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Exchange Rate Volatility and Export of Bangladesh: Impact Analysis through Cointegration Approach

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There is a traditional view that exchange rate depreciation improves exports of a country. However, despite continuous depreciation age long deficit of Bangladesh has not squeezed. This study investigates empirical explanation of real exchange rate and its volatility on export of Bangladesh in long run by using cointegration test and in short run dynamic adjustment from a vector error correction model. As trade partners are heterogeneous in nature, so this study considers aggregate as well as bilateral trade. Results of stability test find no existence of structural break point for aggregate model. However, aggregate trade model shows that depreciation improves export but volatility of exchange rate offsets the export growth by increasing uncertainty. Moreover, previous year's exchange rate also plays a vital role since trade contracts are made at earlier period. Results of bilateral trade provide different direction. Hence, for promoting export earnings of Bangladesh, this study suggests good understanding of economic and business environment of trading partners and formulation of tailor made policies.

JEL Codes: F4

Field of Research: International Business

1. Introduction

After the collapse of Bretton-Woods system in 1973, variability of exchange rate movement increased enormously and this led policy makers to inspect the effect of the exchange rate variability on trade balance. Though there was a common understanding about the direction but previous studies found somewhat different results. It may be due to lack of product or sector disaggregation, different methodology or time period under study. A country's economic development largely depends on its export performance. There is a traditional view that exchange rate depreciation amplifies export growth of a country. But is it true for Bangladesh? Since independence of Bangladesh, its currency has started to depreciate and subsequently export earnings have found to be increased but the magnitude of the contribution is not clear. Over the year, Government of Bangladesh has taken number of initiatives and changed exchange rate policy to increase export and to reduce trade deficit. Though export has increased but age-long trade deficit has not squeezed much which results in balance of payment crises that has continuously impeded our economic development. From 2003, Bangladesh has introduced free- floating exchange rate system with the expectation of a significant change of pattern and volume of export. But, the direction of change still remained an empirical question and hence, there is no easy solution which leaves the topic open for further research. Therefore, knowledge of the extent to which exchange rate variability affects exports is important for designing exchange rate policy. This paper focuses empirical explanation of real exchange rate and its variability on international trade of Bangladesh.

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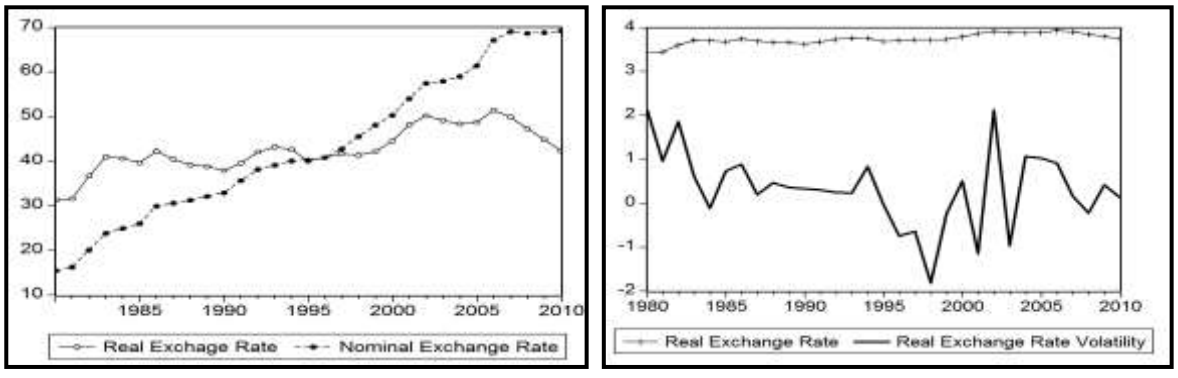
Trade balance is summation of bilateral trade. But, trading nations are heterogeneous in nature and factors that determine overall trade balance may lose its importance for bilateral trade. Even price and income elasticity of different countries are different. Previous studies conducted on this sector considered only aggregate trade data and very few researches have been carried out based on bilateral data. In addition, from 1972 exchange rate policy has changed number of times but very few studies have incorporated this factor into analysis. This study assesses impact of exchange rate and its volatility on export of Bangladesh considering both aggregate and bilateral trade. Moreover, to incorporate the repeated change of exchange rate policy, this study also employs stability test (CUSUM and CUSUMQ tests) to find out the presence of structural break point.

