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Factors Influencing Exchange Rate: An Empirical Evidence from Bangladesh

Md. Shohel Rana [α], Tanvir Hasan Anik [σ] & Md. Nurul Kabir Biplob [ρ]

Abstract- Literature effect of exchange rate fluctuations is caused by some macro-economic variables but there have not enough study in this important field. Our purpose was to generalize the main factors behind exchange rate fluctuations of Bangladesh from 1987-2017. We used ADF and PP test for stationary analysis that is unit root test satisfied preconditions for Johansen co-integrating test. Correlation matrix shows the relationships of independent variables with dependent one and agreed with FMOLS test. We find no serial correlation in Q-statistics, LM and Heteroscedasticity test. Johansen co-integration test specifies that there are no co-integrating equations for long run relationship rather the relationship is short run. VAR model and Ganger causality test shows there is a significant effect of Remittance, GDP growth and International trade to Exchange rate fluctuations because R-squared values are more than 60%. Wald test supports the VAR model results by ensuring that there also joint effect of independent variables. Results from FMOLS test concluded that GDP growth and International trade positively affect exchange rate. Remittance has negative effect on exchange rate. Finally, we can say that rise in GDP growth and international trade, increase the exchange rate volatility but rise in Remittance reduces the exchange rate volatility. We found the relevance of this study with existing the literature in its related filed.

Keywords: exchange rate volatility, johansen co-integrating test, independent variables, dependent variables, GDP growth, remittance, international trade.

I. Introduction

Exchange rate has a broad history different from today's marketing system. In the twentieth century, the exchange rate system was fixed. The increase or decrease of currency value is totally covered by the government. Before First World War, the major currencies of world were fixed in terms of gold. But the changes are made after Second World War. U.S dollar got importance for currency evaluation of most currencies. Despite this, some of the world's most important currency trading rates change frequently. Thus, the equilibrium exchange rate is determined in the market where demand and supply of currencies intersect. The demand of currency is caused by the net export and supply of the currency is based on the net foreign investment. Demand and supply change caused the change in the value of currency in the market place. The increase in the demand makes the currency more valuable than the low demanded currency. The constraint in the supply has a great effect in its value. Under floating exchange rate system, higher currency demand appreciates its value (exchange rate) while the higher currency supply depreciates its exchange rate in the foreign exchange market place. The foreign exchange rate is called Forex rate internationally. It is the rate by which the relative economic soundness of a country determined. The exchange rate stabilization is important while in transmitting money among the countries. A country can be caused in the losses for currency appreciation or depreciation. The foreign exchange department of every country specially watch and analyze the exchange rate to save their position. The trading, manufacturing companies and commercial banks are highly depend on the exchange rate because they have to deal with foreign clients in terms of profit and capital transformation. So, whether you are individual or industry receiving or sending money from the foreign countries need to keep a spontaneous eye on exchange rate of currencies because it is fluctuating in nature. The changes of exchange rates may occurred daily based on the market forces from one country to another the forces are demand and supply. The market forces concept is narrow based while there are some major factors, have long term effect on exchange rate for this the exchange rate fluctuates are our main concern to be analyzed. This study investigates some major factors that have a great importance for the variation in the exchange rates and reason of their volatility can be described accordingly. In this study we have four variables (Remittance, GDP growth and international trade) to show whether there is long term relationship with exchange rate.

In our theoretical logic the remittance has an effect on the exchange rate. But the effect may appreciates or depreciates the currency. The logic for depreciation of real effective exchange rate is the developing countries having small economy and living family members abroad remitting their earnings to the home country. The inflows of huge remittance creates no problem when the economy is large and absorbs the excess money received from the foreign country .But the problem occurs when the economy is small and the absorption of huge remittance cannot be compatible. The negative effective on exchange rate is experienced

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because the currency recipient in home country on behalf of the working members doing job in foreign country received the excess money and spends the money in the local market for purchase of assets and commodities. The purchase creates the local inflation causing home currency depreciation against foreign currency. The government takes the traditional way to fight the inflation imposing higher interest rate but the problem affect the businessmen and local people who are not in the remittance circle. Because the capital for financing business from local becomes expensive. GDP growth is one of the main factors which have significant influence on exchange rate. Currency appreciates by a stable growth in GDP. International trade is a summary of the import and export of a particular country. A country needs to purchase something from another country. In the opposite side, other countries also need to purchase something from outside of the residence. This imbalance of demand and supply creates international trade. Because the home country is unable to fulfill the demand made by its people that creates import from a foreign country. When there is a surplus of product and services after meeting the existing demand, the Export intension is preferable to a foreign country. When the export is greater than import a country is benefited. This causes currency more valuable than other currency and currency appreciates.

