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Testing the Existence of Purchasing Power Parity in Bilateral Trade between Bangladesh and India

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The paper uses the data of exchange rate and ratio of GDP deflators of Bangladesh and India covering the period 1971-2011 to justify the presence of Purchasing Power Parity (PPP) between the two countries. Unit roots test has been used to confirm the stationarity of the data. Cointegration test is used to verify the existence of a long-run relationship between exchange rate and the relative cost of bundles. While these two variables are not observed to be in equilibrium in the long run, Granger causality test finds no causal relationship between the two. This disequilibrium is further escalated due to the imposition of trade restrictions or other conditions affecting the bilateral trade relationship. These obstacles need to be addressed in order to ensure the stability of the exchange rate and maintain favourable trade relationship based on PPP.

Keywords: Purchasing Power Parity, The Cost of Domestic Baskets, The Cost of Foreign Baskets, Cointegration
JEL Classification: C32, C87, F14, F10

I. INTRODUCTION

The Purchasing Power Parity (PPP) relationship becomes a theory of exchange rate determination with the introduction of assumptions about the behaviour of importers and exporters in response to changes in the relative costs of national market baskets. PPP is based on the perfect capital market structure. According to the law of one price, when the price of a good differs between two country's markets, then the profit-seeking individuals attempt to buy the good in the low price market and resell it in the high price market. Similarly, if a market basket, containing many different goods and services, costs more in one market than another, it is expected that profit-seeking individuals will buy the relatively cheaper goods in the low cost market and resell them in the higher priced market.

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If the law of one price leads to the equalisation of the prices of a good between two markets, then it seems reasonable to conclude that PPP, describing the equality of market baskets across countries, should also hold (Suranovic 2006).

Most of the developing countries like Bangladesh as well as the SAARC countries share some basic properties in determining the exchange rate, whereas the exchange rate determination is quite different in developed countries. The most focusing differences are mentioned below:

i. The government intervention is higher in forex in the case of developing countries than the developed countries that sometimes leads to bid up or down of exchange rate from PPP.

ii. The share of non-tradable sectors is high in the developing countries compared to developed countries which leads to under valuation of exchange rate relative to their PPP because of differences in productivity between tradable and non-tradable sectors.

iii. Developing countries impose more trade restrictions, especially in the case of import, than the advanced countries. Sometimes these restrictions lead to different exchange rates from PPP.

iv. Divergences in economic structure and structural change are more rapid in developing countries than in industrially developed countries; as a result, the frequent change in income causes separation in exchange rate and PPP.

v. Volatility in changes in prices is more in less developed countries compared to developed countries. For countries facing high inflation rates (for many years), monetary factors would overshadow real factors and may provide support for PPP.

vi. Speculation is lower in developing countries than in the advanced countries, mainly due to strong control over foreign exchange. A large speculation leads to move exchange rates up and down from PPP.

vii. Industrialised countries have well developed financial markets, in such case the exchange rate is determined by the assets markets, whereas exchange rates and interest rates may dominate the foreign exchange markets.

Therefore, with an unfavourable support of PPP in advanced countries, the role of PPP in exchange rates determination in developing countries is still not clear. The economists as well as researchers continue their efforts to find out the validity of PPP in developing countries along with the advanced countries. But it is still in its early stage (Tang and Butiong 1994).

Bangladesh is a poor country in the third world, and like other developing countries the volume of imports exceeds the volume of exports to a large extent. So, the multilateral trade condition implies a huge trade deficit in Bangladesh. One of the basic properties of Bangladesh economy is that it mainly imports finished goods from the rest of the world which are relatively expensive and exports raw materials or agricultural semi finished goods to the rest of the world which are cheap in price. As a result, the deficit further increases. On the other hand, India, one of Bangladesh's closest neighbours, is also a developing country but it has achieved self-sufficiency in production and consumption in different kinds of commodities and the share of export is also increasing day by day. In bilateral trade relationship Bangladesh is facing trade deficit and India has trade surplus. In the FY2005-06 the official imports of Bangladesh from India was $1851 million but its exports to India were about $242 million. Trade deficit with India was $962 million in FY2001-02, which increased to $1,609 million in FY2005-06. It has further increased in the FY2010-11 and, according to some unofficial source, the import of Bangladesh from India is twenty times larger than its export to India. So, it becomes a burning question, will PPP hold for Bangladesh in bilateral trade relationship?

