

The Role of Exchange Rate in Trade Balance: Empirics from Bangladesh

Nusrate Aziz¹

University of Birmingham, UK

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Abstract

The purpose of this study is to estimate the effect of exchange rate on the balance of trade of Bangladesh. This paper, first, constructed the Nominal Effective Exchange Rate (NEER) and Real Effective Exchange Rate (REER) for Bangladesh and then applied the Engle-Granger and Johansen techniques to investigate the long run cointegration relation between 'trade balance' and REER, and finally employed the Error Correction Mechanism (ECM) to explore the short-run linkage. Estimated results demonstrate that the REER has a significant positive influence on Bangladeshi trade balance in both short- and long-run. The Granger Causality test suggests that the REER does Granger causes the trade balance. The study also examined the Marshall-Lerner condition in Bangladeshi data by using the Impulse Response Function (IRF) which suggests that the J-curve ideal is apposite in response to exchange rate depreciation.

Keywords: *Balance of Trade, Real effective exchange rate, Cointegration, VAR Model, IRF, Granger Causality.*

JEL Classification: *C22, F31, F32*

¹ Current PhD student, Department of Economics, University of Birmingham, UK, and Assistant Professor of Economics, University of Chittagong, Bangladesh. E-mail: nusrate@yahoo.com. http://www.economics.bham.ac.uk/people/PhD_Students

1.1 Introduction

The exchange rate is one of the most important policy variables, which determines the trade flows, capital flows & FDI, inflation, international reserve and remittance of an economy. Many economies, specially Asian countries encountered crisis in 1990s due to imprudent application and bad choice of this policy. However, there is no consensus in the theoretical or empirical literature about any unique effect of the exchange rate volatility on macroeconomic indicators.

Bangladesh followed a 'fixed exchange rate' system until 1979. Between 1979 and mid-2003, the country pursued a managed floating exchange rate regime. Continual devaluation of the domestic currency, in order to maintain a stable real exchange rate and avoid overvaluation of the domestic currency, was the hallmarks of this regime. Since the end of May 2003, Bangladesh has introduced a kind of 'clean floating' exchange rate policy by making it fully convertible on the current account, although capital account controls still remain. All the exchange rate policies Bangladesh has taken, mainly, to accelerate exports, reduce extra pressure of imports and thereby improve the balance of trade. The following studies validate the above statement.

Islam (2003) states that the monetary authority determines the exchange rate policy aiming to achieve two main objectives. First, the 'domestic target', which includes restraining inflation rate, credit growth in the public and private sector, and the growth of liquidity and broad money. Secondly, the 'external target', which includes promotion in international reserves level, reduce the current account gap, control trends of exchange rate changes in the local inter-bank foreign exchange market, and adjust the trends in the exchange rates of neighbouring trade partners: India, Pakistan and Sri Lanka.

Hossain et al (2005) quoted from Rahman (1995) and Bayes et al (1995) that the main objectives of exchange rate changes of Bangladesh were to: (i) promote international competitiveness; (ii) encourage exports diversification; (iii) withdraw subsidies from exports sector; (iv) discourage imports growth; and (v) rearrange resources in import substitutes and export oriented sectors. Aziz (2003) paper states that the finance ministers of last few regimes in their statement stated the following reason of devaluation of currency in Bangladesh: (i) increase export, (ii) discourage import, (iii) protect local infant industries, (iv) encourage the expatriates to send money to home, and (v) improve international reserve situation. According to the

‘Financial Sector Review (2006)’ of the Bangladesh Bank, the key aims of exchange rate policy of Bangladesh are to: (i) maintain competitiveness of Bangladeshi products in the world markets, (ii) encourage remittances inflow from expatriate wage earners, (iii) maintain stable internal price, and (iv) maintain a viable external account position. Thus, all the studies and policy papers have directly or indirectly articulated the export-led-growth and imports contraction targets as the main objectives of the exchange rate policy of Bangladesh.

However, hardly few studies estimated the effect of exchange rates policy on balance of trade. Thus, this study aims at filling this vacuum.

1.2 Historical Overview

Although conventionally ‘Fixed’ and ‘Flexible’ exchange rates are recognised systems in international trade, Edwards and Savastano (1999) has listed nine different exchange rate regimes in the present world. The International Monetary Fund (Annual Report-2006), on the other hand, categorised eight different types of presently practiced exchange rate regimes in the world economy. All regimes and respective number of followers of the regimes are as follows:

Exchange Rate Regimes	No. of Countries
Exchange arrangements with no separate legal tender	41
Currency board arrangements	7
Conventional fixed-peg arrangements	49
Pegged exchange rates within horizontal bands	6
Crawling pegs	5
Exchange rates within crawling bands	**
Managed floating with no predetermined path for the exchange rate	53*
Independently floating	26

Source: IMF Annual Report 2006

*Note: *according to IMF Annual Report 2006, Bangladesh belongs to this exchange rate system, in which the monetary authority tries to influence the exchange rate without taking a precise exchange rate target. Authority intervenes directly or indirectly. However, intervention takes place considering the parallel market status, balance of payments position, international reserves situation etc. ** none.*

The choice of exchange rate policy partly depends on the targets that policy makers aim to attain. IMF (2006) classified the principle objectives of countries for which they choose different exchange rate policies which are as follows.

Monetary policy framework	No. of Countries
Exchange rate anchor	96
Monetary aggregate target	31*
Inflation targeting framework	24
IMF-supported or other monetary program	08
Other	35

Source: IMF Annual Report 2006

*Note: * according to IMF Annual Report 2006, Bangladesh belongs to this group, where the monetary authority takes the exchange rate policy to achieve the targets of international reserve, narrow money (M_1), broad money (M_2) etc.*

Bangladesh fixed its exchange rate with the British Pound Sterling in January 1972. However, after the breakdown of the Bretton Woods system the sterling was floating against the dollar. Since then Bangladeshi currency ‘Taka’ was floated through its link to the sterling. In August 1979, the monetary authority pegged the exchange rate to a basket of major trading partners’ currencies where the sterling was used as the intervening currency. Since 1983 the US Dollar has been replaced as intervening currency instead of the British Pound Sterling.

As an important trade and financial policy measure Bangladesh has changed its exchange rate policy accepting the obligations of IMF article VIII on March 24, 1994 by making the taka (local currency) fully convertible for current account transaction. Subsequently, as a member of IMF, Bangladesh was under pressure to open its exchange rate market. Finally, on May 31, 2003 Bangladesh introduced floating exchange rate system in current account. The IMF approved a loan for Bangladesh under the Poverty Reduction and Growth Facility (PRGF) only after switching to a floating exchange rate system.