II. Objective of the Study

General objectives is to find out the significant factors influencing exchange rate movement. How much they influence the exchange rate is to be determined. We at first selected five independent variables named inflation, interest rate, remittance, GDP growth and international trade in our analysis to show the effect on exchange rate. But for stationary test of ADF and PP in Eviews software, Inflation and Interest rate are stationary at level. Our requirement for at level is Non-stationary. These two variables did not fill our requirement except others. So, we dropped them.

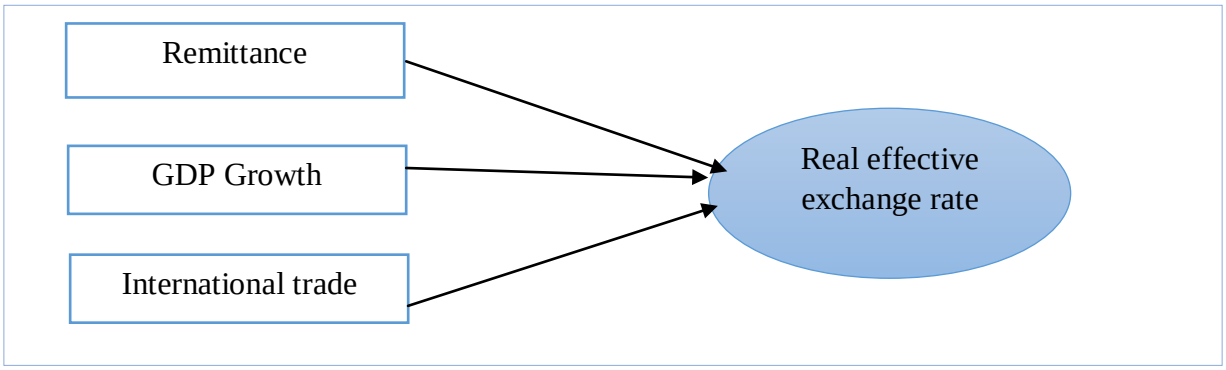
The main objectives are:

1) To analyze the determinants of Foreign Exchange Rate in Bangladesh.
2) To know which of the determinants is playing the main role in foreign exchange rate.
3) To make appropriate suggestions for suitable policy implementation for problems arising from the appreciation/depreciation of currency in the light of finding of the study.
4) To make summary of relationship among the independent and dependent variables.

III. Conceptual Framework

The conceptual model depicts the proposed causal model. Here the real effective exchanger rate is dependent variable which has direct impact from the major three independent variables. Although there have some other variables our focus point is on the Remittance, GDP growth and international trade.

Table 1: Conceptual framework



IV. Literature Review

a) Remittance and exchange rate

Remittance have positive effect evidenced by several analysts in Pakistan. Among them, Nishat 'and Bilgrami (1991) state that remittances increase GNP. They found the positive relation between remittance and GNP analyzing Keynesian macro model and three stage-least squares method using data from 1960 to 1988. Moreover, Haque and Montiel (1992) found that the worker's personal remittance appreciated the exchange rate movement from 1982 to 1991.Ahmed ara and Hyder 2005 investigated in their VAR (vector autoregression analysis). They found the foreign remittance has a significant effect on exchange rate variation in Pakistan. They included it as foreign shocks and the significance of foreign shocks got priority since the year of September 11, 2001. They showed the foreign remittance is a reason being an external shock for exchange rate variation. But, another variable such as trade has little impact on exchange rate, national output and prices of goods in Pakistan. However, the conclusion was external output shrink leads to exchange rate devaluation. The positive effects of remittance form abroad lead to an enhancement of domestic output

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appreciating exchange rate of Pakistan. Barajas et al. (2010) found in their analysis that decreasing trade and capital openness is a result of remittance effect for countries and Fayad's (2010) indicated that FDI (foreign direct investment) attenuation appreciates remittance.