The paper attempts to examine whether PPP exists or not between the two neighbouring trade partners, Bangladesh and India. Section II provides literature review focusing the different works on PPP, while section III discusses the basic concept about PPP as well as equations of PPP. Section IV presents the methodology and section V provides the results. Finally, section VI concludes the paper.

II. LITERATURE REVIEW

A number of studies are published on testing of PPP in determining the exchange rate. Many techniques and econometric tools have been used in searching for relationship between PPP and exchange rates as well. The tests include both parametric ones, such as the Augmented Dickey–Fuller (ADF) and its variants like the ADF–GLS tests, and non-parametric tests, such as the Phillips and Perron (PP) test.

Frankel (1978) tested the validity of PPP but could not find any relationship between the PPP and exchange rate. He did not take into account the nonstationarity of regressors and residuals as well as the standard inferences were not appropriate. Other researchers used Augmented Dickey-Fuller test to detect the unit root. PPP does not hold in the long run if the real exchange rate of a

country contains unit root, which means no equilibrium for the exchange rate in the long run.

Tang and Butiong (1994) used cointegration techniques to scrutinize long run relationship between exchange rate and inflation rate of major Asian developing countries. The short run impacts were also evaluated by using Error-correction mechanism. In their study the PPP in 11 Asian developing countries were analysed and they found that PPP holds as a long run constraint in countries as a lower stage of economic development and characterised by underdeveloped capital market. They found that for both flexible and fixed exchange rate regimes, the exchange rate deviates from PPP.

Chowdhury (2004) depicts a nonlinear analysis about the relationship between the PPP and real exchange rate in Bangladesh over the period 1994 to 2002. But the analysis on such a topic requires a long span of data to find out long run relationship.

Ahmed (2005) uses evidence from some developing countries, especially the south Asian countries and finds that if PPP holds then the nominal exchange rate will not influence the real exchange rate in the same direction and real exchange rate remains constant and vice versa.

Ahmad and Rashid (2008) justify the stationarity of China and four countries of SAARC. According to them, in spite of using linear unit root tests (ADF or KPSS), the use of nonlinear KSS unit root tests gives more evidence of stationarity of real exchange rates.

The studies by Liew (2004) and Zhou (2008) show that the real exchange rates of India, Pakistan and Sri Lanka appear to be nonstationary. They obtained the result by using the nonlinear unit root tests.

Noman (2008) used a panel data approach to find out the relationship between the PPP and exchange rate in SAARC countries. He finds that the PPP relationship does not hold with the currencies of SAARC countries especially in the long run.

Rashid and Abbas (2008) made an analysis with the combination of PPP and UIP (Uncovered Interest Parity) as to show the relationship between exchange rates, price levels and interest rates. In their analysis they found that nominal exchange rates of domestic currencies, price levels and interest rates of domestic and foreign country move together in the long run. They conclude that the equilibrium exchange rate may be determined according to PPP and UIP for South Asian economies.

Bhuyan (2008) examined the nature of trade practices between Bangladesh and India to rationalise prospects of bilateral Free Trade Agreement (FTA). In the study it was suggested that the restrictive trade practices lead to differences in prices of same commodity (Traded) at home and abroad. One of the major reasons of trade imbalance between these two countries is inappropriate valuation (over or under valuation) of exchange rate. Other restrictions are tariff barriers, non-tariff barriers, strict rules of origin and difference in production structures. Based on his findings, it is evident that all these restrictions make difference in cost of commodity bundles (in the case of essential agricultural products this difference is much higher due to high tariffs on agricultural items) between these two countries, which, in turn, enhances trade imbalance (as in bilateral trade India has surplus and Bangladesh has deficit). Finally, he argues for removing such trade restrictions to have a fruitful FTA between these trading partners.

