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Impact of Exchange Rate Regime Change on Bangladesh RMG Exports to the USA and the EU

Abstract: Bangladesh adopted floating exchange rate system in May 2003. After that regime change, the country has faced a relatively higher volatility of nominal exchange rate than previous regime. Economic theories on volatility suggests that trade flow is adversely affected in response of fluctuation of the exchange rate. Bangladesh is the second largest readymade garments (RMG) exporter in the world and it is the main export product of the country. In this research, Difference in Difference (DID) model introduced by Card and Krueger (1994) is used for the yearly data of 1983 to 2022 to discern this impact of volatility on the RMG exports of Bangladesh. The result shows that RMG exports is negatively affected due to the exchange rate volatility and the estimated figure shows that on Bangladesh's average RMG exports has been lessened to the USA and EU regions by US\$1.04 billion and 1.02 billion, respectively, owing to the volatility incurred by the regime change. Therefore, as volatility obviously has hindered RMG exports, the central bank of Bangladesh should stay alert to avoid high volatility of the nominal exchange rate to keep the RMG exports flow uninterrupted.

Keywords: Exports, Exchange Rate, Volatility, Bangladesh.

JEL Classification: F14, F31, O53

Introduction

Ever since the breakdown of the Bretton-Woods agreement in 1971, researchers, regulators, government agencies and policymakers around the globe have sought to find out the answer to the question whether uncertainty about the movements

of the exchange rates affects international trade flows (Asseery and Peel, 1991). Even with numerous empirical attempts ever since, researchers have not reached any consensus. Gist of the theoretical basis and empirical studies says that there is no clear-cut relationship between exchange rate regime change and export performance of a country (Doganlar, 2010, Vita & Abbott, 2004, Choudhry, 2005). Such a heterogeneous conclusion further instigates the researchers across the world to investigate country specific evidence about the impact of exchange rate volatility on trade. As neither theoretical models nor empirical studies provide us with a definitive answer on this issue, leaving obtained results highly ambiguous, inconclusive, and inconsistent, which provokes researchers to examine the impact again and again for individual countries (Mansour, 2008, Arize, 1998, Bahmani-Oskooee, & Goswami, 2004; Bijan, Reza & Trita, 2013; Samimi, & Maryam, 2014; Mohammadi, Taghavi & Bandidarian 2013; and Naseem, Tan, & Hamizah, 2009). This paper is a part of this endeavour and seeks to provide empirical evidence to the area within the context of a demand type export model (Bahmani-Oskooee, 2016) where both exporting countries are still in developing stage and both importing regions are constituted by the most developed areas in the world. It is an attempt to probe whether any connection between exchange rate volatility incurred by major regime shift and a commodity level export performance of Bangladesh. As the importing countries policy on import is largely to allow free import from developing countries and both exporting regions export policy is giving multiple incentives to the exports, obstruction created by exchange rate regime change and volatility may have significant impact on the export levels of Bangladesh and China.

Bangladesh has switched to floating rate system from the fixed exchange rate regime in early 2003 (Annual Report, Bangladesh Bank, 2003-2004). Prior experience of such regime changing of small countries show that regime change incurs excessive volatility which depresses exports of that country (Aristotelous, 2001, and Egert, & Amalia, 2008). Bangladesh prime export (73% of total exports comes only from RMG, (Bangladesh Bank, 2023) item is RMG mainly to the EU and North America (two biggest RMG importer regions in the world). So, the study has importance from both importers' and exporters' perspective. On the other hand, Bangladesh and China are the two biggest RMG exporters in the world. This research article intends to explore whether the exchange rate regime change of Bangladesh has any impact on RMG exports to two its prime markets, namely the United States of America (USA) and the European Union (EU). China is the major competitor of Bangladesh in RMG sector exports to both the USA and the EU. So, we can assume that both Bangladesh and China are in a battle to grab the US and EU markets of RMG. However, China is still following the fixed exchange rate regime, which means that, unlike Bangladesh, the exchange

rate regime of this country has not changed. So, it can be easily conjectured that perhaps the exchange rate is not a vital factor for China's RMG exports to the USA and the EU.

Table 1: Composition of Exports of Bangladesh from 2008 to 2022 (Tk. in Crore)

Year	Raw Jute	Jute & Jute goods	Tea	Leather	Fish & Shrimp	Naptha, Furnace oil & Bitumen	News Print	Fertilizers	Ready Made Garments	% of RMG to total Export	Others (Including EPZ)	Total Export
2008-09	923	2348	82	1963	3131	661	0	712	67257	69	20421	97498
2009-10	1328	3656	37	2431	3208	993	0	236	67248	66	23011	102148
2010-11	1888	4750	19	3365	4149	851	0	182	96711	67	32516	144431
2011-12	1866	5200	28	4115	4758	975	0	130	122701	68	40540	180313
2012-13	1699	5989	17	4778	3399	431	0	0	128285	68	44839	189437
2013-14	948	5315	17	3759	4098	134	0	0	146626	69	52477	213374
2014-15	856	5351	33	3081	3988	291	0	0	156045	69	56841	226486
2015-16	1257	5700	15	2133	3003	101	0	0	163120	69	61473	236802
2016-17	1381	6117	30	1463	3681	130	0	44	166762	70	60048	239656
2017-18	1161	6275	21	1282	4089	72	13	0	185413	69	68852	267178
2018-19	964	5467	21	1126	3559	99	22	0	212895	72	73526	297679
2019-20	1040	6146	21	748	3444	0	0	0	190874	72	63182	265445
2020-21	1049	8095	28	797	3486	87	1	0	212101	71	73720	299364
2021-22	1570	7191	17	1054	4015	0	0	0	283167	73	70953	387767

Source: Economic Trend, Bangladesh Bank, various issues of 2008 to 2023.

