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The Impact of Exchange Rate Volatility on Export and Import in Bangladesh

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Abstract

This study examines the impact of exchange rate volatility on trade in Bangladesh to know the export, import risk, and leverage effect. Time-series implies monthly basis data from 2013M01 to 2019M06. The IFS, BB and FREED are the main data source for selected variables and this study conducts the ARCH, GARCH, EGARCH model to estimate the results. Major findings of the current study are as follows: GARCH models estimate that the exchange rate volatility creates a negative impact on trade but the EGARCH model estimates there is no leverage effect in the studied country. In addition that the findings of this study are to support the economic theory and activities in the aspect of Bangladesh's economy it is suggested that the total trade volume will be increased with respect to time and stability in macroeconomic variables.

Keywords: Exchange rate volatility, export, import, ARCH, GARCH, EGARCH

Introduction

The exchange rate plays a vital role in the determination of trade balance and the foreign exchange market is the most powerful light issue as an important macroeconomic indicator to moderate economic growth and development. The international trade market is vastly competitive day by day whatever the researcher suggests that to survive this kind of competition. The effectiveness of a forex market and the determination of the exchange rate are baseline tasks for both export or import oriented countries. It is commonly said that the exchange rate (EXR) has a consistent effect on both export and import. The basic exchange rate systems in Bangladesh are fixed exchange rates or floating exchange rates. Khalid and Rajaguru (2004) found that neighbour countries like India basically adjusted with fixed exchange rate but several times it takes a managed floating system, where Sri-Lanka also follows the fixed EXR system. Mustafa and Nishat (2004) state that Pakistan follows the fixed exchange rate system. The economic theory explains that the floating exchange rates are mostly volatile to influence the trade where the fixed exchange rate system is comparatively suitable and less volatile in nature.

Most of the study measures the nature of volatility and decisions are, more volatility creates more fluctuation and creates vulnerability in the trade market. Hafner (1996), Balaban (2004), Alam and Rahman (2012), Epaphra (2016), Senadza and Diaba (2017) imply the GARCH (1, 1), EGARCH (1, 1) models to estimate the exchange rate volatility with leverage effect on currency as like as trade. Fluctuation also creates trade and investment risk in both foreign and domestic markets. In sometimes the economy's presence that fiscal policy and monetary policy are hampered by the exchange rate volatility. The findings to Taylor (2005) were financial decisions like risk management, hedging, portfolio, and price-setting both are considered in the volatility of the foreign exchange rate.

It is difficult to stabilize a volatility nature of the exchange rate in Bangladesh because several types of exchange rate policies exist in different countries and those countries are not similar in

trade patterns where some nations are export-oriented and some are import based on fixed EXR systems or floating EXR system. But there is an advantage for Bangladesh which is the exchange rate or trade pattern among the South Asian countries are similarities in regional or geographical locations, it helps to trade creations and exchange rates are sometimes moderated by geographical similarity. On the other hand, the exchange rate or trade pattern is quite different in European and Arabic countries. As the key macroeconomic variables researcher always focuses on the stability of the exchange rate. Kemal (2005) demonstrates the importance of stability in the forex market and he explores that, volatility hampered the total trade volume in the world trade market.

In the exchange rate system, there is no specific time bounce, no specific opening or changing period it creates a function of 24 hours a day and a week consists of 7 days as a continuous process. So the volatility creates the vulnerability merits of an investor, traders in targeted countries. Siregar and Rajan (2002), demonstrate that price and Exr volatility encourage the diminishing export volume with a large interference on trade and investment in the studied country.