Despite these diverse findings and analysis here, the effort is made to authenticate a long-run symmetry between rate of exchange of Taka against Rupee and relative cost of commodity bundles, through using econometric tools. To make meaningful analysis, time series data has been taken for two cross sectional units. Data used in this study is secondary data or processed data.

III. THEORETICAL FRAMEWORK

Purchasing Power Parity (PPP) shows a long run relationship between the exchange rate and ratio of the cost of market baskets of the domestic country and the foreign country of trade relation. The equilibrium condition is shown below:

$$E = CDB/CFB \quad (1)$$

Here, E is the endogenous variable in the PPP theory representing the exchange rate and the CDB and CFB respectively represent the cost of domestic baskets (i.e. domestic price level) and the cost of foreign baskets (i.e. the foreign price level).

If exchange rate falls below the relative costs of bundles between two trading countries, then we have the following inequality:

$$E < CDB/CFB \quad (2)$$

Re arranging the equation 2, we thus get as follows:

$$\text{Or, } E*CFB < CDB \quad (3)$$

The equations 2 and 3 show if the exchange rate falls below the ratio of cost of domestic baskets and foreign baskets (the ratio of price levels) then the

domestic baskets will become cheaper in comparison to the foreign baskets, inducing the consumers to switch on to domestic market and the producers to switch to the foreign market to sell their products at higher prices and vice versa.

The logarithmic version of the PPP (equation-1) can be written as:

$$\text{Ln } E = \beta_0 + \beta_1 \text{Ln } (CDB/CFB) + \omega_i \quad (4)$$

Here, the CDB and CFB are the prices of domestic (Bangladesh) and foreign (India) baskets, β's are the coefficients to be estimated and **ω** is the disturbance term as short run deviation from PPP.

In measuring the cost of domestic baskets (CDB) and the cost of foreign baskets (CFB), we basically take GDP deflator for these two countries. Though there are some debates, which one is a better measure CPI or PPI (Producers Price Index) or GDP deflator as a proxy of price level? CPI represents costs of Consumption baskets for the typical consumer of an economy. Consumption baskets of typical consumer vary from country to country. On the other hand, PPI measures the typical price movements received by domestic producers for goods and services sold on the home or/and on the export markets between one time phase and another, which may also vary across borders (even if in little extent). GDP deflator is amore compact measure which includes all expenditures (such as consumption expenditure, investment, government expenditure and net export), it is the ratio of nominal and real GDP, and its components are same across borders. So to make the analysis robust we will use GDP deflator as a proxy of price level.

IV. METHODOLOGY

4.1 Unit Root Test

First we have to find out whether the time series data about exchange rate and ratio of CDB and CFB is stationary or non-stationary by using unit root test. This could be easily done by the Augmented Dickey-Fuller (ADF) test; the test is conducted through the following equation with a constant and a trend of form:

$$\Delta Y_t = \alpha_1 + \alpha_2 + \delta Y_{t-1} + \gamma_i \sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_i \quad (5)$$

Here, $\Delta Y_t = Y_t - Y_{t-1}$ and Y is the variable under consideration, m is lag in the explained variable with the Akaike Information Criterion and εi is the

stochastic disturbance term. In the case of unit root, the null hypothesis requires that $\gamma=0$. If it is found that the null hypothesis is rejected, it would imply that the series is stationary and no differentiation will be needed in that series in order induce stationary. To find out the stability of the critical values and power over different sampling experiment, we use ADF test.