On this ground, this research will compare between Bangladesh (Treatment Group, TG) and Chinese (Control Group, CG) exports of RMG to the US market after the exchange rate regime shift in Bangladesh. As far as we know, the issue is still unexplored by any previous research. So, to the best of our knowledge, it is the first research of its kind. The research has very high importance for the four countries/regions like the USA, the EU, Bangladesh, and China. The latter two countries are also now the fastest growing countries in the Asian region (Iqbal and Pabon, 2018, and Ding & Knight 2011).

Further, Bangladesh is a labour abundant country (Bakht, Yamagata & Yunus, 2011). A vast amount of youths are unemployed, underemployed or disguisedly employed due to the shortage of scope of employment. The country has a big amount of youths who are employed in the informal sector. Demographic denomination shows that about more than 50% of population of Bangladesh are within the age band of 15 to 45 years (Hossain & Islam, 2012). Hossain and Islam

(2012) also indicate that woman participation in the labour force is hardly 10% in total employment of the country. Ahmed & Nathan (2016) point out that unskilled and lower or even uneducated woman labour force mostly from rural areas of the country gets to work in the RMG sector, which is considered a boon for them, indicating that about 85% of workers in the RMG sector of Bangladesh are illiterate woman. Due to such abundant labour force, Bangladesh has revealed a considerable comparative advantage in the RMG sector. RMG has been the country's main stay of exports over the past three decades. Table 1 shows that the contribution of the RMG sector to the country's total exports in FY-2022 is about 73% (Monthly Economic Trend, Bangladesh Bank, May, 2023). Just this table explains how much the RMG sector is important for Bangladesh economy. So, the fate of Bangladesh economy and its' exports presently depend largely on this sector performance. This is a sector which provides millions of women with a job in industrial and formal sector of the country. Earnings of the government revenues (import tariffs, etc.) and the banking sector profits heavily depend on this sector. So, if, performance of the RMG sector is jeopardized for any reason, it will bring a total collapse of the economy.

Unlike Bangladesh, China and India which are overpopulated countries, the EU and the USA are two regions in this world which are considered highly developed. One of the very inevitable economic consequence of high development is that development incurs higher wage rate (labour cost) for the production process. However, RMG is a highly labour intensive product. Much automation in RMG production process is yet to be incorporated. Technology is yet to allow to adopt a capital intensive production process for the RMG sector. But, the EU and the USA are not labour abundant countries/regions. So, the scarcity of labour input on the one hand, and a high wage rate of labour on the other hand make them bound to import RMG products from the rest of the world for not having comparative advantage of these labour intensive products. So, this study has high importance not only for Bangladesh and China, but also for the USA and the EU.

Policy

Adopting floating exchange rate regime from fixed exchange rate regime by Bangladesh.

Research Question

Whether initiation of flexible exchange rate regime by Bangladesh Bank in 2003 has any impact on RMG exports to the USA and the EU.

Treatment and control group

This research will examine the impact on Bangladesh RMG exports to the US and EU markets after the exchange rate regime change in 2003. Another giant RMG exporter to the US market is China which is still following the fixed exchange rate regime. Thus, Bangladesh and China are treated as Treatment Group (TG) and Control Group (CG), respectively.

Literature Review

Papers based on the impact of exchange rate volatility on exports and other important macroeconomic variables are voluminous but estimating numerically those impacts by diff-in-diff method is absolutely absent in the existing literature. Therefore, I have failed to get any research in such issues based on this method. Thus, I explored the papers that have very high proximity to my research intention. The change of the exchange rate regime has incurred much volatility in the exchange rate of Bangladesh. Hence, the papers described in this section have given some empirical evidence of whether volatility depresses the exports of Bangladesh. Such extreme scarcity of related articles indicates the originality and novelty of this topic using this method. This also shows that selecting the issue is not only a topical innovation but also opening a new avenue for the future research.

Adnan and Saadet (2005) assessed the impact of real exchange rate volatilities on Turkey's exports for the quarterly data of 1982 to 2001. Using Johansen co-integration and error correction models (ECM), they have showed that exchange rate volatility has a significant importance on export quantity in the long-run. Thus, they have advised that SME firms operating in the small economy like Turkey, have little options for dealing with increased exchange rate risk.

Reza (2007) has conducted an empirical investigation on exchange rate volatility on Swedish exports. Based on monthly data from January 1993 to December 2006, using EGARCH model they have come to a conclusion that exchange rate volatility depresses the exports of Sweden.

Andreas (2007) has provided an empirical study seeking to find out an ideal export demand function for the Norway exports to the rest of the world. By applying GARCH model he has tried to get a connection between exchange rate volatility and export performance of Norway. He has not got any significant impact of

exchange rate volatility on Norwegian export performance for the period of 1986 to 2005 by quarterly time series data.

Ahmed (2009) explored the impact of exchange rate changes on Chinese exports for the period of 2000 to 2009. The period is basically an era of Chinese Yuan and Renminbi appreciation. Using monthly panel data in fixed effect models (FEM) he has reached a conclusion that greater exchange rate depreciation dampens Chinese exports of processed goods but smaller appreciation has no significant impacts. Thus, according to him, a greater exchange rate flexibility could contribute to lowering Chinese trade surplus through impeding exports.

Thorbeck and Kato (2011) also examined the impact of exchange rate depreciation on Japan's consumption goods exports. Using a panel data of 17 countries for the period 1988-2009, they reached a conclusion that appreciation of Japanese Yen decreased the export of consumption goods by Japan.

Thorbeck and Kato (2012) again investigated the impact of exchange rate depreciation on Germany's exports to the rest of the world by using Dynamic Ordinary Least Squares (DOLS) method on quarterly panel data for the period of 1980-2011. They estimated that export elasticity to exchange rate was tiny but positive for the German economy. Their final recommendation to boost up Germany's exports was to focus on production level and quality improvement rather than the exchange rate manipulation.

Lee, Mun, Tee, Ying & Xin (2016) used annual time series data for the period of 1975-2013 to define export determinants of Malaysia. They found that nominal exchange rate had a positive relation with export volume of Malaysia. That is, volatility of nominal exchange rate depressed Malaysian exports to the rest of the world. Thus, they also decided that in case of Malaysia Marshall-Lerner condition (MLC) was valid.