Nevertheless, Younus et al (2006) viewed that the free floating exchange rate regime was deployed in order to prevent the overvaluation of home currency because such overvaluation would make the exports less competitive in the world market and the import substitutes harder to compete with import goods. Islam (2003) states that the key objective of the free floating exchange rate regime is to prevent the major misalignment of exchange rate, particularly, to prevent any unexpected appreciation of real exchange rate which can harm exports demand, to promote the present export level and reduce the current account deficit, restrain inflation, and enhance the remittances.

Bangladesh has been pursued an active exchange rate policy from the very inception of the country's independence in 1971, which is reflected in frequently announced nominal exchange rate changes of the Bangladesh Bank. Islam (2003) cited 89 adjustments in the exchange rate of taka in terms of dollar from 1983 onward of which 83 were devaluation. Aziz (2003) observed 41 times devaluation between 1991 and 2000. Younus et al (2006) state that between 1972 and 2002 the 'Taka' was devalued about 130 times to reduce the balance of payment deficits of Bangladesh. Hence this paper rightly chooses the exchange rate as the key explanatory variable of balance of trade.

This paper has calculated the nominal and real effective exchange rate of Bangladesh and the following figure exhibits the variability of the NEER and REER from 1972 to 2005. The graph demonstrates that the REER variability was the highest in the fixed exchange rate regime.

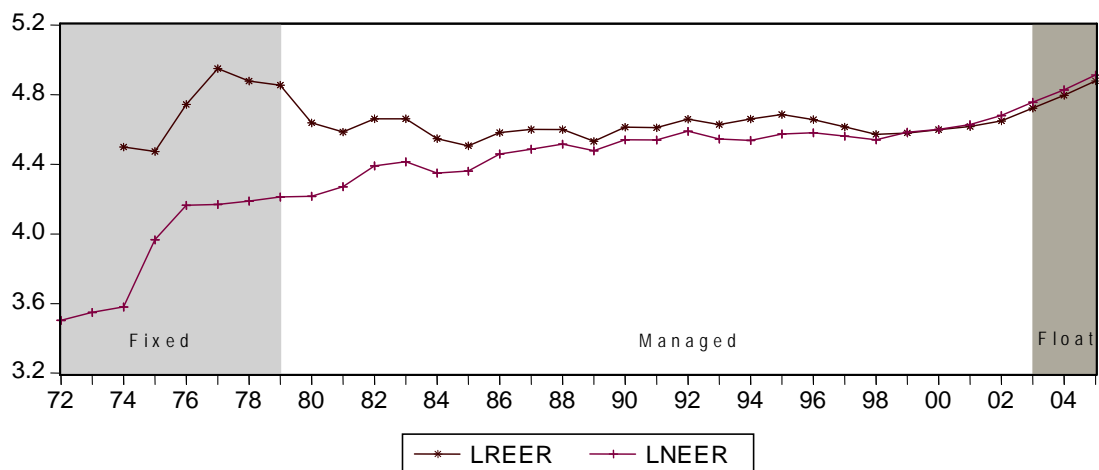


Figure 1: Exchange rate regimes and variability of REER and NEER.

[Note that the study has measured the nominal and real effective exchange rate in this paper by using the following technique:

$$REER_{jt} = \sum_{i=1}^k NEER_{jit} \left(\frac{P_{it}^*}{P_{jt}} \right)$$

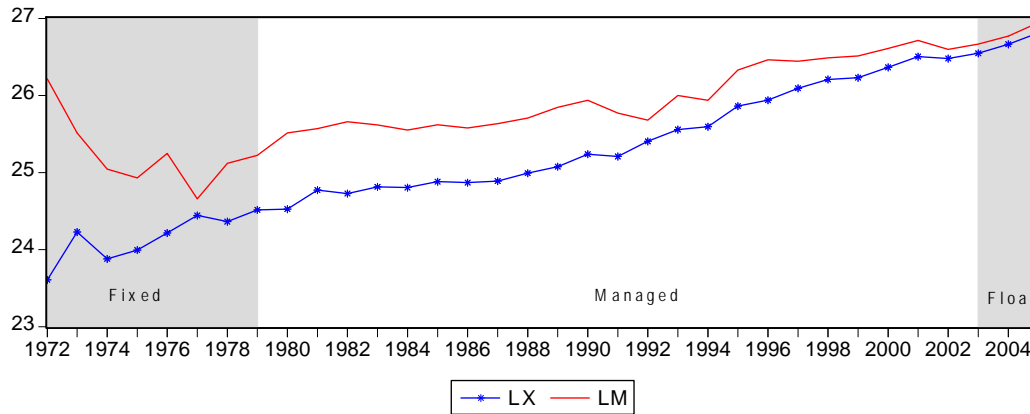
Where, $NEER_{jit} = \sum_{i=1}^k w_{it} E_{it}$; j implies reporting country; i trading partners ($i = 1, \dots, k$), $t =$ time; P_{it}^* , P_{jt} and w_{it} are trading partners wholesale prices index (WPI) if available otherwise consumer price index (CPI), Bangladeshi Price index (the study

had to use GDP deflator because WPI is not available and CPI is available from 1986) and trade weight of partners, respectively.

This study used Bahmani-Oskooee's (1995) four step REER (index) calculation method using IFS data. The study incorporated major 22 countries as Bangladeshi trade partners who explain 66% of total trade and 76% of total export trade of Bangladesh.]

Immediately after independence in 1971, Bangladesh adopted a highly regulated financial, fiscal and industrial policy along with inward-oriented import-substituting trade and overvalued exchange rate system. The resulting macroeconomic performance was not satisfactory in terms of GDP growth, inflation, industrial output, fiscal deficit and balance of trade. Thus, to achieve a high and sustained economic growth and rapid development, Bangladesh, like many other countries, shifted from the inward-looking regime towards a more liberalized market oriented regime. Since 1980s, most of the trade and industrial policies basically have aimed at higher growth in the export sector. International competitiveness, faster growth of export-oriented industries, tariff rationalization, access to bigger markets, encouraging imports of intermediate capital goods were the main objectives of the then exchange rate and trade policies of government. Although trade liberalization has gradually taken place since 1980s, the policy gained its momentum from early 1990s by a huge reduction in tariff rates and quantitative restrictions, and convertibility in exchange rates. Since then Bangladesh has pursued a liberalizing trade policy consistent with the idea of Uruguay Round Accord of the World Trade Organization (WTO).

Trend in trade balance of Bangladesh demonstrates improvements overtime with some volatility in between. The following figure depicts the export-import trends of the country from 1972 to 2005.



Source: World Development Indicators (Edition: September 2006), World Bank

Figure 2: Exports (LX) and Imports (LM) trend (balance of trade) of Bangladesh.

The plan of this study is as follows. Section-2 includes the literature review, model specification, data and estimation of the study, section-3 describes the empirical framework, and section-4 contains the conclusions emerged from the study.