This paper is organized as follows. Section 2 gives an overview of exchange rate policy and pattern of trade of Bangladesh. Section 3 deals with review of literature and next section specifies methodology of the study. Section five analyses empirical results followed by discussion of findings and conclusion is provided in section 6.

2. Exchange Rate Volatility and Export of Bangladesh: An Overview

Following the independence of Bangladesh taka was created as a new exchange rate. In 1972, it was fixed with British pound sterling but actually taka floated with US dollar because after the breakdown of Bretton Woods, pound was also floated with US dollar. In 1975, 85% devaluation took place which made no difference because of expansionary monetary and fiscal policy. So, exchange rate of taka remained overvalued. In 1979, Bangladesh introduced a policy within a pegged exchange rate system where pound sterling was intervening currency. This policy was able to maintain the competitiveness and it made exchange rate stable with no rise of balance of payment crises. In 1983, again minor changes took place as Bangladesh Government made US dollar as intervening currency and up to 1990 multiple exchange rate was allowed to favor export and remittance. This policy finally created macro-economic imbalances. From 2000 to 2003, crawling band was followed where real effective exchange rate was used to declare buying and selling rate. Finally in 2003, Government announced free floating exchange rate system. Now, exchange rate of Bangladesh is determined through market mechanism. But according to Hossain et al. (2009), given its vulnerable financial system, it would be better for Bangladesh if it analyzed exchange rate policy under a managed floating system.

Figure 1: Nominal versus Real Exchange Rate and Volatility



From 1981-2000, merchandised exports saw a radical growth. Traditional exports of Bangladesh declined slowly but ready made garments (RMG) and knitwear grew at a higher rate.. Share of traditional export was 40% in 1981, 33% in 1990 and became only 6% in 2000. Structure of export shifted from primary product in 1980 to manufacturing product in 1990. In 2010, RMG sector and knitwear dominated other products.

3. Literature Review

According to Kabir (1988), Bangladesh is a price taker. The study was based on aggregate data and limited number of observations. He concluded that export of Bangladesh is exchange rate inelastic and it depends more on price level of its trading partners than its export price, so exchange rate variation actually has no impact on Bangladesh.

Hossain & Ahmed (2009) analyzed exchange rate policy under floating regime by analyzing both nominal and real exchange rate. Result of the analysis showed no consistency between the characteristics of exchange rate with freely floating regime. He suggested that Bangladesh Bank supposed to develop technique for inflation targeting, efficiency ensuring and institution building to manage efficient exchange rate. This study considered only floating regime for measuring the impact.

Arize et al. (2000) considered volatility of 13 LDC's using quarterly data from 1973 to 1996 and employed Johansen Multivariate procedure. He found negative relationship between exchange rate volatility and trade policy. According to him, though rate is determined at the beginning of contract period but payment will be made at delivery time. Hence, unpredictable exchange rate may create uncertainty which may reduce benefit of international trade.

Alam (2010) analyzed the impact of exchange rate policy on export with data covering period of 1976-2005. The purpose of the study was to measure the impact of exchange rate on export and OLS method was performed to find out the result. His analysis found that current year depreciation has a negative impact but depreciation at one year lag has a positive effect though the result was not significant. He concluded that the result goes with celebrated J-curve. Export deteriorated first after depreciation but later it improved as it took time for adjustment. Moreover, he said that if trade balance requires improvement within a very short period of time, depreciation will not be a correct choice. But, the study suffered from aggregation bias. Moreover, only impact of exchange rate was considered by the study.

In the study of Jurečka (2007), the impact of exchange rate variability on the demand for real exports of Czech had been examined. This study showed bilateral as well as aggregate trade using OLS method, cointegration, ARDL and stock adjustment model. The main conclusion was that there was no clear cut effect of real effective exchange rate volatility on short run or long run. Bilateral examination of export demand also revealed that the relationship is negative.