Safuan (2017) studied the impact of exchange rate volatility on exports to the major destinations like USA, Japan and China by disaggregated data of Indonesian exports. Based on the monthly data of 1996 to 2014, he estimated separate export demand equations by seemingly unrelated regression techniques and found that exchange rate volatility had a negative impact on exports which also varied among different industries.

Pirzada (2019) inspected the experience of Pakistan and found that real effective exchange rate (REER) appreciation had led to sharp contraction of exports for the period of 1994 to 2018. However, the subsequent depreciation had insignifi-

cant impact to reverse the trend. He also found that the effect materialized with a lag of at least one year.

Vinh and Duong (2019) checked the impact of exchange rate volatility on exports of Vietnam. Using quarterly data from 1990 to 2018, and relying on ARDL Bounds Testing approach, they found that, in general, exchange rate volatility had a negative impact on the export levels of Vietnam. They also found that exchange rate depreciation had negatively affected exports in the short-run and positively in the long-run, which was consistent with the J-curve phenomenon. It also suggested that Vietnam could use the exchange rate as a policy tool to increase exports.

Akosah, Alagidede & Schaling (2019) opine that Ghana's economy is characterised by the exchange rate and inflation volatilities. Therefore, they explore macro-volatility spillovers to determine the effectiveness of monetary policy and ascertain the relevance of the exchange rate. The study reveals interconnectedness among the macro-variables and exchange rate. They get that the exchange rate is a net transmitters of shocks, while inflation and output gaps are net receivers of the shocks. Output gap is the largest net receiver of the shocks generated by the exchange rate volatility.

Onour and Sergi (2020) mentioned that exchange rate volatility emerged as a significant challenge for emerging markets since the adoption of the exchange rate liberalization policies by the developing countries. Higher volatility of exchange rate deterred the emerging markets to liberalize the foreign exchange market or introduce the flexible exchange rate regime.

Kuncoro (2020) sets out an investigation of the hypothesis whether or not an increased volatility of exchange rate helps central bank to achieve inflation targeting policy in Indonesia. Using ARDL technique by including several control variables in the model of monthly data they prove that the exchange rate volatility of the country deteriorates the performance of the adopted interest rate policy of inflation target set by the central bank. So, they concluded that putting too much emphasis on stabilizing the domestic currency that ultimately leads to a failure to stabilize the external value of domestic currency makes ineffective inflation targeting monetary policy in Indonesia.

Fabris and Lazić (2021) attempt to evaluate the role and importance of the exchange rate in monetary policy reaction function on the basis of economic development. To do this, a relevant set of balanced panel data was formed with a group of developed and emerging market economies. Their empirical research based on

the econometric assessment of monetary policy reaction on the dynamics of inflation, output and the real exchange rate volatility. The research results confirm the hypothesis that impact on the exchange rate is statistically significant only in the monetary policy of the emerging market economies. Conversely, monetary policy has impact on macroeconomic fundamentals like inflation and output but not on the exchange rate.

Dudzich (2022) points out that while academics tend to assent that exchange rate regime (ERR) shift has impact on both monetary policy and real economy which leaves room for further research. He opines that increased volatility incurred by the exchange rate regime change have malignant impact both in the real and nominal sectors of the economy.

Özer, Grubišić & Küçüksakarya (2022) investigate the effects of exchange rate volatility on output and inflation volatilities in Turkey by using the ARDL bounds testing and Toda-Yamamoto Granger Causality approaches. The results indicate that the exchange rate volatility has statistically significant and permanent causal effects on output and inflation volatilities.

Tahir, Ibrahim, Zulkafli & Mushtaq (2022) aimed to examine the effect of exchange rate fluctuations on the dividend of foreign subsidiaries of U.S. multinational corporations (MNCs) around the world. The difference GMM estimator was applied to estimate the dividend level. The results suggest that the appreciation of the FDI host-country currencies against the USD leads to higher dividend by the foreign subsidiaries of U.S. MNCs.

Another paper by Aftab and Mehmud (2022) aimed to analyse the dynamic impact of exchange rate volatility in the FDI flows of the country. The economic environment under investigation is characterized by dual foreign exchange markets: (1) a formal or official market for foreign exchange with insufficient foreign exchange reserve holding by the central bank and, (2) a strong and thriving informal market with a higher exchange rate. The findings in the paper indicate that higher volatility of exchange rate causes massive capital outflow both by formal and informal channels where level and speed of outflow depend on the size of available foreign exchange reserve held by the central bank.

The remarkable feature of the above research papers based on various estimation methods, data periods, and countries is that they have enormously diversified impacts on exports and other macroeconomic performance indicators like output, inflation, dividend of multinational companies, foreign exchange reserve, etc. Notable research gaps of the above listed research articles are that none of them have quantified or estimated the level of impact on exports and other tar-

geted variables, and none of the paper has used DID model in their estimation processes. These important research gaps, which are still unexplored and thus unknown to researcher, academicians and practitioners are a strong reminder that conducting further analysis by alternative research techniques like DID and calculating the impact of exchange rate volatility on export and other macro-economic variables is very essential. This paper is just an attempt to fill up this unaddressed, un-navigated, and prolonged literature gap.