b) GDP Growth and Exchange rate

Adusei and Gyapong (2017) investigated in their analysis, included GDP growth as one of the important variables besides foreign debt. Without that, they include inflation, money supply and trade. Among the factors, they concluded GDP growth and external debt as significant factors to predict the exchange rate for Ghana. Stancik(2007) and Oaikhenan ve Aigheyisi, (2015) states that the country's specific factors such as trade, capital flows, economic growth rate, foreign reserve, foreign debt and current exchange rate. They concluded that the effect of factors on the exchange rate is not significant rather the effect is based on techniques of evaluation, analysis periods and the country's financial conditions. Abbas et al (2012) and Ramasamy and Abar (2015) study was based on 15 periods data of ten African countries from the year 1996 to 2010. They tried to show that interest, inflation and GDP has an impact on the exchange rate. But, they found that only GDP has influence for the exchange rate movement but not the others. The same result is found in the analysis of Nucu (2011) in Romania. The analyst uses data from 2000 to 2010 based on the country of Romania. The study concluded that GDP growth increases rate of exchange fluctuation. But the increased imports decreases current account balance hence currency depreciates. They also indicated that USD/RON as their currency is not related to GDP directs to other determinants not included in their study. Parveen et al (2012) in their study named "factors affecting exchange rate variability in Pakistan" from the year 1975 to 2000. They uses statistical tests such as ADF, Linear regression specified by OLS for results. Factors were Export, import, economic growth rate and inflation. They found that 98% variability in exchange rate just because of these factors.

c) International trade and exchange rate

Excessive exchange rate volatility leads to delays in investment decisions, causing uncertainty in the economy. The uncertainty that is caused by volatility also negatively affects economic growth by affecting investment and investor confidence, productivity, consumption and international trade and capital flows (Oaikhenan and Aigheyisi, (2015: 49). In the study of Baldwin and Krugman (1989), they investigated capital inflow and trade balance to show the relationship with real exchange rate. In their analysis, the conclusion was large inflow of foreign capital primarily appreciates exchange rate. But, when they tried to show the relationship with trade balance, the conclusion was the depreciation of exchange rate is caused by Trade balance.

V. Data and Methodology

a) Sample description

This study used annual data for the period 1987-2017. Different sources for the data were approached (world development indicator, private sector, and international organizations) to find out the nature of the available data. All these sources of data are recognized, accepted and the provided information that has been used widely in the country. So, data and information of the sources incorporated in this analysis are reliable.

b) Research design

The stationarity of data is determined, by using Augmented Dickey-Fuller (ADF) test. To select the optimum ADF lag, Akaike Information Criterion (AIC) is used. Stationarity of the variables are checked once with an intercept is included only, and again when both an intercept and a linear deterministic trend is included. Johansen co-integration test is used to determine the co-integration in the regressions used for analysis. In order to analyze the factors affecting the exchange rate, a linear regression model has been used. The two stage least square method has been used for estimating the important linear regression equation models.

The following is the main linear regression model which will be used for analysis:

$$LREER = \alpha + \beta 1\ (LREMIT) + \beta 2\ (LGDPG) + \beta 3\ (LINTTRADE) + \mu$$

Where LREER is real effective Exchange rate, LREMIT is Remittance, LGDPG is GDP Growth rate, LINTTRADE is International Trade and μ is the residual term.

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c) *Variables Description and Data collection*

Abbreviation	Definition	Source
LREER	Real effective exchange rate (CPI based) considering 67 trading countries, (19787-2017)	Bruegel Database 2017
LREMIT	Personal remittance received from (1987-2017)	The World Bank (WB) (World Development Indicators 2018)
LGDPG	GDP growth (% of GDP) (1987-2017)	The World Bank (WB) (World Development Indicators 2018)
LINTTRADE	International trade (% of GDP) (1987-2017)	The World Bank (WB) (World Development Indicators 2018)

d) *Model Specification*

To investigate the factors influencing real effective exchange rate, we used the econometric model. We used three independent variables and one dependent variables. Independent variables in the model are namely Remittance, GDP growth, and International trade. The dependent variable is real effective exchange rate. We converted all the variables in log transformation because the nature of date are not same. Log Normal conversion helps to equalize the base of variables.

The econometric model is,

REER= F(REMITTANCE, GDP GROWTH, INTERNATIONALTRADE)……(1)

$LREER = \alpha + \beta1(LREMIT) + \beta2(LGDPG) + \beta3(LINTTRADE) + \varepsilon i$ ……..(2)

Where:

L=Log.