Ozturk et al. (2006) evaluated different contribution of scholars since 1978 and concluded that exchange rate depreciation demoralized trade volume and the reason attributed to not only foreign demand but also to domestic supply. It was quite difficult to compare because of different sample period, model specification and risk

measurement but large number of studies proved that exchange rate volatility depresses level of trade.

Islam (2010) estimated import and export demand elasticities employing Johansen's cointegration test and found that Marshall-Lerner condition does hold for Bangladesh. Therefore, this study concludes that given relative price and income, currency devaluation or depreciation will improve trade balance for Bangladesh in the long run.

Jamilov (2013) applied cointegration and vector autoregressive methods to estimate the impact of exchange rate volatility on trade and this study concluded that trade ratio diminishes after the depreciation and will not return to pre-depreciation level in the long run. But it found that following depreciation balance of trade tends to improve.

A key contribution by Mustafa et al. (2004) showed that the volatility of exchange rate has negative and significant effects both in the long run and short run with UK, USA, Australia, Bangladesh, and Singapore. Volume of trade with Pakistan was comparatively consistent and less volatile. Study conducted by Wong & Tang (2007) revealed that unique long run relationship exist among quantities of export, relative price, real foreign income and real long real exchange rate variability. This study used Johansen multivariate cointegration test and proved that real exchange rate variability has some effect on semiconductor exports both in short run and long run.

Using Johansen cointegration test and with variable such as foreign income, domestic GDP, exchange rate volatility and trade balance Khatoon & Rahman (2009) proved that depreciation has positive influence on both short run and long run trade balance. This relationship was not robust rather Granger test suggested that a bidirectional relationship exist between depreciation and trade balance. Again the study found no evidence of "J-curve" in Bangladesh.

Shirvani & Wilbratte (1997) used multivariate cointegration approach to assess the relationship between real excahage rate and trade balance based on trade between U.S.A and other G7 countries and found that in the short run though trade balance is unresponsive to the exchange rate. Moreover, this study supported the validity of Marshall-Lerner condition.

We see that, empirical studies relating to exchange rate volatility and export of Bangladesh are largely based on aggregate data and most of the researches considered very short time period which is not adequate to reflect volatility and its effect on trade. Moreover, while measuring the effect on export, no study incorporated the repeated change of exchange rate in Bangladesh. So, there exists ample opportunity for further development.

4. Methodology

4.1 Research Method

As the study is based on time series data so stationary test is needed to perform in order to avoid spurious regressions. To check for non stationary property, unit root test has been employed in this study. To determine whether the variables have long run relationship cointegration test has been employed which shows there exists cointegration among the variables. If the variables are cointegrated, then there exists

an error correction model and hence, vector error correction model is employed to measure the short run dynamic of the long run relationship.

4.1.1 Unit Root Test

To test short run dynamics and long run relationship among the time series variables, unit autoregressive test has been employed. In the non stationary data, features of Durbin Watson (DW), T-statistics and R^2 may not remain valid. If regression is run on that data, it may produce wrong results. So, stationary test need to be performed for the variables. In this study Graphical analysis and Augmented Dickey Fuller (ADF) are employed to run the test.

4.1.2 Johansen Cointegration Method

This method uses maximum likelihood test to determine presence of co integrating vectors. The first likelihood ratio statistics is the maximum eigen value statistics and the second one is the trace statistics. Null hypothesis of first one should be exactly r cointegrating vectors against alternative of (r+1) vectors and for latter there should be at most r cointegrating vectors against the alternative.

4.1.3 Vector Error Correction Model

A VEC model is designed to use non-stationary cointegrated series. It allows short run dynamics but limits long run behavior if endogenous variables converge to their cointegrating relationship. The deviation from the long run equilibrium is corrected gradually by short run adjustment.