History of Exchange Rate regime of Bangladesh

Economic theory almost always opines in favour of flexible exchange rate system as it is determined by the market forces, i.e. by supply and demand of foreign currencies. Further, in the flexible exchange rate regime, economic resources are allocated efficiently and bring good fortunes for the sectors that have already shown their comparative advantage in production process. When economists were engaged in much level of ado with such arguments Breton-Woods conference took place in the United States of America in 1971 and developed countries across the world decided to introduce gradually the flexible exchange rate systems in their countries. Afterwards, economists around the world expressed their satisfaction and exhaled a long breath as they believed that world embodied an efficient system especially in international transaction process (Bernstein, 2012). After that historical event, developed world and donor agencies also launched pressure on the developing countries to initiate such system. This pressure got further strength after the collapse of the Soviet Union in 1991. However, there are many countries in the world that are still following the fixed exchange rate regime ignoring such pressures. Unlike import tariff rate, the manipulation of exchange rate is still an economically and internationally accepted method of controlling foreign trade (Guzman, Ocampo & Stiglitz, 2018). However, unlike many other developing countries, Bangladesh has adopted flexible exchange rate in May 2003 though it is still somewhat managed floating by occasional intervention by the central bank. So, the exchange rate regime of Bangladesh can be divided into two purely and mutually exclusive regimes in its' post independent period: (a) fixed exchange rate regime from 1971 to 2002 and (b) flexible exchange rate regime from 2003 to 2022.

However, flexible exchange rate system does give very intuitive empirical results for many small economies across world (Frankel, 2003). The system brings multiple problems for small countries as low level of export base hinders foreign currency inflows in those countries. Moreover, as economy gets larger it causes higher imports than exports as flexible rate is trade expansionary for some cases

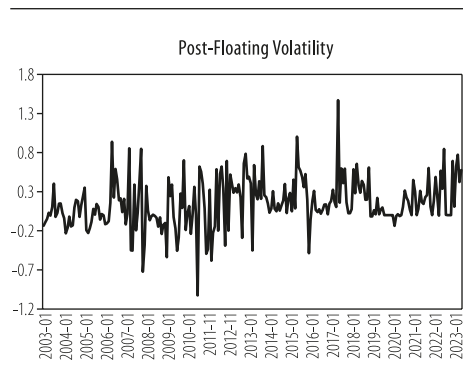
(Conrad, 2020). As a result, country faces negative balance of trading account. Such negative trade balance causes negative current account balance of the country too. Consequently, the country falls in the balance of payments (BoP) shortage problems and, finally, flexible rate initiation causes volatility of exchange rate.

This research is an attempt to investigate the case of Bangladesh in the same issue. The research will also provide a guideline to the central bank of Bangladesh whether it needs to be more prudent in designing the exchange rate policy to avert the risk of losing export market to its two prime destinations.

Measurement and Consequences of volatility

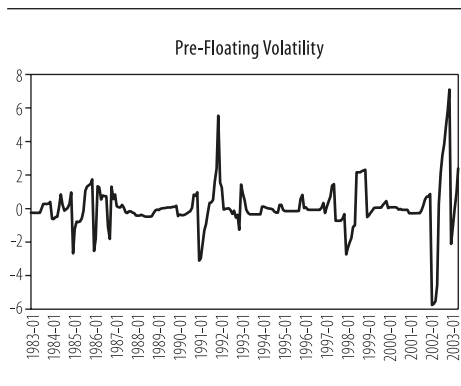
We measured volatility by the variance of change of nominal exchange rate of Taka with the US Dollar. Variance for exchange rate differential for the period of 1978 to 2002 is $\text{Var}(\Delta\text{Nominal Exchange Rate}) = 0.283$. Again, variance for exchange rate differential for the period of 2003 to 2022 is $\text{Var}(\Delta\text{Nominal Exchange Rate}) = 0.358$. As variance of nominal exchange rate differential is higher in the post regime change period than in the pre-regime change period we can surmise that the regime change has brought volatility of exchange rate of Bangladesh to a some extent. This is more clearly revealed by the plotting of differential of nominal exchange rate (or volatility) of two regimes in Figures 1 and 2.

Figure 1: Exchange rate volatility of Bangladesh from January 2003 to May 2023



Source: Monthly Economic Trend, Bangladesh Bank (Author's own compilation)

Figure 2: Exchange rate volatility of Bangladesh from January 1983 to April 2003



Source: Monthly Economic Trend, Bangladesh Bank, (Author's own compilation)

As volatility in post regime change is higher than in the pre-regime change period which is very clear and confirmed only by visual inspection of Figures 1 and 2. So, perhaps our presumption that post-floating rate has more frequent ups and downs than pre-floating rate in the sense that post-floating volatility is higher than pre-floating volatility is correct.

Data

We use 1983 to 2022 data for both Bangladesh and China. Up to 2002, the Bangladesh had followed fixed exchange rate policy and after this period until 2022 it followed floating exchange rate regime. But, China was following the fixed exchange rate regime for whole the sample period.

Here, the considered policy is adopting flexible exchange rate by Bangladesh which was implemented in May 2003. We use annual data for the period 1983-2022. Hence, our sample time length is 40.

Summary Statistics

Table 2: Summary Statistics for Master data (control and treatment group together)

Variable	Means	Std. Deviation	Minimum	Maximum
RMG Export	13.0171	12.5451	0.2600	40.7300
Exchange Rate	0.0929	0.0839	0.0118	0.3412
RGDP	2067.4800	3258.5952	33.6200	13608.15
US RGDP	11278.1300	4868.889	4217.47	20494.12
EU RGDP	422.67	1251.863	14.271	4029.241
Number of Observation	40	40	40	40

Table 3: Summary Statistics for treatment data (Bangladesh; treatment group)

Variable	Means	Std. Deviation	Minimum	Maximum
RMG Exports	10.4058	10.5010	0.9100	33.7500
Exchange Rate	0.0202	0.0073	0.0118	0.0358
RGDP	86.8156	49.9744	33.6200	220.1200
US RGDP	11278.13	4868.889	4217.47	20494.12
EU RGDP	12981.12	422.67	1251.863	14.271
Number of Observation	40	40	40	40

Table 4: Summary Statistics for control group data (China; Control group)

Variable	Means	Std. Deviation	Minimum	Maximum
RMG Export	15.6256	13.9727	0.2600	40.7300
Exchange Rate	0.1657	0.0576	0.1160	0.3412
RGDP	4048.1520	3670.4640	570.2800	13608.1500
US RGDP	11278.13	4868.889	4217.47	20494.12
EU RGDP	12981.12	422.67	1251.863	14.271
Number of Observation	40	40	40	40