4.2 Cointegration Test

In order to perform the cointegration test the variables in the time series analysis should have the property that they must be integrated in the same order. In this respect we can use a special method called Engle-Granger two-steps method (Engle-Granger, 1987). In first step the integration between the variables is identified and in the second step the OLS (Ordinary Least Square) is employed to estimate the residuals. Engle-Granger method verified that two variables such as Ln E and Ln (CDB/CFB) are co-integrated if they are integrated in the same order i.e., *I(d)* and the residuals in the regression of Ln E and Ln(CDB/CFB) are integrated of order less than *d.*

The cointegration between these two series was made through the Johansen-Juselius cointegration technique. Two types of test statistics, Trace test and Maximum Eigen value test statistic, are used to justify the cointegrated vectors. These are as follows:

$$\lambda_{trace} = T \sum_{i=r+1}^{n} \ln (1-\lambda_i) \quad (6)$$

$$\lambda_{max} = -T \ln (1-\lambda_{r+1}) \quad (7)$$

r and r+1 in the max statistic are the alternative roots to be tested for. Where r+1 will be tested to verify whether it is rejected or not in favour of r root. According to Johansen (1988), these two tests have non-standard distribution under the null hypothesis and provide approximate critical values for the statistic originated by Monte Carlo methods. The alternative hypothesis of trace test requires that the cointegrating vector is either equal or less than r+1, whereas r+1 is hold for the maximum Eigen value test. Replacing E with Ln E and (CDB/CFB) with Ln (CDB/CFB), this paper carries out the Johansen's maximum likelihood procedure.

4.3 Granger Causality Test

The Granger Causality test is also carried out to test the causal relationship between two variables such as X and Y. It is a prediction based econometric

concept. If a single value of X causes Y, then it is assumed that the previous values of X must have some information that assists predict Y before and after the information contained in the previous values of Y alone assuming both variables are stationary. This test is solely based on the time series data and for making prediction the following regressions are used:

$$Y_t = \delta + \sum_{i=1}^{m} \alpha_i Y_{t-1} + \sum_{i=1}^{n} \varphi_i X_{t-1} + \psi_i \quad (8)$$

$$X_t = \mu + \sum_{i=1}^{m} \chi_i X_{t-1} + \sum_{i=1}^{n} \phi_i Y_{t-1} + \eta_i \quad (9)$$

Here ψ_i and η_i are the white noise errors terms which are assumed stationary and both m and n are the lags. Both of the equations represent that the present values of any one of the variables are related to the past values of itself and other variable. X will Granger cause Y if the calculated F-statistics is significant at conventional level and similar will occur in the case of Y to X. The lag length should be taken on the basis of Akaike information criterion.

V. DATA AND RESULTS

In this study the annual data on exchange rate between Bangladesh and India and the ratio of GDP deflators of Bangladesh and India as a proxy of CDB/CFB have been taken for the period 1971 to 2011. The main source of data is the Data Bank of the *World Development Indicators* published by World Bank. Here, first the exchange rate of Indian Rupee in terms of US dollar and Bangladeshi Taka in terms of US dollar were converted into US dollar in terms of Rupee and Taka and thus then derived the exchange rate between Taka and Rupee. The ratio of CDB and CFB is simply obtained by dividing GDP deflator of Bangladesh and GDP deflator of India. The results are obtained by using econometric software Eviews version 3.1.

According to the methodology mentioned above, both sets of data are examined and empirical results are presented in this section. Both variables are tested for the unit root to find out whether they are stationary or non-stationary according to the ADF test. Here test is applied in series in level and first differences with lag parameters determined by Akaike Information Criterion. The results are reported in Table I.

TABLE I
UNIT ROOT TEST (ADF) FOR THE TIME PERIOD 1971 TO 2011

Without Trends		
Variables	Series in Levels	First difference
LNE	-2.114707	-3.56990*
LN(CDB/CFB)	-4.11580**	-3.96439**
With Trends		
Variables	Series in Levels	First difference
LNE	-2.495909	-3.695820*
LN(CDB/CFB)	-5.30039**	-4.302210**

Note: ** and * represent significant at 1% and 5% level respectively. In terms of Akaike information criteria, it is assumed that the optimal leg length is 1.

The result of ADF unit root test shows that with the presence of unit roots in the original series such as in LNE and LN (CDB/CFB) which are non-stationary in the levels. But in their first differences they are stationary as the first differences remove these unit roots, that is, they are integrated of the order one. And for running cointegration test, it is a necessary condition to have stationary within the variables in same degree. Both variables are I(1); it is necessary to take step for the cointegration tests to determine whether there is any long run connection between these two variables to hold PPP between Bangladesh and India.