4.1.4 Data and Sources of Data

This study considers annual data and quarterly data for aggregate model and bilateral trade respectively. Data covers period of 1980-2010 as within this period exchange rate policy of Bangladesh has been changed five times. Moreover, 31 years data is sufficient enough to measure the impact. Data has been collected from Direction of Trade Statistics, Bangladesh Bank Economic Review and Bangladesh Bank Monthly Economic Trend. This database contains export, exchange rate, volatility of exchange rate, GDP and industrial production index of the trading partners of Bangladesh. Trading partners that are considered for annual trade are USA, UK, Germany, Belgium, Canada, Italy, Netherlands, Japan, India, and Singapore and for bilateral data, the countries are USA, India, Japan, Canada and Singapore. Trading partners are chosen based on their contribution to total export of Bangladesh and availability of data over the study period.

4.1.5 Export Demand Model

This paper has improved the results obtained from previous studies by incorporating both bilateral and aggregate trade data and employing stability test to measure the fluctuation of exchange rate policy. The dynamic model is:

$$\ln(RXPRT) = \alpha + \beta_1 REXCHNGE + \beta_2 \ln FORGNIN + \beta_3 \ln VOLATILITY + \varepsilon_t$$

Where, RXPRT = real export of Bangladesh, REXCHNGE = real exchange rate. FORGNIN= Foreign Income and VOLATILITY= real exchange rate volatility. Real export of Bangladesh is measured in following way:

$$RXPRT = \ln(Export / P^{x})$$

Where, Export is defined as nominal export and P^{x} is export price index of Bangladesh in taka. Real exchange rate is the nominal exchange rate deflated by overall purchasing power as measured by consumer price index. Real exchange rate is calculated in following the way:

$$REXCHNGE = \log(Exchangera\ te \frac{CPI_{USA}}{CPI_{BD}})$$

Where exchange rate is nominal exchange rate between Bangladeshi taka and US dollar, CPI_{USA} is the consumer price index of USA and CPI_{BD} is consumer price index of Bangladesh.

The higher the income of foreign trading countries, the higher would be their demand for imported goods and therefore, they will trade more form Bangladesh. For our aggregated model, foreign income is defined as weighted average of GDP of the trading partners of Bangladesh and weight is given as the respective country's share to the total export of Bangladesh. But for bilateral trade we have considered quarterly data, so industrial production index has been employed to represent foreign income.

To measure uncertainty, standard deviation of exchange rate is used which was also used by Akhtar and Hilton (1984). The formula is shown below:

$$\sigma_{it} = Ln\left[\sqrt{\frac{1}{n-1}\sum_{k-1}^{n}(RER_{IK} - \overline{RER_{t}})^{2}}\right]$$

Where σ_{it} is the volatility of real exchange rate and $\overline{RER_{ik}}$ is the monthly exchange rate of Bangladesh and $\overline{RER_{t}}$ is the monthly average of real exchange rate.

5. Empirical Results

5.1 Summary Statistics

Table 1 represents the summary statistics of the variables for the period on which exchange rate policy has changed. During 1980-1982, average real export was $1249.6 million with a negative growth rate. With a very high growth rate it became $1687.4 million in 1983-1999. With the introduction of crawling band in 2000-2003, average mean of export became $3946.8 million and uncertainty decreased to 3.5 which forced this period to witness high growth rate of export despite lower growth rate of income of importing countries. Floating regime (2003-2010) saw a three times increased of average export coupled with higher growth rate of foreign income.

Table 1: Summary Statistics

1980-1982	REXPRT	REXCHNGE	FORGNIN	VOLATILITY
Mean	1249.6	33.2	13.3	60.3
Std Dev	183.1	3.0	4.6	4.2
Growth Rate	-24%	17%	-50%	15%
1983-1999				
Mean	1687.4	40.8	303.7	96.7
Std Dev	714.6	1.5	283.4	7.5
Growth Rate	214%	3%	1076%	20%
2000-2003				
Mean	3946.8	48.0	1067.1	83.7
Std Dev	1353.1	2.5	88.5	3.5
Growth Rate	89%	10%	-10%	-7%
2003-2010				
Mean	9081.1	47.6	1565.4	75.9
Std Dev	1394.2	3.1	519.1	5.2
Growth Rate	54%	-12%	138%	-12%

Table 2 represents how the variables are correlated and the strength of the relationship. We see that strong positive relationship exists between export and exchange rate but in case of volatility and exchange rate the direction is negative.