We have used an augmented version of Bahmani-Oskooee (2016) model to examine the impact of exchange rate regime change for Bangladesh's RMG exports to its two top markets. Data of exports of Bangladesh and China to the USA were collected from Exports receipts published on the Bangladesh Bank's and the Bank of China's websites. Bangladesh data on exports to the EU were collected from various issues of Monthly Exports Receipt published by the Bangladesh Bank, and Chinese exports to the EU was collected from the Bank of China's website. GDP and inflation rate of the USA collected from Penn World Table (PWT). GDP, CPI, exchange and inflation rate data of Bangladesh and China were collected from the PWT. All data were converted by related exchange rate or collected in US Dollar as this currency is in almost 100 percent cases invoice or vehicle currency in the international trade in the present day. After taking natural Log we have made first differencing in the case of Real GDP of China, USA, EU and Bangladesh, and RMG exports by Bangladesh and China before using in our fitted model. In case of exchange rate, we have done only first differencing. Same action has also been taken in the case of Bangladesh and Chinese exports and exchange rates to the USA and the EU. To avoid autocorrelation problems in the case of Real GDP, Exchange rate and Exports of China and Bangladesh, we have used the first difference of them and DW statistics of our regression models that were close to 2.00 but higher than R-squared in case of each country model. In this way, we have confirmed that data and econometric model do not suffer from autocorrelation problem.

Theories in Exchange Volatility

Volatility means uncertainty of the exchange rate. However, any uncertainty is bad for economy. Further, over-volatility of the exchange rate depresses international trade. In other words, volatility decreases exports of a country due to the exchange rate uncertainty. Additionally, Orcutt (1950) hypothesis claims that trade flows are more disturbed in response to change in the exchange rate

than changes in internal price level of a country. The theories clearly suggest that frequent ups and downs of the exchange rate may hinder exports of a country considerably. In this way, the theories suggest that a country's export may be negatively affected by volatility of its exchange rate.

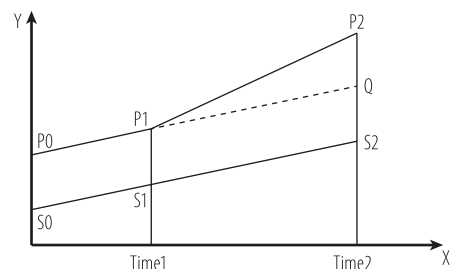
Methodology

We have relied on difference-in-difference (diff-in-diff) method for estimation as a statistical technique that is widely used in observational econometric, social and medical science, and empirical studies. It calculates the effect of a treatment on an individual or a group of individuals by comparing the average change over time in the control group. Diff-in-diff requires data measured at two or more different time periods.

In our case, the treatment group is represented by the line P and control group is represented by the line S in Figure 3. Both groups are measured on the outcome variable at time 1 before either group has received the treatment, represented by the points P1 and S1. The treatment group then receives or experiences the treatment and both groups are again measured after this by applying the treatment at time 2. It is assumed that the difference between the treatment and control groups at time 2 can be explained as an effect of the treatment applied on the treatment group. Therefore, diff-in-diff calculates the "normal" difference in the outcome variable between the two groups, represented by the dotted line Q. The treatment effect is the difference between the "observed" outcome and the "normal" outcome.

During econometric operation, all of the assumptions of the classical OLS model are applied equally to diff-in-diff. In addition, diff-in-diff assumes a parallel trend assumption which says that trend of both treatment and control groups would have been the same as before if the treatment had not been applied to the treatment group. To guarantee the accuracy of the diff-in-diff estimate, the composition of individuals of the two groups is assumed to remain unchanged over time and no OLS assumption should be compro-

Figure 3: Diff-in-Diff Method Graphically



Source: Author's own sketch drawn based on DID model notion

mised. As illustrated in Figure 3, the treatment effect is the difference between the observed value of Y and what the value of Y would have been with parallel trends, had there been no treatment. In econometric model during running of regression, the impact of policy applied to the treatment group is captured by the dummy variable.

Variables and Basic Model

Bahmani-Oskooee (2016) introduced a trade model which has been amalgamated both demand and supply phenomenon by incorporating the variables income of both importing and exporting countries and real exchange rate of between them. This trade model is basically an alternative version of famous gravity model originated from Newtonian Physics notion. We have fitted this model in an extended version to check the exchange rate regime changing impact on Bangladesh RMG exports to the USA and EU. The Model is as follows:

$$\Delta \ln RMG_{cst} = a + b \Delta \ln Y_{st}^{imp} + c \Delta \ln Y_{ct}^{exp} + e \Delta \ln REX_{cst} + \epsilon_t \quad (1)$$

Where,

$\Delta(\ln RMG)_{cst}$ = Change of Ln(Total RMG Exports in Billion USD) by country c to state s at time t.

$\Delta(\ln Y_{imp})_{st}$ = Change of Ln(Total GDP in Billion USD) by importing state s at time t.

$\Delta(\ln Y_{exp})_{ct}$ = Change of Ln(Total GDP in Billion USD) by exporting country c at time t.

$\Delta(\ln REX)_{cst}$ = Change of Ln(Total Nominal Exchange Rate Between Tk. & USD) of exporting country c at time t, where Tk. Means Bangladeshi currency Taka.

The model is specified to Bangladesh perspective, meaning that E_t is defined as Bangladesh exports to USA and EU, real income of Bangladesh $Y_t^{USA/EU}$, real income of Bangladesh $Y_t^{BD/China}$, and the real bilateral exchange rate denoted by REX. The same model will be also applied for China. Our prime target is to understand the impact of regime switching policy of Bangladesh has any impact on Bangladesh RMG exports to the US and EU market. Thus, variables necessary for this research are RMG exports, consumer price index (CPI), exchange rate and RGDP of Bangladesh and China, and RGDP and CPI of the USA and EU where Bangladesh and China are considered as treatment and control group of the research respectively.