REER= Real effective exchange rate

REMIT= Personal remittance received

GDPG= GDP growth rate

INTTRADE= International trade

β1 is the co-efficient for remittance

β2 is the co-efficient for GDP growth

β3 is the co-efficient for International trade

εi is error terms

In our study, we used Statistical tools like as Agumented dickey fuller test, Phillips-Perron test, Johansen co-integration test, fully modified ordinary least square, Regression model by Eviews 10 statistical software. In our analysis ADF and PP test is used to investigate the variables are Stationary or not. Because, the data must be non stationary at level and stationary at 1st difference. Regression model is used to specify the coefficients of different variables. Johansen co-integration test is used to find whether there are long-run economic relationship between the variables or not. FMOLS (Fully modified ordinary least square) is used to determine the significance of independent *variables* to influence the dependent variable.

i. *Unit Root Test*

Many macroeconomic data is nonstationary data. Therefore, it has to be converted those non-stationary data to stationary data. Unit Root test is carried out to test whether the series is level stationary (I (0)) or first difference stationary (I (1)).ADF and PP test of stationary is performed by the Eviews 10 software where the three independent variables (Remittance, GDP growth and International trade) and the dependent variable is real effective exchange rate. The results of test is shown below. The ADF and PP test must confirm that the variables are non-stationary at level and stationary at 1st difference. Then we can be able to test the johansen co-integration test and regression analysis.

Unit Root Test is based on the following three regression forms:

Without Constant and Trends: $\Delta Y_t = \delta Y_{t-1} + U_t$ ····· (3)

With constant: $\Delta Y_t = \propto + Y_{t-1} + U_t$ ····· (4)

With constant and trend: $\Delta Y_t = Bt + \delta Y_{t-1} + U_t$ ····· (5)

The Hypothesis is H0: δ=0 (Unit Root)

H1: δ≠ 0

ii. *Regression Model*

The regression model helps to determine the influence of independent variables over the dependent variable. How much change in independent variable cause the change in the dependent variable can be detect easily through the regression analysis. It helps to determine the coefficients of different variables.

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iii. *Johansen Co-integration Test*

The test of co-integration helps to detect whether there is any long run association between variables or not. In this study, we tried to show the long run association between of independent variables (remittance, GDP growth and international trade) and real effective exchange rate. Johansen co-integration test need two conditions to be filled up in Unit root test statistics. One is the data should be non- stationary at level and another is the data should be stationary at first difference. In our analysis the unit root test is performed by Augmented Dicky-Fuller Test and Phillips–Perron test. This test includes two types of results one is trace test statistics and other is maximum eigenvalue test.

Trace Test Statistics

The trace test statistic can be specified as: The output of the trace test assumes that the null hypothesis assumes in which the number of distinct co-integrating vector(s) be less than or equal to the number of co-integration relations (r).

In Trace statistics-

Null hypothesis: The number of co-integrating vectors are equal to r.

Alternative hypothesis: The number of co-integrating vectors are more than r.

Maximum Eigenvalue Test

The maximum eigenvalue test examines the null hypothesis of exactly r co-integrating relations against the alternative of r+1 co-integrating relations with the test statistic.

In maximum Eigen value test-

Null hypothesis: The number of co-integrating vectors are equal to r.

Alternative hypothesis: The number of co-integrating vectors are r+1.

iv. *Standard VAR*

We use Standard Var when we detect in the series that there have not exist long run associations between variables. In that case, we use Standard Var to investigate short run properties in the series. Then we may go for Granger causality tests/Wald block Test under Standard VAR environment to establish causal links between variables.

v. *Wald test statistics*

Wald test is named after the famous statistician Abraham Wald especially for parametric statistical test. When we check whether the individual independent variable has the significant effect on the dependent variables or not, we use OLS test. But we use *Wald test* to check whether there are any joint effect of independent variables to the dependent variable ignoring their coefficients [C=(0)]. If the P value is less than 5% then we can tell that the independent variables have joint effect to explain the dependent variable. The test is based on true statistics because it uses parameters only from the sample statistics.

Assumptions about the Error Terms:

The expected residuals are zero: $E\ \varepsilon i,t = 0$

With i=1, 2

The error terms are not auto correlated:

$E\ \varepsilon i, t.\ \varepsilon j, ł = 0$ with $t \neq ł$

VAR-Model does not allow us to make statements about causal relationships. This holds when VAR-Model is only approximately adjusted to an unknown time series Process, while a causal interpretation requires an underlying economic model. However, VAR-Models allow interpretations about the dynamic relationship between the indicated variable.