Table 2 : Correlation Matrix

	REXPORT	REXCHANGE	FORGNIN	VOLATILITY
REXPORT	1	0.738	0.957	-0.416
REXCHANGE	0.738	1	0.758	-0.335
FORGNIN	0.957	0.758	1	-0.453
VOLATILITY	-0.416	-0.335	-0.453	1

5.2 Stability Test

Cumulative Sum (CUSUM) and Cumulative Sum of Square method (CUSUMQ) have been employed to test for break point. It is shown below:

Figure 2: CUSUM and CUSUMQ Tests (Aggregate Model)

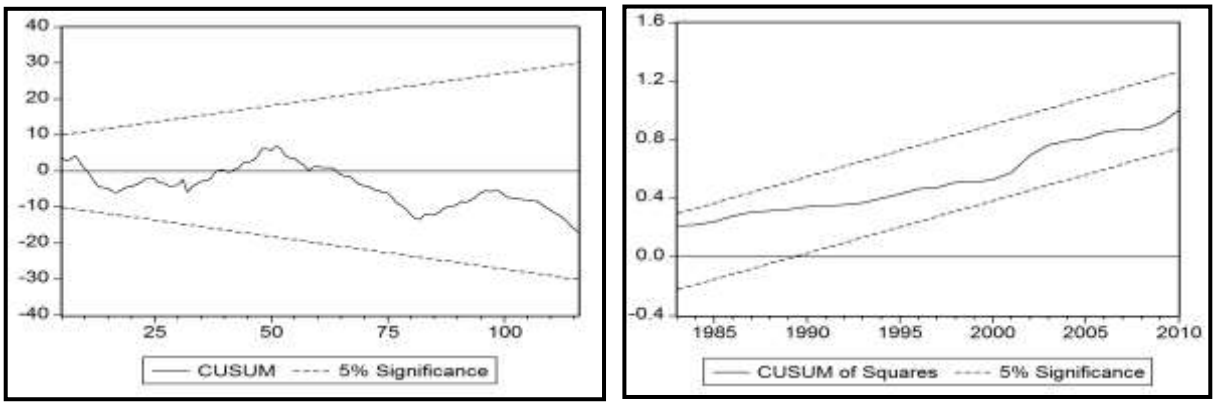
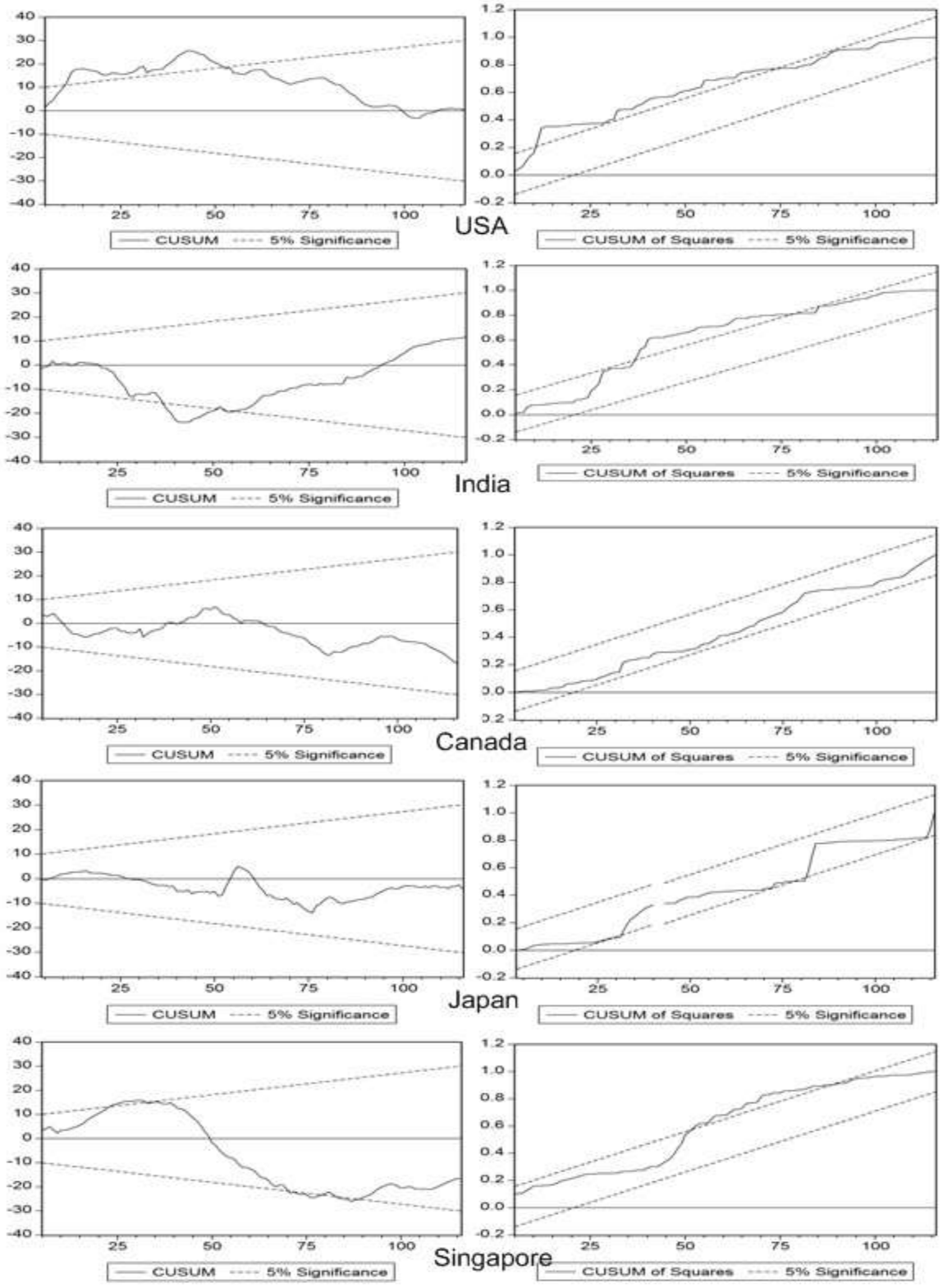


