it}^{f}/r_{it})\}CPI_t^{d}] \quad (8)$$

Where,

$\sum\alpha_{it}=1$

E_t= The exchange rate of Bangladeshi Taka against US$

α_{it} = ith country's share in the total trade of Bangladesh at time t; i = 1, 2, 3…21.

CPI_{it} = ith country's Consumer Price Index

r_{it} = ith country's exchange rate against US$ at time t

CPI_t^d = Bangladesh's Consumer Price Index

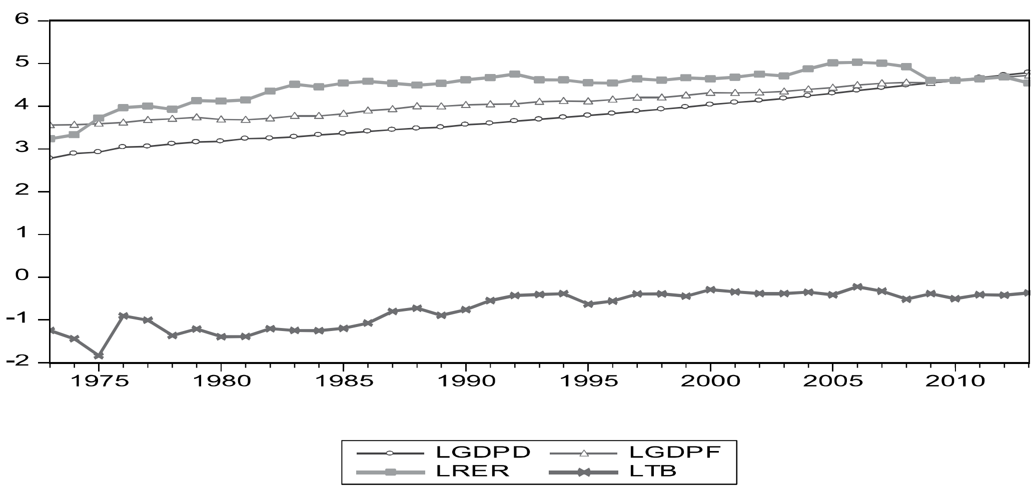
RER is then adjusted as an index with (2010=100).

In this paper, Error Correction Model, Johansen Procedure (Johansen, 1996) and Vector Error Correction Model are employed while exploring the short run and long run impact of real exchange rate on trade balance. To find out causality between exchange rate and trade balance, Granger Causality Test has been applied.

Stationarity test:

To test the short and long run relationship among the variables, it is important to examine the univariate properties of the variables considered (i.e. LTB, LGDPD, LGDPF and LRER), that is whether the variables are stationary or not. If the variables are stationary, then simple Ordinary Least Square (OLS) method is sufficient to show the long run relationship among the variables under consideration. If the variables are not stationary, we need to employ cointegration analysis. Figure 1 shows the time series plot of the variables used for cointegration analysis.

Figure 1: Balance of Trade, Real Exchange Rate, Domestic GDP and Foreign GDP



For the formal test of unit root we use the ADF test and the Phillips-Perron test. The ADF test is based on equation 9.

$$\Delta y_t = \alpha + \beta t + \rho y_{t-1} + \sum_{j=1}^{p} \left(\Upsilon_j \Delta y_{t-j}\right) + \varepsilon_t \qquad (9)$$

In this paper lag order p is determined by Schwarz Information Criteria (SIC). SIC is used rather than Akaike Information Criteria (AIC), because it has better large sample property than AIC i.e. p tends to true p as sample size rises. The Phillips-Perron test is used to adjust if there is serial correlation and heterosecasticity. The Phillips-Perron tests correct for any serial correlation and heterosecdasticity in the errors by modifying the Dickey Fuller test statistics. The Phillips-Perron test is based on the following equation 10.

$$\Delta y_t = \alpha + \beta t + \rho y_{t-1} + \varepsilon_t \qquad (10)$$

We attempt to examine whether all the variables have the same integrating order if the variables are not stationary. Table 1 represents Phillips-Perron and ADF test statistic for the four variables in level and first difference form to determine the order of integration.