2.1 Literature Review

Rose (1991) paper examined the empirical relation between real effective exchange rate and trade balance of major five OECD countries in the post-Bretton Woods era. Rose's study depicts the exchange rate as insignificant determinant of balance of trade. Rose and Yellen (1989) could not reject the hypothesis that the real exchange rate was statistically insignificant determinant of trade flows. They examined the bilateral trade flows between the United States and other OECD countries using quarterly data.

Singh (2002) demonstrates that 'real exchange rate' and 'domestic income' show a significant influence while 'foreign income' shows an insignificant impact on 'trade balance' finds in Indian data. Singh's study shows a very significant effect (+2.33) of real exchange rate and domestic GDP (-1.87) on Indian trade balance.

Vergil (2002) investigated bilateral trade flows of Turkey with the United States, France, Italy and Germany. Vergil's paper measured the real export of Turkey as a function of real foreign economic activity, bilateral real exchange rate and exchange rate volatility. The study indicates that real exchange rate shows a significant impact (+2.24) on real exports of Turkey to the United States. However, bilateral real exchange rate shows very small influence on real exports to France (+0.31), Italy (+0.65) and Germany (+0.72).

Onafowora's (2003) paper examined the effects of real exchange rate changes on the real trade balance. The study investigated three ASEAN countries, Malaysia, Indonesia and Thailand in their bilateral trade to the US and Japan by employing a cointegrating vector error correction model (VECM). The result indicates a positive long-run relationship between the real exchange rate and the real trade balance in all cases, i.e., Indonesia-Japan (+0.351), Indonesia-US (+0.243), Malaysia-Japan (+1.252), Malaysia-US (+0.644), Thailand-Japan (+1.082), and Thailand-US (+1.665). The estimations for Malaysia-US, Indonesia-US, and Indonesia-Japan indicate that real trade balance has a negative relationship with real domestic income and a positive relationship with real foreign income in the long run. However, the real trade balance in the models for Malaysia-Japan, Thailand-US, and Thailand-Japan depicts a different result, the positive relationship with real domestic income and a negative relationship with real foreign income.

2.2 Model Specification, data and estimation

Bangladesh is a small country in the sense that its imports prices are given in the world market and the prices are independent of volume of imports. Thus demand for imports would depend on mainly real domestic income. However, the demand for imports can also be determined by real exchange rates. The following figures demonstrate the likely impacts of REER changes on balance of trade.

Small Open Country Case

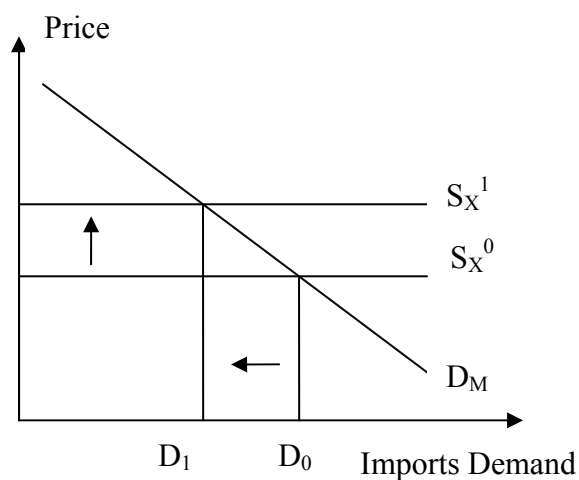


Figure 3(a): Increase in imports price due to increase in the REER which reduces imports demand.

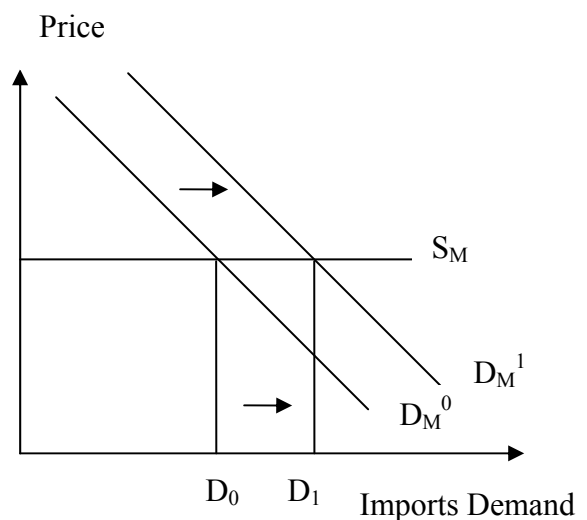


Figure 3(b): Imports demand rises due to the increase in the real domestic income.

On the other hand, export demand generally depends on the relative prices of competing goods from the competing countries and on foreign (trade partners) GDP. If REER increase, the exports commodities become cheaper to the importers and thus, the exports increases which can be shown in the following figure.

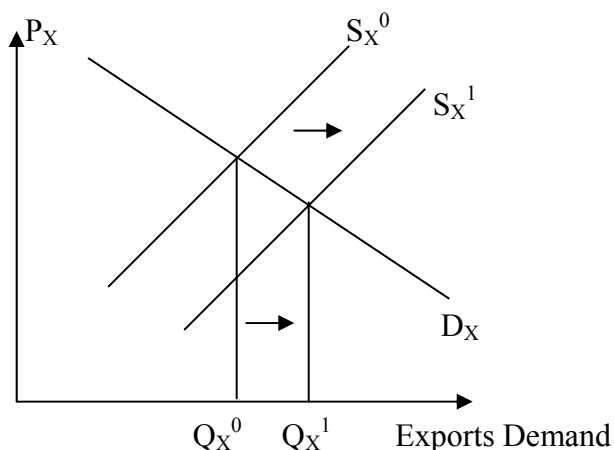


Figure 3(c): Increase in exports demand due to increase in REER

Therefore, it is expected that an increase in the real exchange rate would improve the balance of trade. The study investigates whether this is the reality for Bangladesh export and import trade.

This study attempts to develop a similar model applied by Singh (2002) and Rose (1991) in their studies that the trade balance is a function of real exchange rate and the domestic and foreign real income. A log-linear specification of the model can be stated as follows:

$$\ln TB_t = \beta_0 + \beta_1 \ln REER_t + \beta_2 \ln Y_t + \beta_3 \ln Y_t^* + \varepsilon_t$$

Where, $\ln TB_t$, $\ln X_t$, $\ln M_t$ imply logarithm of balance of trade ($\ln X_t - \ln M_t$), exports and imports at time t respectively. $\ln REER_t$, $\ln Y_t$, $\ln Y_t^*$ are logarithm of real effective exchange rate, real gross national product of Bangladesh and world real industrial production index (proxy of trade partners income). Data come from the ‘World Development Indicators (April 2007)’ of the World Bank. All data are in local currency term (Taka). The study employed 34 annual observations (1972-2005) of Bangladesh and we have used annual data because quarterly data of some relevant variables are not available.