Figure 3: CUSUM and CUSUMQ Tests (Bilateral Model)



However, the CUSUM and CUSUMQ tests for aggregate model do not show any structural break points. Therefore, it can be said that regression coefficient of aggregate model is a good representation of the relationship over the sample period. But for bilateral trade, model for all countries (except Canada and Japan) found break point.

5.3 Stationary Test

Figure 4: Graphical Analysis

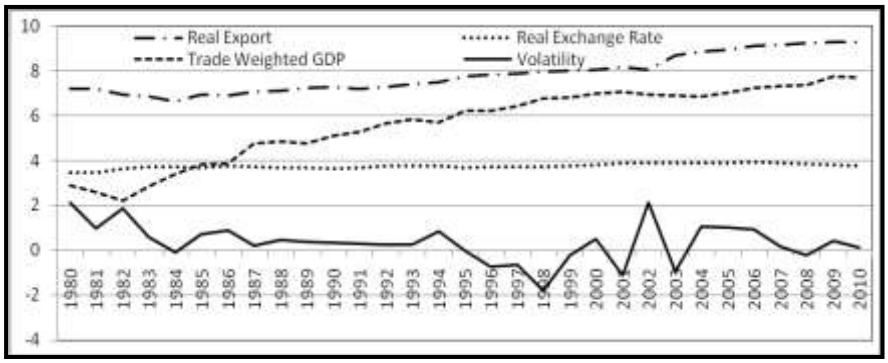


Figure 4 exhibits upward trend of all the variables except exchange rate volatility which has fluctuated over the period. So, we can expect all variables are non-stationary.

Table 3: ADF Test for Aggregate Model

	Real Export		Real Exchange		Foreign Income		Volatility	
	Level	1st difference	Level	1st difference	Level	1st difference	Level	1st difference
WOT*	-1.39	-4.04	-2.45	-5.3	-0.03	-3.1	-1.73	-3.84
WT**	-1.54	-3.65	-2.65	-4.2	-0.99	-3.57	-2.01	-4.34

** WOT=Without Trend and * WT=With Trend

ADF test suggests that, all the variables are non-stationary. In addition, all the variables are cointegrated to order one I(1).