VI. Result and Discussion

a) *Descriptive statistics*

	LREER	LREMIT	LGDPG	LINTTRADE
Mean	4.768538	1.589159	1.630063	3.398506
Median	4.752097	1.653009	1.656232	3.366170
Maximum	5.076545	2.359716	1.985709	3.873509
Minimum	4.588409	0.902149	0.882220	2.814678
Std. Dev.	0.118668	0.503139	0.265062	0.319650
Skewness	1.189897	0.175185	-0.989733	-0.241886
Kurtosis	4.346288	1.472260	3.735890	1.938742
Jarque-Bera	9.656385	3.173300	5.760598	1.757061
Probability	0.008001	0.204610	0.056118	0.415393
Sum	147.8247	49.26394	50.53197	105.3537
Sum Sq. Dev.	0.422461	7.594472	2.107736	3.065284
Observations	31	31	31	31

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The descriptive statistics is basically used to explain the nature of data based on the few indicators. The base of skewness is 3. When the skewness value is greater than the base, the skewness is positive meaning that it has a long right tail. If the value is less than the referred base then we can call it mirrors normal skewness and platykurtic. The jarque bera test statistics measures the difference of the skewness and kurtosis of the series with those from the normal distribution. Here, the Jarque-Bera test statistics significantly favours the remittance, GDP growth and international trade because the probability is significant.

b) Unit root test

The unit root test is performed by Augmented Dicky-Fuller Test and Phillips–Perron test. The results are as below:-

	ADF (at 5%)		Phillips-Perron (at 5%)		
Variable	Level (Intercept)	1st Difference (Intercept)	Level (Intercept)	1st Difference (Intercept)	Order of integration
LREER	-1.023373 (-2.967767)	-3.622682 (-2.967767)	-0.183213 (-2.96397)	-3.630361 -2.967767	I(1)
LREMIT	-2.331987 (-2.976263)	-1.084847 (-2.976263)	-1.106911 (-2.963972)	-3.354757 (-2.967767)	I(1)
LGDPG	-2.587014 (-2.963972)	-5.069809 (-2.981038)	-2.375314 (-2.963972)	-9.879061 (-2.967767)	I(1)
LINTTRADE	-1.846738 (-2.963972)	-5.019223 (-2.967767)	-1.865249 (-2.963972)	-5.014660 (-2.967767)	I(1)

The test statistics value are in number without having first bracket and the critical value in the parenthesis. We can see that at level the test statistics value is less than critical value meaning that the data is non stationary. And at first difference the test statistics value is greater than critical value meaning that the data is stationary.

c) Correlations matrix

	LREER	LREMIT	LGDPG	LINTTRADE
LREER	1.000000	-0.044355	0.116216	0.101870
LREMIT	-0.044355	1.000000	0.651187	0.911895
LGDPG	0.116216	0.651187	1.000000	0.771432
LINTTRADE	0.101870	0.911895	0.771432	1.000000

d) Serial correlation test

The test for serial correlation is performed by three test those are Q-statistics test, LM test and Breusch-Pagan-Godfrey's Heteroskedasticity Test. The results are:-

Q-statistic probabilities adjusted for 1 dynamic regressor						
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. |**. |	. |**. |	1	0.255	0.255	2.1485	0.143
. | . |	. | . |	2	0.012	-0.057	2.1531	0.341
.*| . |	.*| . |	3	-0.145	-0.144	2.9040	0.407
.*| . |	. | . |	4	-0.078	-0.004	3.1293	0.536
. |*. |	. |*. |	5	0.090	0.121	3.4403	0.632
. |*. |	. | . |	6	0.133	0.066	4.1512	0.656
.*| . |	.*| . |	7	-0.083	-0.167	4.4368	0.728
.*| . |	. | . |	8	-0.137	-0.061	5.2550	0.730
. | . |	. |*. |	9	-0.003	0.113	5.2553	0.812
.*'| . |	.*| . |	10	-0.098	-0.168	5.7171	0.838
. | . |	. | . |	11	-0.012	-0.028	5.7245	0.891l
.*| . |	.*| . |	12	-0.131	-0.117	6.6449	0.880
.**| . |	.**| . |	13	-0.293	-0.244	11.504	0.569
.**| . |	.**| . |	14	-0.307	-0.248	17.169	0.247
. | . |	. |*. |	15	-0.004	0.090	17.170	0.309
. | . |	. | . |	16	0.034	-0.040	17.248	0.370

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Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	1.044983	Prob. F(2,23)	0.3678
Obs*R-squared	2.498965	Prob. Chi-Square(2)	0.2867

Heteroscedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.625343	Prob. F(4,25)	0.1991
Obs*R-squared	6.191514	Prob. Chi-Square(4)	0.1853
Scaled explained SS	3.383385	Prob. Chi-Square(4)	0.4958