The theoretical notion suggests that the exports and imports increases as the real income of the trade partners and domestic income rises respectively, and vice

versa. In that case we could expect $\beta_2 < 0$ and $\beta_3 > 0$. However, imports may decline as income increases if the real income rises due to an increase in the production of import-substitute goods, and in that case we would expect $\beta_2 > 0$ and $\beta_3 < 0$. The effect of changes in real effective exchange rate on balance of trade is ambiguous. Hence, β_1 could take any sign, positive or negative. Generally, if real depreciation/devaluation takes place, which causes the real effective exchange rate to increase, the exports go up, the imports fall as a consequence and it improves the trade balance.

This study, first of all, attempted to examine the variables of the model whether all of them are the same order of integration. We graphically plotted the values of variables to have a primary idea about stationarity of data and then used most popular ‘Augmented Dickey-Fuller’(ADF) and ‘Kwiatkowski-Phillips-Schmidt-Shin’(KPSS) test statistic of unit roots to affirm the results which we have found from graphical representation. After being confirmed that all the variables are of the same order of integration, I(1), the study proceeded on to test the long-run behaviour of economic variables, named cointegration test. We carried out the Johansen maximum likelihood cointegration testing procedures and found that there was a long-run stationary steady state. Finally, a general-to-specific parsimonious dynamic model based on the Engle-Granger residual was derived. Diagnostic check of model appropriateness was employed in the end. We plotted the values of recursive estimates of the coefficients of the error correction model (ECM). One-step residual, chow and forecast graphics were employed to check any structural break. Figure of actual and fitted values was also derived to observe the fitness of the model. The paper, then, tested pair-wise Granger causality among the variables. Finally the study investigated the short- and long-run response of balance of trade to real exchange rate of Bangladesh graphically by using IRF.

3.1 Empirical results

3.1 (a) Test for order of integration

Before estimating the cointegration and ECM, the study examined each individual series, balance of trade ($\ln TB_t$), real exchange rate ($\ln REER_t$), real income ($\ln Y_t$), and trade partners real income ($\ln Y_t^*$) using the ADF and KPSS tests statistic. Tests results portray that the variables of interest show unit roots at level and

stationary at its first difference, which is presented below. We used KPSS because it is argued that the power of the ADF test statistic is poor at deciding (in case: $X_t = \mu + \phi X_{t-1} + \varepsilon_t$) whether $\phi=1$ or $\phi=0.97$, especially in small sample case and on the other hand KPSS statistic is powerful in this regard.

Table 1: Tests for order of integration

	Tests for I(0)				Test for I(1)			
	ln(BT)	ln(REER)	ln(Y)	ln(Y*)	Dln(BT)	Dln(REER)	Dln(Y)	Dln(Y*)
<i>Augmented Dickey-Fuller test</i>								
no trend	-1.401	-2.277	4.520	-0.466	-4.247	-4.929	-3.082	-4.116
with trend	-3.163	-1.867	-0.403	-2.915	-4.152	-5.733	-4.522	-4.213
<i>Kwiatkowski-Phillips-Schmidt-Shin test</i>								
No trend	0.987	0.373	3.365	3.357	0.294	0.117	0.351	0.044
with trend	0.146	0.396	0.711	0.124	0.102	0.105	0.031	0.028

Note: Null hypothesis for Augmented Dickey-Fuller (ADF), is the series has a unit root (non-stationary), but null hypothesis for Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test is the series is stationary. The critical values for ADF are -3.65 (without trend), -4.26 (with trend) at 1%, -2.96 (without trend) -3.56 (with trend) at 5% and -2.62 (without trend), -3.21 at 10% level of significance which have been tabulated from Mackinnon (1996) one-sided p-values. The critical values for KPSS are 0.739 (without trend), 0.216 (with trend) at 1% 0.463 (without trend), 0.146 (with trend) at 5% and 0.347 (without trend), 0.119 (with trend) at 10% level of significance.

3.1 (b) Cointegration Analysis

Many economic time series show a stochastic trend and a general pattern of change over time and thereby apparently give misleading idea that they are cointegrated. However, if we examine them properly we find that many of those actually have spurious relation. In modern economics, the Engle-Granger and the Johansen technique help us to test for non-cointegration relation among the economic variables. We statistically tested the relationship among the variables using both methods.

Engle-Granger's residual based two-step cointegration test

We started the cointegration analysis employing the Engle-Granger two-step procedure. In the first step the long-run equilibrium relation among the variables has been estimated. The result is as follows:

$$lnTB_t = 9.83 + 1.07lnREER_t - 0.75lnY_t + 0.27lnY_t^* + 0.054Trend$$

Then we obtained the residuals:

$$\hat{\varepsilon}_t = \ln TB_t - 9.83 - 1.07 \ln REER_t + 0.75 \ln Y_t - 0.27 \ln Y_t^* - 0.054 \text{ Trend}$$

In the second step, we tested the order of integration of residuals $\hat{\varepsilon}_t$ using ADF statistic and the result indicates that we can reject null hypothesis of non-stationary i.e., $\hat{\varepsilon}_t$ is stationary of I(0) order (result is presented in appendix).

The same can be shown graphically as well. The following figure shows no trend (no random walk) and thereby, long-run equilibrium relation (cointegration) holds.

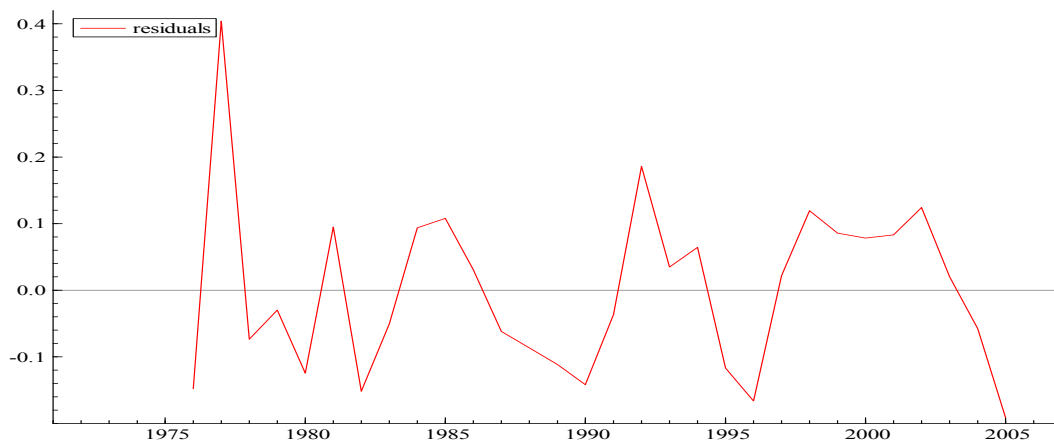


Figure 4: Unit Roots test result of residual in Engle-Granger procedure

Therefore, Engle-Granger two-step procedure affirms that the $\ln B_t$ and $\ln REER_t$, $\ln Y_t$ and $\ln Y_t^*$ are cointegrated. The results suggest that the REER has a significant positive impact on balance of trade and its elasticity is more than one which indicates that if REER increases (depreciation/devaluation) by 1 percentage point the balance of trade improves 1.033 percentage points. Real GDP and real foreign income also show the expected negative and positive signs, respectively.