Difference in Difference Model

We have modified the basic model introduced by Bahmani-Oskooee (2016) and we will use an augmented version of the Bahmani-Oskooee trade model to check the exchange rate regime changing impact on Bangladesh RMG exports to the USA and EU. The Model is as follows:

$$\ln\Delta(RMG)_t = a + bState + cTime + dPolicy + e\ln\Delta Y_t^{imp} + f\ln\Delta Y_t^{exp} + g\ln\Delta Rext + \epsilon_t \quad (2)$$

Coefficients of equation (2) can be written in the following tabular form where e, f and g are the coefficient of control variables:

	Bangladesh	China	Difference
Before Exchange Rate Regime Change	a+b+(e+f+g)	a+(e+f+g)	b
After Exchange Rate Regime Change	a+b+c+d+(e+f+g)	a+c+(e+f+g)	b+d
Difference	c+d	c	d

On average, Bangladesh RMG exports to the USA and EU regions changed (decreased actually) by “d” due to the volatility created by the exchange rate regime change in Bangladesh. The expected sign of **d** is thus negative.

Exercise by Econometric Tools

Panel Unit Root Test

Panel unit root tests are almost the same as that of single time series but they are not completely identical. They are, in fact, multiple series unit root tests where multiplication arises from a number of cross sections of the panel data series. As panel data series has both time and cross section dimensions, the variables used in this study may suffer from non-stationary problem which will give a spurious result of OLS estimation. Further, when time period of the series increases, the probability of having non-stationarity will be increased. In our case, data series are considered for the period of 1983-2022, almost full three decades, which is enough for incurring non-stationary problem for the series.

To this end, we have chosen five conventional literature suggested panel unit root tests which are more powerful than unit root tests conducted for a single time series. Namely, they are Levin, Lin and Chu (2002), Breitung (2000), Im, Pesaran and Shin (2003), Fisher ADF and Fisher PP, and Hadri (2000) panel unit

root tests. Among them Levin, Lin and Chu and Breitung (2000) are known and called Common Root tests, which means that these tests are estimated by assuming a common autoregressive (AR) structure for each of the individual series.

However, the autoregressive coefficients are allowed to vary across the cross-sections for Im, Pesaran and Shin (2003), Fisher ADF and Fisher PP, and Hadri (2000) tests. Such tests are called Individual Root. Panel unit root tests are mostly derived for the hypothesis that error terms are not autocorrelated. When this hypothesis is rejected, the asymptotic distributions will be inconsistent.

Table 5: Panel Unit Root Test

Variables	Level			First Difference		
	None	Intercept	Intercept & Trend	None	Intercept	Intercept & Trend
EU Income	-14.75***	-8.58***	-7.71***	-	-	-
US Income	-3.63***	-3.72***	-1.96**	-	-	-
BD Income	-9.84***	-5.83***	-1.99**	-	-	-
China Income	-9.59***	-4.63***	-2.33**	-	-	-
RMG Exports to USA by BD	-4.30***	-3.06***	-2.50***	-	-	-
RMG Exports to USA by China	19.52***	18.92***	21.34***	-	-	-
RMG Exports to EU by BD	54.80***	54.20***	18.66**	-	-	-
RMG Exports to EU by China	30.63***	35.03***	96.63***	-	-	-
BD & USA Real Exchange Rate	30.96***	34.36***	96.52***	-	-	-
BD & EU Real Exchange Rate	17.81***	16.21***	62.38***	-	-	-
China & USA Real Exchange Rate	14.94***	48.98*	96.01***	-	-	-
China & EU Real Exchange Rate	28.30***	46.01***	58.06***	-	-	-

Source: Author's own calculations

Cross Section Dependence Test

According to Baltagi (2013), cross sectional dependence is not a problem of micro panels (a panel data of fewer years (time dimension) but larger number of individuals (cross section unit)) but certainly is a problem of macro panels (a panel data of larger years but fewer numbers of individuals). In our sample, we have included data of 2 countries for 40 years, our panel is macro panel and perhaps our panel data sample is affected by cross sectional dependence. So, we need to test Cross Sectional Dependence Test. It is important to consider the influence of cross sectional dependence in cross-nation panels (Awad, 2019). Cross sectional dependence can also exist due to unobserved common characteristics that turn

out to be an element of the error terms. That is why Driscoll and Kraay, 2001 pointed out that if cross sectional dependence exists in the data but is not accounted in the estimation process, it may give inconsistent standard errors and thus t-statistics of the estimated coefficients. For confirming the presence of cross sectional dependence, we conduct three types of cross sectional dependence tests like Breusch-Pagan (1980), Pesaran (2007) scaled LM test, and the Pesaran CD test. The result of the cross sectional dependence test are shown in the table 6.

Table 6: Cross Sectional Dependence Tests

Variables	Degrees of Freedom	Breusch-Pagan LM Test	Pesaran Scaled LM Test	Pesaran CD Test
EU Income	66	0.118767	-2.025369**	-0.625256
US Income	66	0.023653	-2.526891**	-0.322565
BD Income	66	0.156894	-1.145860	-0.441625
China Income	66	0.986532	-2.825310**	-0.562523
RMG Exports to USA by BD	66	0.365981	-1.425363	-0.582634
RMG Exports to USA by China	66	0.789652	-2.011340**	-0.389652
RMG Exports to EU by BD	66	0.632589	-2.124580**	-0.775823
RMG Exports to EU by China	66	0.582965	-1.976230**	-0.856237
BD & USA Real Exchange Rate	66	0.879652	-1.885232*	-0.865925
BD & EU Real Exchange Rate	66	0.586478	-0.999910	-0.586321
China & USA Real Exchange Rate	66	0.876711	-1.555256	-0.358632

Source: Author's own calculations

The result is bit confusing. For some variables the null hypothesis of cross-sectional independence is not rejected. Thus, the existence cross sectional dependence is not detected for these variables. However, in some cases, Pesaran Scaled LM Test cannot reject the cross sectional dependence but other two remaining methods reject the cross sectional dependence. So, as the majority of the tests reject the presence of cross sectional dependence, we may conclude that perhaps our model is not affected by the cross sectional dependence problems. In this way, we are sure that we can run panel pool, fixed effect or random effect models and, in that case, we need not to be worried about our error terms for problems arise from cross sectional dependence.