The test of serial correlation helps to detect whether there are any serial correlations between the variables or not. The null hypothesis= No serial correlations and alternative hypothesis = There are serial correlations. The decisions can be made on P value. When the P value is greater than 5% the null hypothesis support that there is no serial correlations. Here, all three types (Q-statistics, LM and Heteroscedasticity) of Serial correlation test statistics signifies that there is no any serial correlation.

e) Determination of Lag Length and Appropriate Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	39.17611	NA	1.04e-06	-2.425939	-2.237346	-2.366874
1	136.5548	161.1786*	3.85e-09*	-8.038264*	-7.095302*	-7.742940*
2	142.2057	7.794302	8.43e-09	-7.324531	-5.627198	-6.792948

** indicates lag order selected by the criterion*
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

In the lag length table, most desirable number of lag length is model for unrestricted VAR because it favors the information criteria of LR, FPE, AIC, SC and HQ. The optimal lag length determination is one of the preconditions for testing Johansen co-integration test statistics. The long run associations between variables can be determined after the optimal lag length selection. When we test the Johansen co- integration test, we must notice that constant, parameter and trend that are affect by the variables we selected. The Akaike and Schwarz value is important when we select appropriate model. The minimum value get preference while selection and becomes a quadratic deterministic trend model.

f) Johansen co-integration test

Johansen co-integration test statistics is developed by the Johansen (1988) and Juselius (1990). The model can be used though there are more than one co-integrated associations between variables and the VAR takes all endogenous variables. Co-integration test is basically the long run associations between variable that are non-stationary at their levels and stationary at 1st difference.

Unrestricted Co-integration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.506951	34.97980	47.85613	0.4491
At most 1	0.257488	14.47256	29.79707	0.8131
At most 2	0.145788	5.838786	15.49471	0.7145
At most 3	0.042817	1.269074	3.841466	0.2599
Trace test indicates no co-integration at the 0.05 level				
** denotes rejection of the hypothesis at the 0.05 level*				
***MacKinnon-Haug-Michelis (1999) p-values*				

Trace test shows that there is no any co-integrating equations. That means there are no long run relationships among the variables at 5% significance level.

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Unrestricted Co-integration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None	0.506951	20.50724	27.58434	0.3071
'At most 1	0.257488	8.633775	21.13162	0.8608
At most 2	0.145788	4.569712	14.26460	0.7949
At most 3	0.042817	1.269074	3.841466	0.2599
Max-eigenvalue test indicates no cointegration at the 0.05 level				
* *denotes rejection of the hypothesis at the 0.05 level*				
**MacKinnon-Haug-Michelis (1999) p-values*				

Johansen co-integration test associates to statistics one is Trace statistics and other is Maximum eigenvalue statistic. According to the both statistic the null hypothesis (r = 0), there is no co-integrated associations between variables is rejected against alternative hypothesis that is co-integrated associations. The result shows that there are no co-integrating equations at 5 % significance level in both trace and maximum eigenvalue statistics.

g) VAR model

Vector auto-regressive model (VAR) is used to test the short run relationship among the variables. The lagged one variables are the independent variables of dependent variables (REER, LREMIT, LGDPG, and LINTTRADE). Here, the numbers are coefficients, Standard errors are in 2nd bracket and t-statistics in the 3rd bracket. The result is,

	LREER	LREMIT	LGDPG	LINTTRADE
LREER(-1)	1.009403	-0.686565	0.224090	-0.239511
	(0.09706)	(0.17507)	(0.37287)	(0.15340)
	[10.4002]	[-3.92163]	[0.60099]	[-1.56137]
LREMIT(-1)	0.004419	0.794698	0.076991	0.115976
	(0.04992)	(0.09005)	(0.19179)	(0.07890)
	[0.08852]	[8.82487]	[0.40143]	[1.46983]
LGDPG(-1)	-0.019447	0.080309	0.173932	0.098354
	(0.06006)	(0.10833)	(0.23073)	(0.09492)
	[-0.32381]	[0.74132]	[0.75385]	[1.03616]
LINTTRADE(-1)	0.072215	0.222218	0.344923	0.681986
	(0.09360)	(0.16884)	(0.35960)	(0.14794)
	[0.77150]	[1.31611]	[0.95917]	[4.60981]
C	-0.255211	2.727361	-1.000043	1.900599
	(0.43913)	(0.79211)	(1.68703)	(0.69405)
	[-0.58118]	[3.44317]	[-0.59278]	[2.73842]
R-squared	0.840370	0.970232	0.505621	0.937908
Adj. R-squared	0.814829	0.965469	0.426520	0.927973
Sum sq. resids	0.067437	0.219424	0.995319	0.168460
S.E. equation	0.051937	0.093685	0.199531	0.082088
F-statistic	32.90304	203.7042	6.392123	94.40683
Log likelihood	48.89821	31.20103	8.520179	35.16564
Akaike AIC	-2.926547	-1.746735	-0.234679	-2.011043
Schwarz SC	-2.693014	-1.513202	-0.001146	-1.777510
Mean dependent	4.768487	1.604659	1.640142	3.417967
S.D. dependent	0.120696	0.504157	0.263483	0.305866