Johansen Full-Information Maximum Likelihood Method

Although Engle-Granger (1987) first proposed cointegration techniques, there are some shortcomings in their methodology. First, Engle-Granger method gives deliberate choice of the endogenous variable to put on the left-hand side of the model. They also ignore the possibility of more than one cointegrating vector when more than two variables are included in the model. On the contrary, in the Johansen multivariate

approach, all the variables are explicitly endogenous so that no arbitrary normalization has to be made without testing. Thus, the study also employed the Johansen cointegration test technique using Trace Statistic and Maximum Eigenvalue statistic. The test result is presented as follows:

Table 2: Johansen’s Cointegration test (Sample: 1977 - 2005)

Null hypothesis	Alternative hypothesis	Trace test		Maximal Eigenvalue test	
		Statistics	95% critical value	Statistics	95% critical value
$r = 0$	$r = 1$	72.088	63.876	32.344	32.118
$r \leq 1$	$r = 2$	39.744	42.915	19.820	25.823
$r \leq 2$	$r = 3$	19.924	25.872	13.762	19.387
$r \leq 3$	$r = 4$	6.162	12.518	6.162	12.518

Note: the ‘r’ implies the number of cointegrating vectors and critical values are from the MacKinnon-Haug-Michelis table (1999) at 5% level of significance. Both the Trace statistic and maximal eigenvalue test statistics confirm one cointegration relation among the variables. We reject zero cointegration relation but cannot reject one cointegration I(1) relation at 5% level of significance.

Both the ‘trace statistic’ and ‘eigenvalue test’ leads to the rejection of the null hypothesis of $r = 0$ (no cointegrating vectors) against the alternative hypothesis $r > 0$ (one or more cointegrating vectors) while the null of $r \leq 1$ against the alternative of $r > 1$ (two or more cointegrating vectors) cannot be rejected at 5% level of significance. Therefore, we have assumed that there is only one cointegrating relationship in our model. This result greatly simplifies the interpretation of the first cointegrating vector, I(1) as a stable long-run relationship among $\ln TB_t$ and $\ln REER_t$, $\ln Y_t$ and $\ln Y_t^*$.

Weak exogeneity

After being confirmed the existence of one cointegrating vector in the process, we examined the exogeneity status of variables by imposing general cointegration restrictions, which was required for efficient inferences in our single-equation error-correction model. The study assumed four possible long-run relationships among $\ln TB_t$, $\ln REER_t$, $\ln Y_t$ and $\ln Y_t^*$ variables where each of the variables could be dependent whilst others would be exogenous in the same equation. However, we imposed restrictions to investigate the $\ln TB_t$ as endogenous and $\ln REER_t$, $\ln Y_t$ and

$\ln Y_t^*$ variables were exogenous in the model subject to three other possible relations could not hold. The χ^2 based long-run weak exogeneity test validated our restriction at 5% level of significance. The weak exogeneity test gives the following long-run equilibrium relation² (standard errors in parenthesis):

$$\ln TB_t = 0.96 \ln REER_t - 0.402 \ln Y_t + 0.57 \ln Y_t^* + 0.033 \text{Trend}$$

The above long run relation suggests that real effective exchange rate and real income of trade partners influence the balance of trade of Bangladesh positively, whereas real (home) GDP effects negatively. Similar to the previous long-run relationship stated using the Engle-Granger method, this equilibrium relationship explains that in the long-run the real effective exchange rate has a big positive significant impact on balance of trade of Bangladesh.

3.1 (c) General-to-specific dynamic model

The short-run dynamics of the balance of trade of Bangladesh was estimated following general-to-specific modelling approach. Given that all variables are in their first difference, we restricted the lag structure to three periods. Insignificant lags were eliminated sequentially. We employed the following model to construct a dynamic model -

$$\Delta \ln TB_t = \alpha_0 + \sum_{i=1}^3 \alpha_i \Delta \ln TB_{t-i} + \sum_{i=0}^3 \beta_i \Delta \ln REER_{t-i} + \sum_{i=0}^3 \gamma_i \Delta \ln Y_{t-i} + \sum_{i=0}^3 \delta_i \Delta \ln Y_{t-i}^* + \lambda EC_{t-1} + \psi \text{Trend}$$

The short-run dynamic estimate suggests that current REER has a positive and significant effect on balance of trade (although one-and two-year lag REERs shows a negative influence). The coefficient of EC_{t-1} (speed of adjustment) appears to be negative, which is a feature necessary for model stability. The coefficient of lagged equilibrium (-0.66) implies a rapid speed of adjustment back to the equilibrium. The results of ECM analysis are reported as follows:

² Long-run test of restrictions: $\chi^2 = 7.4136$ [0.0598] which implies that we can reject the imposed weak exogeneity restrictions.

Table 3: Estimated ECM.

<i>Independent Variables</i>	<i>ECM based on the Johansen technique (SE in bracket)</i>	<i>ECM based on Engle-Granger residual (SE in bracket)³</i>
<i>Constant</i>	0.73*** (0.2107)	-0.127* (0.0659)
$\Delta \ln REER_t$	0.62** (0.2706)	0.627** (0.267)
$\Delta \ln REER_{t-1}$	-0.87*** (0.2599)	-0.931*** (0.250)
$\Delta \ln REER_{t-3}$	-0.70*** (0.2442)	-0.705*** (0.241)
$\Delta \ln Y_{t-1}$	3.38** (1.538)	3.411** (1.516)
EC_{t-1}	-0.66*** (0.1461)	-0.66*** (0.1423)
Diagnostic Check for Model Appropriateness		
	<i>Johansen estimator based</i>	<i>Engle-Granger residual based</i>
R^2	0.76	0.77
<i>Sigma</i>	0.085	0.084
<i>RSS</i>	0.160	0.156
<i>log-likelihood</i>	27.0777	32.96
<i>F(5,22)</i>	13.86***	14.36***
<i>DW</i>	1.83	1.77
<i>no. of observations</i>	28	28
<i>no. of parameters</i>	6	6
<i>AR 1-2 test:</i>	$F(2,20) = 0.12835 [0.8803]$	$F(2,20) = 0.20117 [0.8194]$
<i>ARCH 1-1 test:</i>	$F(1,20) = 0.77904 [0.3879]$	$F(1,20) = 0.66501 [0.4244]$
<i>Normality test:</i>	$\chi^2(2) = 6.1052 [0.050]$	$\chi^2(2) = 6.4874 [0.040]$
<i>hetero test:</i>	$F(10,11) = 0.27853 [0.9732]$	$F(10,11) = 0.25665 [0.9796]$
<i>RESET test:</i>	$F(1,21) = 0.46269 [0.5038]$	$F(1,21) = 0.43482 [0.5168]$