Table 1: Unit root tests

Variables	Phillips-Perron test	ADF test
LTB	- 3.341399*	- 3.323897*
LTB	- 10.03340***	- 8.617208***
GDPD	- 0.772903	- 0.528035
LGDPD	- 8.195769***	- 2.922**
LGDPF	- 2.773691	- 2.635897
LGDPF	- 6.117112***	- 5.914800***
LRER	- 2.591023	- 2.591193
LRER	- 4.582167***	- 4.601706***

Source: Prepared by the author

Note: 1. The null hypothesis in the ADF test is that the variable contains a unit root against the alternative hypothesis of stationarity.

2. Intercept and linear time trend for the variables are incorporated in level form and no trend in first difference form to perform ADF test.

3. *, **, *** indicate significance level of 10%, 5% and 1% respectively.

For all four variables in level form, calculated value is less than critical value which implies both of the tests cannot reject the null hypothesis of unit root at 1 percent and 5 percent level of significances. So all variables are nonstationary in level form. On the other hand, both ADF and Phillip's-Perron test imply that all variables are stationary in the first difference form. As all variables become stationary at first difference, they have one unit root. Therefore, the variables are integrated of order one, I(1).

Estimated Results and Findings

Both ADF test and Phillips-Perron test confirm that all the variables are I(1) in level form. Therefore, cointegration technique can be applied to find out long run relationship among the variables.

The Engle-Granger procedure:

Cointegration among the variables are first examined using Engle- Granger two step procedures (Engle and Granger, 1987). If two variables are integrated of order d and their linear combination have an order of integration which is less than d, then the two variables are cointegrated. The Engle-Granger first step equation is estimated as in equation 11.

$$LTB = -10.06 - 1.69LGDPD + 3.5LGDPF + 0.29\ LRER \qquad (11)$$

Adjusted $R^2 = 0.82$ and DW=1.62

The standard error does not provide any basis for the long run valid relationship among the variables as they are nonstationary in level form. The ADF test of the residual obtained from the estimation of the above is summarized in equation 12.

$$\Delta E_t = -0.0044 - 0.77E_{t-1} - 0.058\Delta E_{t-1} \qquad (12)$$

t-ratio (-0.153) (-3.619) (-0.353)

The estimated t-ratio of the lagged residual is greater than the McKinnon critical value (-3.45) at 90% confidence level implying that null hypothesis of no cointegration is rejected. This provides a long run cointegrating relationship among the variables. The long run exchange rate elasticity of trade balance is 0.29. According to Granger representation theorem, if two variables are cointegrated, then there exist an error correction model (ECM) of that cointegrating relationship. Using 'general to specific' methodology, the estimated model is reported in Table 2.

Table 2: Error correction model in Engle-Granger procedure

Variables	Estimated coefficients	t-ratio
Intercept	-0.170636	-2.1535
ΔLGDPF	2.224801	2.1729
ΔLRER(-1)	0.422826	1.9217
ΔLGDPD	2.388697	1.5598
Adjustment (error correction term)	-0.575737	-3.5667
Adjusted R^2	0.440262	
Heterosecdasticity F(4,34)	1.401435	0.2544*
Serial correlation F(1,33)	0.444987	0.5094*

Source: Prepared by the author

Note: 1. * indicates for P value.
2. The diagnostics tests that are preformed are Breusch-Godfrey LM test for serial correlation, White's general heteroscedasticity test and Jarque-Bera test for normality.

The error correction model of the long run equation is described in equation 13.

$$\Delta\ LTB = -0.171 + 2.22\Delta LGDPF + 2.39\Delta LGDPD + 0.42\Delta LRER(-1) - 0.58Res(-1) \qquad (13)$$

t-ratio (-2.154) (2.173) (1.56) (1.922) (-3.567)

Here, the coefficient of the error correction term is negative, less than one in absolute value and statistically significant. Therefore, any deviation from the long run equilibrium will be adjusted in some future date. About 58% of disequilibrium is adjusted each period. The short run exchange rate elasticity is positive which implies that devaluation in taka leads to an improvement in trade balance. The foreign and domestic GDP also have a positive significant impact on trade balance in the short run.

Unrestricted Error Correction Model (UECM):

The unrestricted error correction model (UECM) captures the short and long run dynamics in a single equation. Using general to specific methodology, the estimated model is reported in Table 3.