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We see that the adjusted R-square value of three dependent variables are better representative of combined effect of independent variables. But how much an independent variable is significant to explain the dependent variable is shown by ordinary least square method using proc equations as follows.

LREER = C(1)*LREER(-1) + C(2)*LREMIT(-1) + C(3)*LGDPG(-1) + (4)*LINTTRADE(-1) + C(5)---------- (6)

LREMIT = C(6)*LREER(-1) + C(7)*LREMIT(-1) + C(8)*LGDPG(-1) + C(9)*LINTTRADE(-1) + C(10)---------- (7)

LGDPG = C(11)*LREER(-1) + C(12)*LREMIT(-1) + C(13)*LGDPG(-1) + C(14)*LINTTRADE(-1) + C(15)----------(8)

LINTTRADE = C(16)*LREER(-1) + C(17)*LREMIT(-1) + C(18)*LGDPG(-1) + C(19)*LINTTRADE(-1) + C(20)----------(9)

Here, the proc makes four equations that includes 20 coefficients. The t-statistics is the result of coefficient divided by standard error. Now after estimating the OLS (ordinary least squares) method we get the probability (P) value. The decision can be given using P value. When the p value is more than 5 %, the particular independent variable is not significant to explain the dependent variable.

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.009403	0.097056	10.40024	0.0000
C(2)	0.004419	0.049923	0.088519	0.9296
C(3)	-0.019447	0.060057	-0.323806	0.7468
C(4)	0.072215	0.093604	0.771496	0.4422
C(5)	-0.255211	0.439128	-0.581176	0.5624
C(6)	-0.686565	0.175071	-3.921634	0.0002
C(7)	0.794698	0.090052	8.824867	0.0000
C(8)	0.080309	0.108332	0.741318	0.4602
C(9)	0.222218	0.168844	1.316114	0.1911
C(10)	2.727361	0.792108	3.443170	0.0008
C(11)	0.224090	0.372866	0.600993	0.5492
C(12)	0.076991	0.191793	0.401426	0.6890
C(13)	0.173932	0.230726	0.753847	0.4527
C(14)	0.344923	0.359605	0.959172	0.3398
C(15)	-1.000043	1.687031	-0.592783	0.5547
C(16)	-0.239511	0.153398	-1.561366	0.1216
C(17)	0.115976	0.078904	1.469834	0.1447
C(18)	0.098354	0.094921	1.036161	0.3026
C(19)	0.681986	0.147942	4.609807	0.0000
C(20)	1.900599	0.694050	2.738420	0.0073

The probability value helps to see which independent variable is significant to explain the dependent variable. The decision is to be taken at 5 % significance level. If the p value is greater than 5% than null hypothesis is rejected that is there is no significant relationship between independent and dependent variable with their respective coefficients. Here, C (1), C (6), C (7), C (10), C (19) and C (20) is significant at 5% significant level where the P value is less than 5% in the following four equations above.

h) Wald Test statistics

Wald test statistics helps to identify whether there are any short run causality or not. The null hypothesis explains there is no short run causality and alternative hypothesis favors the short run relationship. P value determines accept or reject null hypothesis. When it cross 5%, Null hypothesis is accepted and there is no short run causality.

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Wald Test:			
System: %system			
Test Statistic	Value	d/f	Probability
Chi-square	4.890965	2	0.0867
Null Hypothesis: C(2)=C(4)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2)		0.453830	0.227491
C(4)		-0.029163	0.053320

We use the equation number six for wald test to determine whether the joined variables have short run causality or not to explain the dependent variable. The result from C (2) and C (4), coefficients of REMIT and INTTRADE signifies that there are short run relations at 5% significance level. Because the P value is greater than 5%.