***, ** and * implies statistically significant at 1%, 5% and at 10 % level.

Note: $R^2 = 0.76$ imply that the model is good fit. F-test result indicates the overall significance of the model. The AR test is the Lagrange Multiplier test for detecting autocorrelation where the null hypothesis is 'no-autocorrelation'. This test examines up to 2nd order serial correction and cannot reject the null hypothesis at 5% level of significance. The null hypothesis of 'autoregressive conditional heteroscedasticity (ARCH) test is: 'no heteroscedasticity' and we cannot reject the null hypothesis. Normality test is χ^2 based test, which assumes that residual contains all the properties of classical linear regression model and the test statistic cannot reject this hypothesis at 10% level of significance. Hetero test is F statistic based 'White test' which assumes 'no heteroscedasticity' in the regression and the test statistic cannot reject that assumption. Regression Error Specification (RESET) test assumes that 'regression coefficients are significant' which we cannot reject at 5% level of significance. The

³ If we delete the insignificant constant (at 5% level) we find a different parsimonious equation which is reported in Appendix B.

study graphically examined the 'structural stability' test. All recursive graphic tests (figure-5) ensure that there is no structural break, which affirms structural stability of the model. The graph of actual and fitted values of balance of trade (figure-6) shows fitness of the model.

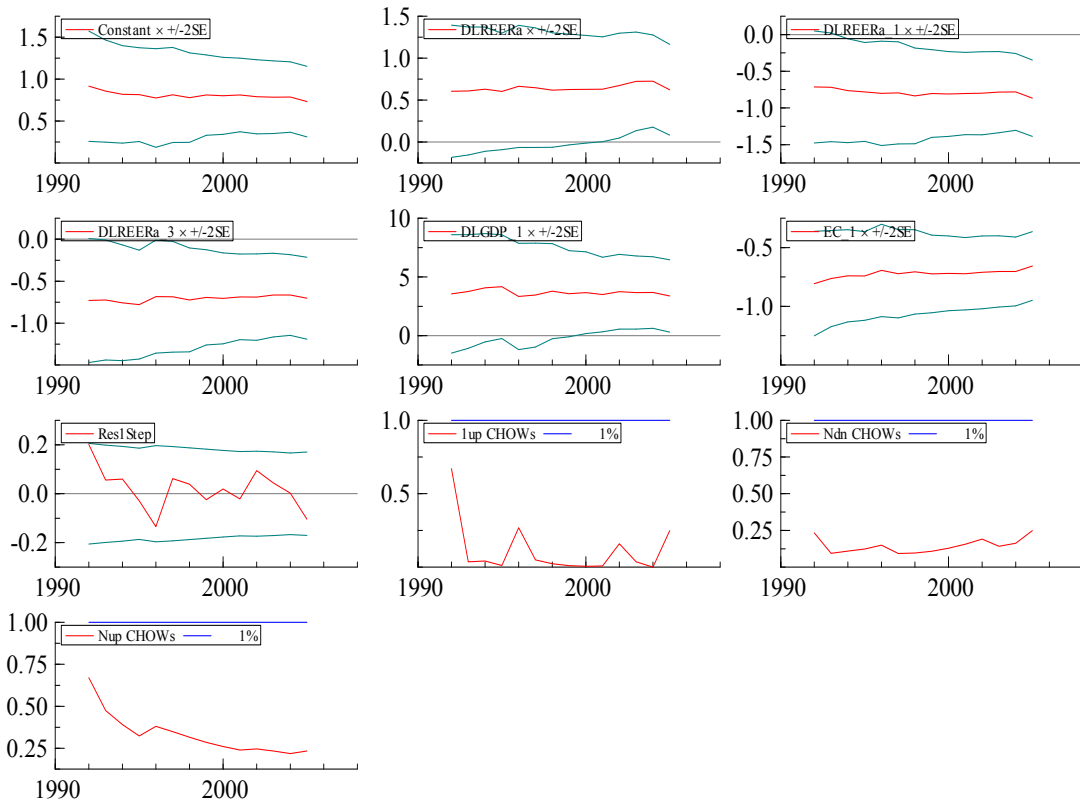


Figure 5: Recursive estimates of beta coefficients of the error correction model and structural instability test (1-step Residuals +/- 2SE, 1-step chow, beak-point chow and forecast chow tests)

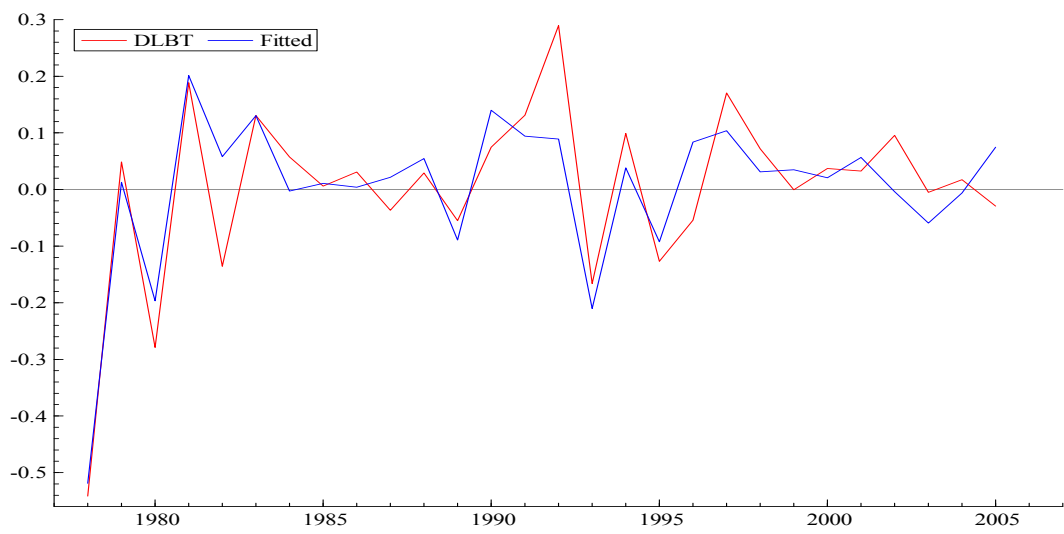


Figure 6: Actual and fitted balance of trade.