TABLE II
JOHANSEN AND JUSELIUS TEST OF COINTEGRATION

Data Vector	Lag	Hypothesis	λ trace	λ max
LNE, LN(CDB/CFB)	1	$r \leq 0$	27.15170	15.41
		$r \leq 1$	3.065986	3.76*

Test assumption: Linear deterministic trend in the data, Series LNE and N (CDB/CFB), Lag interval-1

	Likelihood	5 Per cent	1 Per cent	Hypothesized
Eigen value	Ratio	Critical Value	Critical Value	No. of CE(s)
0.460753	27.15170	15.41	20.04	None **
0.075604	3.065986	3.76	6.65	At most 1

Note: * and ** denote rejection of the hypothesis at 5% and 1% significance level respectively. L.R. test indicates 1 cointegrating equations at 5% significance level.

The Johansen and Juselius (1990) test has been done here with taking 1 lag length where Eigen value, Likelihood Ratio and trace tests are simultaneously represented. Eigen value statistic is used to determine whether conintegration within the variables exists or not. Cointegration is said to be exist if the Eigen values are significantly differed from zero. But here it is found that the Eigen values are close to zero. The likelihood ratio is lower than the Critical value since 3.065986< 3.76. The tests are used to determine the cointegration rank; r. Exchange rate and relative price of Bangladesh and India are not cointegrated in the long run. As a result, it can be said that PPP will not hold for Bangladesh in the long run.

To check for causal relationship, the results of Granger Causality test are shown in Table III.

TABLE III
THE GRANGER CAUSALITY TEST

Null Hypothesis	Obs	F-Statistic	Probability	Causation
LN (CDB/CFB) does not Granger Cause LNE	40	0.32069	0.57461	LN (CDB/CFB) ≠> LN E
LNE does not Granger Cause LN(CDB/CFB)	40	0.75054	0.39189	LNE≠> LN (CDB/CFB)

Note: ** and * indicate significant at 1% and 5% level respectively.

Here, any of the null hypotheses could not be rejected, as the probability values are greater than 0.05 and the F-Statistics are not in the rejection area. So, according to this test there is no unidirectional causality between these two variables.

VI. CONCLUSION AND POLICY IMPLICATION

With a persisting trade gap between Bangladesh and India, there is no steady relationship between exchange rate and relative cost of commodity bundles. The scientific econometric tools have established this outcome. The unpredicted and non-competitive nature of foreign exchange market structure influences the condition in multidimensional ways, as devaluation of Bangladeshi currency is very high in comparison to Indian currency. On the other hand, year after year India is becoming economically strong in international trade, so its pricing decisions may influence the pricing decisions of the global market. Moreover, restrictive trade practice, such as imposition of excessive tariffs, duties and other restrictions in bilateral trade, is one of the most dominating factors for the

deviation of exchange rate from the relative costs of bundles between Bangladesh and India. Excessive restrictions lead to increase informal trade, which further deepens this deviation as Khanna (2001) mentioned, "Such trade is encouraged by restrictions imposed by India on some of their exports (for example, the ban on the export of cattle), which keep Indian domestic prices of those commodities lower than comparable world prices." There are also some non-tariff barriers such as health and quality standard, permits and licenses, condition for obtaining ISI certificates and quarantine requirements which also adversely affect the long run relationship. On the other hand, some prospects in bilateral trade can also be seen, such as SAFTA preferences, the introduction of Free Trade Agreement (FTA), the Free Trade Group (FTG), etc., which could improve the bilateral trade relationship and help to get long run balance condition. Theoretically, the less the trade restrictions, the more will be competitive environment in the case of bilateral trade and there will be a greater chance of having equality between exchange rate and relative costs of commodity bundles (i.e., PPP will hold with perfect competitive market structure when the law of one price dominates both home and abroad). So, it is desirable to maintain a mutually helpful bilateral trade relationship by reducing restrictions in order to achieve Purchasing Power Parity between the two countries.

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