Housman Test

As we are using panel data, we need to check whether fixed or random effect model is suitable in our data. We have conducted this test (results are in Appendix C & D). As the null hypothesis of Housman test is rejected, we can decide that fixed effect model performs better than random effect model. So, perhaps fixed model is the best fitted model with our data. Accordingly, we have used fixed effect model in our regression models both for USA and EU models.

Analysis and Implication of the Results

Before introducing flexible exchange rate average change of exports of Bangladesh was 3.39 Billion. However, after the regime change average exports of Bangladesh was 4.42 Billion. Corresponding Chinese exports figures are also provided in the Table 7. According to the rules of Diff-in-Diff model decrease of exports of Bangladesh due to the regime change can be calculated. Calculation is given in the table below:

Table 7: Average exports change of Bangladesh and China

	Bangladesh Exports	China Exports	Difference
Before Exchange Rate Regime Change	3.39	3.66	-0.27
After Exchange Rate Regime Change	4.24	4.44	-0.20
Difference	-0.85	-0.78	-0.07

Source: Author's own calculation

On average, Bangladesh's yearly RMG exports to the USA and EU regions decreased by 0.07 unit due to the volatility created by the exchange rate regime change of Bangladesh. Anti-Log of $0.07 = 1.1749$ billion, i.e. Bangladesh exported 1.1749 billion less, on average, from its actual capacity due to the exchange rate volatility.

As per theoretical presumption, the impact of exchange rate volatility on export volume should be negative. The logic is that higher volatility in the exchange rate means increased uncertainty about the future profitability of the exporting firms. Such uncertainty will cause less supply of exports (or even less demand for imports) and, thus, the negative relationship between exchange rate volatility and the volume of exports is a valid speculation. However, the intention of this research is not to investigate direct link between exchange rate volatility and exports of Bangladesh. Rather we have assumed that this recent switch of Bang-

ladesh from fixed to flexible exchange rate regime may incur higher volatility. The visual inspection of data has confirmed the validity of this assumption (figures 1 & 2). Disregarding the source of the volatility, we can presume that such volatility of exchange rate may hinder exports. Therefore, our hypothesis is that the exchange rate regime change may impede the exports of Bangladesh due to higher volatility caused by regime change. More specifically, the issue examined is whether the regime change of the exchange rate of Bangladesh has any impact on RMG exports to the USA and the EU or not.

RMG is the major export item of Bangladesh. The USA and the EU are the major export markets of Bangladeshi RMG products. China is the main competitor of Bangladesh in occupying the US and EU markets of this product. China is still following fixed exchange rate regime while Bangladesh initiated floating exchange rate regime in 2003. Exchange Rate is considered one of the prime factors or determinants of export of a country. To this end, this research has investigated whether this regime switch of Bangladesh has a negative or a positive impact on Bangladeshi RMG export to above two markets. We got negative relationship between these two variables as per theoretical expectation for both the USA and the EU (Appendix A & B).

We have used an augmented version of Bahmani-Oskooee (2016) model which is reformed in Diff-in-Diff format to draw an inference whether exchange rate volatility acquired by regime change has any impact on country's key exports item RMG to the largest two destinations USA and EU. In addition to the necessary variables of Diff-in-Diff model, we have used first difference of real GDPs of trading countries and bilateral exchange rate as control variables. In both cases, we have got three variables: State, Policy and exporting country's Real GDP change as significant, where State and exporting country's Real GDP changes have given positive sign, and Policy has given negative sign. State and Policy are dummy variables. In case of State, we have used 0 for China and 1 for Bangladesh and, in case of, Policy, according to the rule of Diff-in-Diff model, we have used 0 for China for the whole period 1983-2022 and 0 for Bangladesh for the period 1983-2002 and 1 for the remainder period 2003-2022. Therefore, according to the results, if RGDP of Bangladesh and China are increased, RMG exports of these two countries to the USA and the EU should increase. Significance of State variable means that Bangladeshi RMG exports to both the USA and the EU is higher than China's. Likewise, significance of Policy variable with negative sign, which is our target variable, means that growth of RMG exports of Bangladesh to the USA and EU regions from 2003-2022 decreased due to the regime change of exchange rate. Other variables, like importer countries, real income change, and change of nominal exchange rate have no impact growth of Bangladesh exports.

To get the estimated numerical value of less RMG exports by Bangladesh due to the exchange rate regime change, we have to do an Anti-log of co-efficient of Policy dummy variable estimated in last two regression models:

1. To USA 1.04 Billion (=Anti-log of 0.0165).
2. To EU 1.02 Billion (=Anti-log of 0.0141).

It means that in each year Bangladesh exported on average throughout the period 2002-2022 1.04 billion and 1.02 billion less to the USA and the EU due to the exchange rate volatility.

Conclusion and Policy Recommendation

The study intends to explore the impact of the exchange rate regime change and consequent volatility on Bangladeshi RMG exports to the USA and the EU. The research has focused on the impact of volatility originating from the introduction of the floating exchange rate system in Bangladesh which was taken place in May 2003. The paper has addressed the issue that after that regime change, the country has faced a relatively higher volatility of nominal exchange rate than in the case of the previous regime. Using DID method the paper has spotted a negative impact of exchange rate volatility on the country's RMG exports and have estimated that in each year, on average, Bangladeshi exports has been lessened to the USA and EU regions by US\$1.04 and US\$1.02 billion, respectively, due to the volatility incurred by the regime change. The paper used adequate Econometric tools which are Panel unit root tests and cross sectional dependence test, Housman test, DID method. Methodologically, the paper is quite strong to rely on the estimated results. The study has importance both from importers' and exporters' perspective and it has the potential to be considered for further policy making of developing countries, particularly for Bangladesh.