3.2 Granger Causality Test

This section contains the Granger causation that examines the short-run relations among the four variables employed in balance of trade regression equation.

The Granger (1969) method test the causal relationship using the following technique. For instance, if we want to test whether X causes Y, we examine that how much of the present Y can be illustrated by lagged values of Y and X. It is worth mentioning that both-way causation (X causes Y and Y causes X) also a common case in the real world. In the Granger causality we test null hypothesis that X does not granger cause Y; and if we can reject the null, it implies that X does Granger cause Y. A bivariate regression form for the Granger causation is as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^l \alpha_i Y_{t-i} + \sum_{i=1}^l \beta_i X_{t-i} + \varepsilon_t$$

$$X_t = \alpha_0 + \sum_{i=1}^l \alpha_i X_{t-i} + \sum_{i=1}^l \beta_i Y_{t-i} + \nu_t$$

The joint hypothesis of F-test based Wald statistics for each equation:

$$H_0 : \beta_1 = \beta_2 = \beta_3 = \dots = \beta_l = 0$$

The empirical results are reported as follows:

Table 4: Pairwise Granger Causality Tests (F-statistic; sample: 1972-2005; lags: 2)

	$\Delta \ln TB_t$	$\Delta \ln REER_t$	$\Delta \ln Y_t$	$\Delta \ln Y_t^*$
$\Delta \ln TB_t$	-	7.7124*** (30)	6.4663*** (32)	3.9553** (32)
$\Delta \ln REER_t$	0.8443 (30)	-	1.3920 (30)	2.1224 (30)
$\Delta \ln Y_t$	4.6688** (32)	1.9564 (30)	-	4.5015** (32)
$\Delta \ln Y_t^*$	1.8229 (32)	0.4673 (30)	10.4321*** (32)	-

Notes: The F-statistic values of overall significance are given in the table. Number of observations is given in parenthesis. ** reject the null hypothesis that horizontal variable does not cause the respective vertical variable to change at 5% level of significance. *** reject the null at 1% level of significance.

The Granger causality test statistic reveals that the REER, real gross domestic income and real foreign income Granger cause the trade balance of Bangladesh. It also gives another idea about Bangladesh economy that the REER causes the real gross domestic income of Bangladesh to change. Real gross national expenditure

causes the world real income to change which implies that Bangladesh is longer a very tiny economy.

3.3 Exchange Rate Dynamics and J-Curve: IRF⁴ analysis

Onafowora (2003) investigated the Marshall-Lerner condition using IRF and found that the Marshall-Lerner condition holds in the long-run in three ASEAN countries: Indonesia, Malaysia and Thailand. This paper also examined the response of the balance of trade to the real effective exchange rate of Bangladesh through Impulse Response Function (IRF) analysis similar to Onafowora (2003).

The results demonstrate that depreciation leads to an unexpected fall in exports earning and rise in imports cost for Bangladesh immediately after devaluation. Thus the balance of trade deteriorates immediately after depreciation and then starts improving from the second period and eventually goes to the baseline. The combined results support the Marshall-Lerner condition through the J-curve idea.

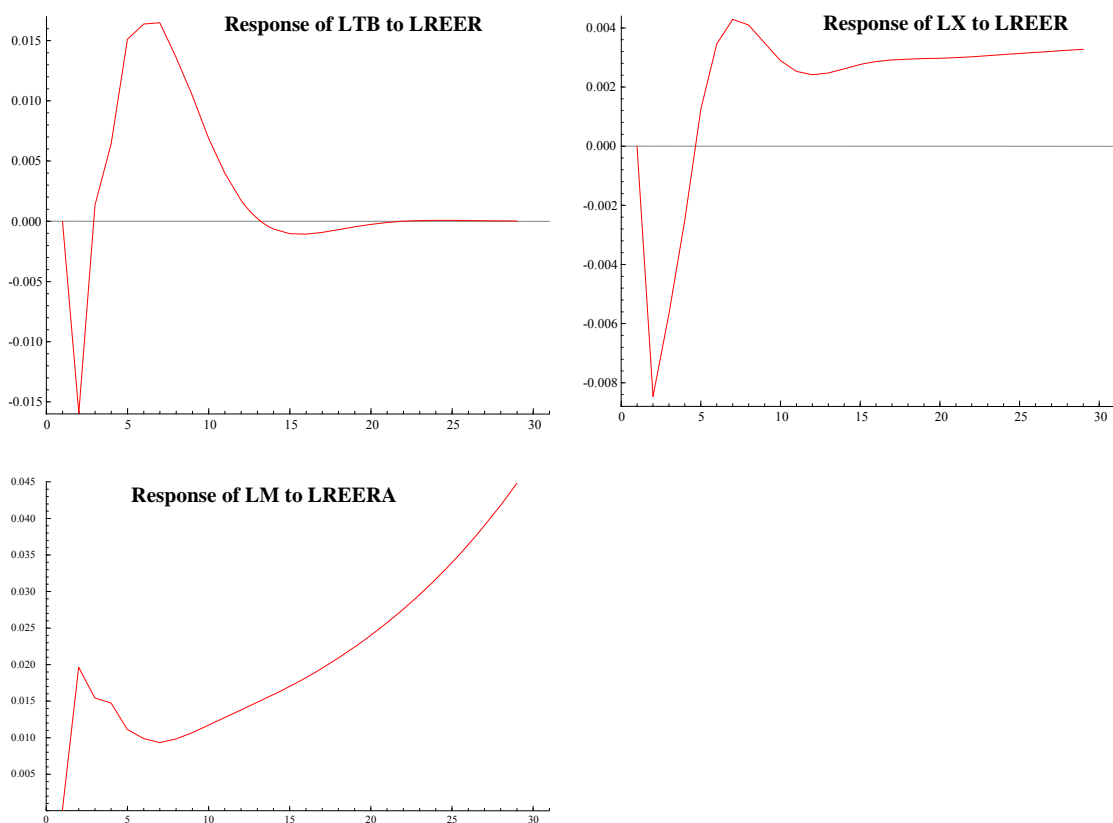


Figure 7: IRF (standard error based) of balance of trade (LTB), exports (LX) and imports (LM) to REER.