5.4 Long Run Relationship Using Cointegration

Table 4: Trace and Max-Eigen Statistics for Cointegration

Trace Statistic	5% Critical Value	1% Critical Value	Null	Alternative
75.6	47.21	54.46	K=0	K=1
24.03	29.68	35.65	K<=1	K=2
7.91	15.41	20.04	K<=2	K=3
3.09	3.76	6.65	K<=3	K=4
Max-Eigen Statistic				
51.67	27.07	32.24	K=0	K=1
16.12	20.97	25.52	K<=1	K=2
4.82	14.07	18.63	K<=2	K=3
3.09	3.76	6.65	K<=3	K=4

The results from table 4 indicate that there exist relationship between variables at both 5% and 1% significance level. Therefore, all the variables are cointegrated. The relationship among the variables is given in table 5:

Table 5: Normalized Cointegrated Equation (Aggregate Model)

Log likelihood 64.76				
	REXPRT	REXCHNGE	FORGNIN	VOLATILITY
Co-efficient	1.00	-8.80	-0.18	0.26
T-statistics	-	9.21	2.18	2.29

From table 5, it can be concluded that, real export is positively influenced by real exchange and foreign income and negatively related with volatility of real exchange rate. In all the cases the results are significant. Thus, depreciation has a positive influence on export of Bangladesh and policy makers decision is correct.

5.5 Short Run Adjustment using Vector Error Correction Model

Table 6: VEC Model

Error Correction:	D(REXPRT)
CointEq1	-0.325[-4.87]
D(REXPRT(-1))	-0.409[-2.82]
D(REXPRT(-2))	-0.169[-1.17]
D(REXCHNGE(-1))	2.288[4.67]
D(REXCHNGE(-2))	-0.950[-1.33]
D(FORGNIN(-1))	-0.237[-3.08]
D(FORGNIN(-2))	-0.075[-0.93]
VOLATILITY	-0.067[-3.09]
R-squared	0.782

Values in parenthesis show T-statistic

The error term has a negative sign. Therefore, it can be concluded that the real export is adjusting to long run equilibrium at rates of 32.5% and the result is statistically significant. So, export market will reach to equilibrium and it will require 3 years to reach equilibrium. Moreover, results also show previous year's exchange rate has a significant impact on export.

5.6 Bilateral Trade

Table 7: ADF Test for Bilateral Model

T-statistics	USA		Singapore		Canada		Japan		India	
	WOT*	WT**	WOT	WT	WOT	WT	WOT	WT	WOT	WT
Real Export										
Level	-2.67	-2.46	1.56	-1.85	-1.85	-2.7	-1.85	-1.02	-1.35	-1.25
1st***	-3.7	-3.5	-4.6	-4.85	-2.9	-3.05	-3.82	-3.59	-2.99	-4.67
Real Exchange										
Level	-2.39	-1.73	-2.7	-3.31	-2.44	-2.65	-1.54	-1.31	-1.06	-1.27
1st	-3.99	-4.08	-3.5	-3.87	-4.78	-3.67	-2.76	-3.56	-4.32	-3.67
Foreign Income										
Level	-1.12	-0.77	0.1	-0.84	-2.56	-2.54	-1.55	-1.63	1.23	-1.86
1st	-4.54	-3.87	-3.3	-3.65	-2.83	-3.92	-3.64	-4.09	-3.5	-4.87
Volatility										
Level	-0.25	-1.95	-2.3	-1.6	-2.24	-2.8	-1.26	-1.97	-1.73	-1.52
1st	-2.95	-2.87	-3.54	-4.96	-2.98	-2.12	-5.84	-5.02	-4.56	-5.08

*WOT=Without Trend **WT=With Trend and ***1st=First Difference

ADF test reveals that all the variables are non-stationary and cointegrated into order one.