Table 3: Estimated results from unrestricted error correction model

Variables	Estimated coefficients	t-ratio
Intercept	-4.755758	-2.1352
LGDPD	3.586387	2.2793
LRER	0.408500	1.4975
LRER(-1)	0.488185	3.7312
LGDPD(-1)	-0.503934	-0.8805
LGDPF(-1)	0.946137	0.9208
LTB(-1)	-0.550871	-3.4312
Adjusted R^2	0.378150	
Heterosecdasticity (Chi-Square)		0.0790*
Serial correlation F(2,27)	0.091150	0.7647*
Normality (Jarque-Bera)	0.275828	0.8711*

Source: Prepared by the author

Note: * indicates p-value.

The coefficient of the error correction term is correctly signed, less than one in absolute value and statistically significant. The short run exchange rate elasticity of trade balance is positive alike the error correction model. The long run equation of the estimated model is obtained by setting ΔLGDPD and ΔLRER equal to zero. The long run model is estimated as in equation 14.

LTB= -8.632+0.886 LRER +1.717LGDPF -0.915LGDPD (14)

The test for cointegration is F test of the joint significance of the coefficients of lagged independent variables in level form. The critical values provided by Pesaran, Shin and Smith (2001), have upper bound (FU) and lower bound (FL). If the calculated F statistic is greater than FL, we reject the null hypothesis of no cointegration. The computed F value in this case is 4.87 and the upper and lower critical values are FU=4.01 and FL=2.86. This suggests the existence of cointegrating relationship among the variables. The long run elasticity of trade balance with respect to exchange rate is 0.886. The foreign GDP has a positive impact and the domestic GDP has a negative impact on trade balance.

Johansen Cointegration:

The Johansen-Juselius multivariate likelihood ratio test has been used to analyze the cointegrating relationship among variables. Johansen procedure is based on vector autoregressive model of the form:

$$\Delta X_t = \alpha + \sum_{j=1}^{p-1} (\Pi_j \Delta X_{t-j}) + \Pi X_{t-j} + u_t \quad (15)$$

Where, Xt is the vector of k endogenous variables and these variables are integrated of order 1, II_i are k×k matrices of unknown parameters, and u_t is an error term. All long-run information contained in the matrix II When matrix II is nonsingular, it has full column rank which implies that all the variables are stationary. When the matrix II is singular and has zero rank, the variables are not cointegrated. However, when II is singular and the rank of II lies in the open interval 0 to k, there exists r cointegrating vectors where $0 < r < k$, that make the linear combinations of nonstationary variables cointegrated.

Johansen procedure is very sensitive to lag length. The lag length of Vector Autoregressive (VAR) model is selected based on R squared value, log likelihood, AIC and SIC. The appropriate model chosen to be VAR(2) i.e. lag length is 2. Based on Johansen (1988, 1991, 1995) and Johansen and Juselius (1990), there are two test of cointegrating relationship; trace test and maximum eigenvalue test. These two test statistics often produce different results. It is up to the researcher to carefully examine the cointegrating relationships. According to the results by Toda (1994), trace test is slightly better than the corresponding maximum eigenvalue test in terms of power.

The test has been employed using maximum eigenvalue statistic and trace statistic at 1 percent level of significance. The null hypothesis of no cointegrating relationship is rejected in the trace test against the alternative of at least one cointegration. But the null hypothesis of one contegration cannot be rejected. Therefore, the trace test confirms the existence of one cointegrating relationship among the variables. On the other hand, the maximum eigenvalue test indicates no cointegrating relationship. It is noted that we restrict the model to have intercept and no deterministic trend in error correction and no intercept in VAR(2).

Table 4: Johansen Cointegration Test

	Maximum eigenvalue test		Trace test	
# of cointegrating relationship	Statistic	95% critical value	Statistic	95% critical value
None	24.45904	33.73292	63.27021	61.26692
At most one	21.87083	27.06783	38.81117	41.19504
At most two	13.66911	20.16121	16.94034	25.07811
At most three	3.271233	12.76076	3.271233	12.76076

Source: Prepared by the author

From the above test results, the long run cointegrating relationship is restricted to be one. The cointegrating relationship based on the estimation is described in equation 16.

$$LTB = 17.62 + 0.16LRER - 4.51LGDPD + 8.05LGDPF \quad (16)$$

When the variables of a VAR are cointegrated, we use a vector error-correction model (VECM) to find out the short run dynamics. The VECM specification restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short-run dynamics. VECM shows how the deviation from long run equilibrium is adjusted through successive short run adjustments. For