⁴ Impulse Response Function

Depreciation of currency does not always necessarily improve the balance of trade due to a bunch of reasons. First, if the Marshall-Lerner condition, the sum of the elasticities of demand for exports and imports is greater than one, does not satisfy, currency devaluation can not improve the balance of trade, although it is sufficient not necessary condition for improvement of trade balance. Note that at a special circumstance where the supply elasticities are infinite, the Marshall-Lerner condition satisfies both the necessary and sufficient conditions. Secondly, if the change of term of trade is given by the following elasticity approach:

$$\hat{t} = \hat{P}_X - \hat{P}_M = \left(\frac{\varepsilon_M \varepsilon_X - \eta_M \eta_X}{(\eta_X - \varepsilon_X)(\eta_M - \varepsilon_M)} \right) \hat{e}$$

The trade balance will improve following a devaluation if the product of demand elasticities ($\varepsilon_M \varepsilon_X$) exceeds that of supply elasticities ($\eta_M \eta_X$). Thirdly, as Williamson (2004) stated that if the considered country finances its current account deficit by foreign loan, both the principle and interest would increase in home currency term with the devaluation/depreciation of currency and therefore, advantage of devaluation would be eaten up by the repayments of its pervious commitments. Finally, if there is interdependence between exports and imports markets, depreciation may not improve the balance of trade immediately due to following reasons: (i) higher exports generates higher incomes and the citizens may spend part of it on imports, (ii) higher exports demand may require more intermediate inputs to import and may deteriorate the balance of trade initially, (iii) devaluation may encourage higher investment by raising profits and hence investment goods may be imported for more investments to take place.

The main reasons behind the J-curve behaviour for Bangladeshi balance of trade, to my opinion, firstly, as a small country the production capacity of Bangladesh determines exports supply. Thus following a devaluation/depreciation when exports demand increases, it raises the imports demand of intermediate inputs of exporting industries. Due to lack in production capacity it takes time to install the fixed inputs in exporting industries and most of which are imported (Appendix C) from trade partners and thereby, raises the imports demand in the beginning of depreciation. For instance, RMG controls 74.16 percent of exports earnings and ‘textiles and textile articles’ which directs 41.55 percent of total imports costs are the intermediate input of RMG industry.

4. Conclusion

Both the Engle-Granger and the Johansen test confirm the presence of a long-run cointegrating relationship among the variables of interest in the study. The study also suggests that the real exchange rate has a significant impact on balance of trade of Bangladesh both in the short-run and long-run. The Granger causality test affirms the causal relation between exchange rate and balance of trade of Bangladesh. The IRF also supports the above mentioned positive impact of real effective exchange rate on balance of trade in the long run.

The study clearly indicates that real devaluations/depreciations of exchange rate have been positively associated with improvement of balance of trade. Thus, depreciation/devaluation of currency as a whole seems to be beneficial for Bangladeshi exports. However, economists discourage continual depreciation as because highly volatile exchange rate makes macroeconomic variables such as inflation, interest rate, narrow & broad money supply etc, unstable. Moreover, complete credibility of trade partners on the exchange rate is important for stable trade flows. As Bangladesh currently operates its exchange rate policy under free floating exchange rate system, a stronger official market is required so that the speculators cannot bring a total collapse in the currency market. It needs to ensure the lower degree pass-through from exchange rate to inflation as well. Otherwise undervalued exchange rate policy could be proved detrimental for Bangladesh.

Unfortunately, Bangladesh has to compete with some very big competitors such as China, India, Indonesia, Sri Lanka and Pakistan in its top most export item, garments. In case of other export commodities such as tea, jute and jute products, frozen fish and foods, leather etc it has to compete, more or less, with the neighbouring countries India, Pakistan and Sri Lanka. Thus, the experiences of those countries also can provide useful lessons for Bangladeshi exchange rate policy.

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APPENDICES

Appendix A: Order of integration of residuals in Engle-Granger (1978 – 2005, constant)

Lag	ADF (t-statistic)	Beta	Sigma
1	-3.768**	0.118	0.1064
0	-5.262**	0.150	0.1044

Appendix B:

<i>Independent Variables</i>	<i>ECM based on the Johansen technique (SE in Parenthesis)</i>	<i>ECM based on Engle-Granger residual (SE in Parenthesis)</i>
<i>Constant</i>	0.73*** (0.2107)	-
$\Delta \ln REER_t$	0.62** (0.2706)	0.951*** (0.2738)
$\Delta \ln REER_{t-1}$	-0.87*** (0.2599)	-0.626** (0.2575)
$\Delta \ln REER_{t-3}$	-0.70*** (0.2442)	-
$\Delta \ln Y_{t-1}$	3.38** (1.538)	-
EC_{t-1}	-0.66*** (0.1461)	-0.72*** (0.1572)

<i>Diagnostic Check for Model Appropriateness</i>		
	<i>Johansen estimator based</i>	<i>Engle-Granger residual based</i>
R^2	0.76	-
<i>Sigma</i>	0.085	0.095
<i>RSS</i>	0.160	0.226
<i>log-likelihood</i>	27.0777	27.73
$F(5,22)$	13.86***	-
<i>DW</i>	1.83	1.40
<i>no. of observations</i>	28	28
<i>no. of parameters</i>	6	3
<i>AR 1-2 test:</i>	$F(2,20) = 0.12835 [0.8803]$	$F(2,23) = 1.7596 [0.1945]$
<i>ARCH 1-1 test:</i>	$F(1,20) = 0.77904 [0.3879]$	$F(1,23) = 0.92400 [0.3464]$
<i>Normality test:</i>	$\text{Chi}^2(2) = 6.1052 [0.050]$	$\text{Chi}^2(2) = 0.18748 [0.9105]$
<i>hetero test:</i>	$F(10,11) = 0.27853 [0.9732]$	$F(6,18) = 0.58543 [0.7376]$
<i>hetero-X test:</i>	-	$F(9,15) = 0.60307 [0.7762]$
<i>RESET test:</i>	$F(1,21) = 0.46269 [0.5038]$	$F(1,24) = 0.92148 [0.3467]$

***, ** and * implies statistically significant at 1%, 5% and at 10 % level.

Appendix C⁵ : Share of total imports of Bangladesh (%)

Year	Percentage of Total Imports			Total (1+2+3)	Depreciation of exchange rate (Percentage)
	Foods items (1)	Intermediate Inputs (2)	Other inelastic imports (3)		
1991	16.00	36.39	34.05	86.43	5.86
1992	15.31	40.19	29.99	85.49	6.43
1993	15.87	43.02	26.41	85.30	1.58
1994	12.79	45.78	24.73	83.30	1.63
1995	17.25	41.41	25.00	83.65	0.17
1996	18.67	42.02	23.71	84.39	3.76
1997	13.01	43.78	25.72	82.51	5.02
1998	16.01	43.44	23.81	83.25	6.87
1999	26.60	38.44	19.23	84.27	4.65
2000	16.78	40.65	24.85	82.28	6.23
2001	15.31	43.20	23.86	82.37	7.03
2002	14.54	42.64	24.52	81.70	3.73
2003	19.84	39.63	22.82	82.29	0.45
2004	19.01	41.06	21.96	82.03	2.34

⁵ Calculated from Key Indicators 2006 (Bangladesh)-Asian Development Bank (www.adb.org/statistics)