Table 8: Normalized Cointegrated Equation

USA	REXPRT	REXCHNGE	FORGNIN	VOLATILITY
Coeffecient	-1.00	-1.93	-3.69	0.084
T-statistics	-	4.76	3.73	2.86
India				
Coeffecient	-1.00	-5.22	-23.95	2.69
T-statistics	-	2.77	3.09	5.33
Japan				
Coeffecient	-1.00	1.22	-0.57	0.047
T-statistics	-	2.59	1.39	0.26
Canada				
Coeffecient	-1.00	5.03	-4.88	0.75
T-statistics	-	4.50	10.39	4.06
Singapore				
Coeffecient	-1.00	5.33	-6.09	3.86
T-statistics	-	2.16	3.12	4.33

We found that, depreciation is likely to improve export demand of USA and India but in case of Japan, Canada and Singapore the opposite is true though the results are significant in all cases. Volatility of exchange rate actually decreases export demand and except Japan the results are significant. Finally, increase of importers income results in a significant increase in export demand.

Table 9: Vector Error Correction Model

	USA	India	Japan	Canada	Singapore
Error Correction	D(REXPRT)				
CointEq1	-0.008	-0.004	-0.072	-0.012	-0.020
T-statistics	[-0.25]	[0.14]	[-2.11]	[-1.24]	[-1.48]

Table 9 shows results are negative and a significant only in case of Japan. So, it will take 125, 250, 13.89, 83.33 and 50 quarters to reach the equilibrium for USA, India, Japan, Canada and Singapore respectively. So, export market will be converged to long run equilibrium.

6. Conclusion

This study inspects how exchange rate depreciation and its volatility affect export of Bangladesh. Though in Bangladesh exchange rate has changed manifold times but our CUSUM and CUSUMQ tests find that there exists no structural break point for aggregate model. But for bilateral trade, the tests reveal that the models are stable only for Canada and Japan. Cointegration reveals that exchange rate depreciation has a positive impact on export of Bangladesh and the result is consistent with the results of Hossain and Ahmed (2009) and Islam (2010). But, it contradicts with the conclusion of Alam (2010). But by increasing uncertainty, volatility of exchange rate that corresponds with depreciation counterbalances the growth in export demand and this result confirms the results provided by Arize (2000), Ozturk et al. (2006), Mustafa et al. (2004) and Wong Tang (2007) but contradicts with the findings of Kabir (1988). Moreover, previous year's exchange rate plays a crucial role which supports the result found by Alam (2010). On the other hand, segregated analysis of export reveals that

in case of USA and India export demand increases with depreciation. Like aggregate behavior, volatility and income have the same effect on export.

Despite positive link between export demand and exchange rate depreciation, we found our trade balance deteriorating over the year. The reason may attribute to too much fluctuation in exchange rate that offsets the export growth generated by depreciation. Furthermore, international trade also depends on interpersonal relationship and because of long run relationship between countries; trade may not response immediately with the change of exchange rate policy. Therefore, previous year's exchange rate plays significant role in augmenting export. Moreover, a good understanding of economic and business environment of trading partners and tailor made policies are needed to improve export earnings of Bangladesh. But it is not only export, rather overall trade balance that should be taken into consideration. To improve the overall trade balance, policies targeting import reduction should be taken into account along with export.

Empirical literatures relating to impact exchange rate depreciation and its volatility on export of Bangladesh are largely based on aggregate behavior. This paper shows the results obtained from previous studies can be improved in at least two ways: Firstly, by decomposing the aggregated data and measuring the impact in both aggregated and segmented basis and secondly, by employing CUSUM and CUSUMQ tests to find out structural break point. In this study, exchange rate and its volatility both are considered. In addition, this study has used strong methodology to measure foreign income for aggregate model by taking advantages of weighted average method and considering the income of 10 major trading partners of Bangladesh. This study builds on previous studies and for further advancement this paper sets itself as a compliment to previous papers. This research is a major contribution to the international business due to the findings of the study which will help policy makers to formulate policy.

However, this study is not beyond limitations. The impact of depreciation and its volatility of exchange rate might not be same for all sector of export. Moreover, the scope of the study is not wide enough as it is not only export rather overall trade balance should be taken into consideration. For future study, we plan to investigate each incentive policy that will help to select an effective policy to support export. Moreover, impact of depreciation on other sector of economy should also be considered. Researchers can use this study to develop stronger models for further research to enhance international business in emerging economies.

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