Wald Test:			
System: %system			
Test Statistic	Value	Df	Probability
Chi-square	4.352429	2	0.1135
Null Hypothesis: C(2)=C(3)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2)		0.453830	0.227491
C(3)		0.029428	0.111789

The result from C (2) and C (3), coefficients of REMIT and GDPG signifies that there are short run relations at 5% significance level. Because the P value is greater than 5%.

i) Ganger causality test statistics

Null Hypothesis:	Obs	F-Statistic	Prob.
LREMIT does not Granger Cause LREER	30	4.70589	0.0390
LREER does not Granger Cause LREMIT		11.6294	0.0021
LGDPG does not Granger Cause LREER	30	2.20910	0.1488
LREER does not Granger Cause LGDPG		0.50224	0.4846
LINTTRADE does not Granger Cause LREER	30	5.31615	0.0290
LREER does not Granger Cause LINTTRADE		4.95205	0.0346
LGDPG does not Granger Cause LREMIT	30	1.69732	0.2036
LREMIT does not Granger Cause LGDPG		5.50706	0.0265
LINTTRADE does not Granger Cause LREMIT	30	0.48273	0.4931
LREMIT does not Granger Cause LINTTRADE		3.44885	0.0742
LINTTRADE does not Granger Cause LGDPG	30	7.41094	0.0112
LGDPG does not Granger Cause LINTTRADE		0.72710	0.4013

Here, the decision depends on probability. If the P value less than 5% then we can tell that that independent variables affects dependent variable. Here, we can see that the LREMIT(Remittances received) and LINTTRADE (International trade) significantly affect the REER (real effective exchange rate) at 5% significant level.

j) Analysis of Variables Affecting Real Effective Exchange Rate FMOLS

The johansen co-integration test helps to detect the long run and short run relationship between variables according to test results. But the severity and the direction is tested by associating the fully modified ordinary least square (FMOLS) test statistics by Phillips

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and Hansen (1990). The preconditions for FMOLS test is the variables should be stationary at first difference and having no co-integrated relationship between variables.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LREMIT	-0.168211	0.075180	-2.237438	0.0340
LGDPG	0.019098	0.086303	0.221294	0.8266
LINTTRADE	0.254514	0.146977	1.731663	0.0952
C	4.161396	0.328534	12.66657	0.0000
R-squared	0.091675	Mean dependent var		4.768487
Adjusted R-squared	-0.013131	S.D. dependent var		0.120696
S.E. of regression	0.121486	Sum squared resid		0.383730
Long-run variance	0.005928			

R-squared value indicates about 9.17 % of real effective exchange rate volatility is due to the volatility of independent variable. The strong significant relations is hold when the R-squared value is greater than 60 %. Our calculated value is less than the standard. But we should also think that we used three independent variables excluding all other variables affect the real effective exchange rate. So, we cannot underestimate the result because other 80% of the variation of real effective exchange rate as a results of the other variables such as inflation, interest rate, FDI, monetary and fiscal policy and so on. The t-statistics shows that the remittance have negative effect on real effective exchange rate, as my description in introduction part but other two variables (GDP growth and International trade) have positive effect.

VII. Conclusion

Our purpose was to investigate the factors affect real effective exchange rate. We used factors that affect real effective exchange rate fluctuations for the 1987-2017 period in Bangladesh. The use of statistical software helps us to show relationship among the dependent and independent variables and significance with one another.ADF and PP test statistics ensured us to go for further analysis. Correlogram test helps us to certify that the variables are non-stationary at level and stationary at 1st difference. Q-statistics, LM and Heteroscedasticity shows that there is no serial correlations among variables.

After fulfilling these conditions we went for analysis to test whether there is any long run relationship or short run relationship with real effective exchange rate. Johansen co-integration test result shows that there is no long run co-integrating relationship at 5% significance level according to trace maximum eigenvalue test. The short run relationship specifies us to use VAR model to determine how much lagged independent variables affect the dependent variables. The VAR model ensued us that there is a combined effect on dependent variables because their adjusted R-squared value is statistically significant. OLS test helps us to detect the variables significantly affect the dependent variable. We saw that real effective exchange rate has its own significance having a constant growth over the years and other independent variables affect it such as international trade, remittance. The joint effect is tested by the Wald test where we saw that "Remittance and international trade, Remittance and GDP growth" have combined effect on real effective exchange rate volatility. Ganger causality test statistics indicates LREMIT (Remittances received) and LINTTRADE (International trade) significantly affect the REER (real effective exchange rate) at 5% significant level. The FMOLS test now tell that the Remittance affects real effective exchange rate negatively. International trade (trade openness) and GDP growth have positive effect on real effective exchange rate volatility. The FMOLS test also certifies the result of correlation matrix having negative correlation with remittance and other two independent variables (GDP growth and International trade) have positive correlations with real effective exchange rate.

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