Bangladesh's prime export item is RMG. Bangladesh exports mainly to the EU and North America. The EU and the USA are not labour abundant countries/regions. So, scarce labour input and high labour wage rate make them bound to import RMG products from the rest of the world for not having comparative advantage of these products. On the other hand, Bangladesh and China are the two biggest RMG exporters in the world. China, Vietnam, etc. are major competitors of Bangladesh in RMG sector exports to both the USA and the EU. Thus, Bangladesh and China are in a battle to grab the US and the EU markets of RMG. How-

ever, China is still following the fixed exchange rate regime, which means that, unlike Bangladesh, the exchange rate regime of this country has not changed. So, it can be easily conjectured that perhaps the exchange rate is not a vital factor for China's RMG exports to the USA and the EU. On this ground, this research has compared Bangladesh (TG) and Chinese (CG) exports of RMG to the US market after the exchange rate regime shifting of Bangladesh.

This research article intends to explore whether the exchange rate regime change of Bangladesh has had any impact on RMG exports to its prime markets, the United States of America (USA) and the European Union (EU). So, the research simply inquires whether the initiation of flexible exchange rate regime by the Bangladesh Bank in 2003 has had any impact on RMG exports to the USA and the EU. The paper shows that the exchange rate regime change might hinder the exports of Bangladesh due to higher volatility caused by the regime change. Thus, it came to the conclusion that the central bank of Bangladesh should stay more alert to avoid higher volatility of the exchange rate. A stable exchange rate of Bangladesh may bolster a sustained growth of RMG exports to the USA and EU regions. As this issue has remained unexplored by any previous research, it can be considered as a pioneer research in the topic.

As volatility incurs more volatility and as volatility hinders major item exports of Bangladesh, and as going back to fixed exchange rate regime is not a prudent option for several reasons, the central bank of Bangladesh should stay more alert to avoid hyper volatility of the exchange rate to keep its prime export flow unharmed. A stable exchange rate of Bangladesh may ensure a sustained growth of RMG exports to the USA and EU regions in future.

Limitation of this research

Data of this research is collected only from two countries, Bangladesh and China. If the standard errors are clustered at the country level, then there are only two effective observations available for standard error calculation, which is too few. For this specification, clustering at the country level is impossible. We cannot rule out clustered dependence structures and we cannot use clustering methods only on two countries. So, it is inappropriate to put too much trust in the reported standard errors of our models.

Further, we have detected autocorrelation in some variables although they are applied after first differencing to overthrow the autocorrelation defects of the data. The results of autocorrelation tests are not reported, however. Presence of such

autocorrelation gives higher value of t-statistic that begets spurious inferences about the significance of the related variables.

There may be some other type of developments which have very similar trend of exchange rate for the considered period and that may also cause such results which cannot be detected and segregated from the aggregate impact of our model. This is a serious limitation of the Diff-in-Diff model.

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Appendix

A. Result of EU Model

Dependent Variable RMG EU

Sample 1983-2022

Period Included 33 Years

Cross Section Included 2 (Bangladesh & China)

Variables	Coefficients & Signs	t-Statistic	Probability
C	0.001367	0.274830	0.7844
STATE	0.032081***	10.34160	0.0000
TIME	-0.003398	-0.956343	0.3428
POLICY	-0.014057***	-4.378373	0.0000
INCOME	1.192032***	17.66840	0.0000
EUINCOME	0.068557	0.959258	0.3413
XRT	0.081743	0.144478	0.8856
R2= 0.96161			
Adj R ² =0.95770			
F-stat = 2551.373			
Prob (F-stat) = 0.0000			
DW Stat = 1.7654			

B. Result of USA Model

Dependent Variable RMGUSA

Sample 1983-2022

Period Included 33 Years

Cross Section Included 2 (Bangladesh & China)

Variables	Coefficients & Signs	t-Statistic	Probability
C	-0.011902	-0.850271	0.4006
STATE	0.073264***	4.226903	0.0001
TIME	0.006309	0.768210	0.4472
POLICY	-0.038948***	-4.393110	0.0001
INCOME	2.890380***	6.220720	0.0000
EUINCOME	-0.207921	-0.755180	0.4549
XRT	6.676490	0.484741	0.6307
R2= 0.977775			
Adj R ² =0. 974170			
F-stat = 271.2937			
Prob (F-stat) = 0.000000			
DW Stat = 1.407068			

C. Housman Test for EU Model

Dependent Variable: RMGEU

Method: Panel EGLS (Period random effects)

Sample (adjusted): 1983 2022

Periods included: 40

Cross-sections included: 2

Effects Specification			
		S.D.	Rho
Period random		0.001289	0.0620
Idiosyncratic random		0.005015	0.9380
Weighted Statistics			
R-squared	0.996093		
Adjusted R-squared	0.995696		
F-statistic	2507.163	Durbin-Watson stat	1.759292
Prob(F-statistic)	0.000000		
Unweighted Statistics			
R-squared	0.996158	Mean dependent var	0.097121
Sum squared resid	0.001921	Durbin-Watson stat	1.758799

D. Housman Test for USA Model

Dependent Variable: RMGEU

Method: Panel EGLS (Period random effects)

Sample (adjusted): 1983 2022

Periods included: 40

Cross-sections included: 2

Effects Specification			
		S.D.	Rho
Period random		0.001121	0.0995
Idiosyncratic random		0.003373	0.9005
Weighted Statistics			
R-squared	0.997396		
Adjusted R-squared	0.997131		
F-statistic	3765.770	Durbin-Watson stat	1.315425
Prob(F-statistic)	0.000000		
Unweighted Statistics			
R-squared	0.997470	Mean dependent var	0.097215
Sum squared resid	0.001260	Durbin-Watson stat	1.310906