This study will measure the impact of exchange rate volatility on trade in Bangladesh. The current study considers a time series estimate using monthly basis data from 2013M01 to 2019M06 in the aspects of Bangladesh, with a total no of observations 78 months. There is a limitation of this study are lack of data availability in a similar source, the similar kind of problems faced by Baum et al. (2001), Bilquees et al. (2010). Most of the authors state that the Autoregressive Conditional Heteroscedasticity (ARCH) family model is slightly appropriate to investigate the exchange rate volatility. The current study conducts with ARCH family as ARCH, GARCH, and EGARCH model to investigate the exchange rate volatility on trade in Bangladesh. In the next part of this study, section 2 about the setup objective, section 3 shows the summary of the literature. The methodology is presented in section 4, section 5 discussed the empirical results and findings and lastly summary and conclusion present in section 6.

The Objective of this Study

The main objective of this study is to measure the impact of exchange rate volatility on trade in Bangladesh.

1) to examine the nature of exchange rate volatility in Bangladesh
2) to quantify the impact of exchange rate volatility on export and import volume
3) to measuring the leverage effect of exchange rate volatility on export and import volume

Literature Review

There are numbers of study exist to emphasis the exchange rate volatility on trade. In this manner, the following Table 1 represents the summary of relevant literature.

Table 1. Summary of literature

Name of Author	Type of Data, Country & Duration	The framework of Study	Variables	Results
Dhankar and Chakraborty (2007)	Time Series; South Asian; 1996 – 2005; (daily basis)	ARMA, GARCH model	Stock exchange rate	Return on the forex market is not identically distributed
Hasan and Mukit (2015)	Time Series; Bangladesh; 1991 to 2012. (monthly basis)	The VECM framework	Exchange rate, export	Long-run relations and EXR cause to export

Name of Author	Type of Data, Country & Duration	The framework of Study	Variables	Results
Hooy and Choong (2010)	Panel data; SAARC countries; 1980-2010; (monthly basis)	CCC-GARCH model	Real exchange rate, foreign income, and exchange rate volatility	Export volume is negatively affected by EXR volatility
Olowe and Ayodeji (2009)	Time series data; Nigeria; 1970-2007; (monthly basis)	ARCH (1,1) family model)	Fixed, floating and foreign exchange rate	Volatility presents in both fixed and floating exchange rate
Kikuchi and Shoji (2004)	Panel data; East Asian countries; 1993-2003; (monthly basis)	GARCH and ECM modeling	Export, relative price of export, nominal exchange rate	The volatility of Exchange rate influence the trade pattern
Todani and Munyama (2005)	Time series; South Africa; 1984-2004; (quarterly basis)	ARDL and GARCH model	Exports, income on trade, relative price and exchange rate	The empirical result does not ensure to discreet result, the result is differ based on different variables
Sauer and Bohara (2001)	Panel data developing and industrialized countries; 1973–93; (annual basis)	VAR, VEC model	Exports, foreign income, relative price, EXR volatility (VOL), effective EXR, terms of trade	South Asian countries are less vulnerable than Latin American and African LDCs exporters
Hooy and Baharumshah (2015)	Panel data; East Asian countries; 1990-2008; (monthly basis)	EGARCH and ARDL model	Exchange rate volatility, import, export	Forex volatility negatory effect on trade in studied countries.
Shoaib (2009)	Time series data; Bangladesh; May 2003 - Dec2008; (monthly basis)	VECM framework	Exchange rate volatility, IPI, export	Negatory significant impact on trade growth
Lotfalipour and Bazargan (2014)	Time series; The USA and Iran; 1993-2011; (monthly basis)	GARCH (1, 1)	Trade balance, effective- exchange rate, import, and export	The empirical study state that imports effect to the trade balance

Name of Author	Type of Data, Country & Duration	The framework of Study	Variables	Results
Baak (2004)	Panel data; The Asia Pacific Countries; 1980-2002; (annual basis)	OLS and Gravity model	Export, VOL, GDP, geographical distance	Volatility has a statistically negatory impact on trade
Asteriou et al. (2016)	Panel data; MINT; 1995 -2012; (monthly basis)	ARDL and GARCH model	Export, import, nominal and real exchange rate	There is no link between EXR vol and trade in Turkey but, Indonesia, Mexico have causal in the short term
Wang et al. (2005)	Time series; Developed and South Asian countries; 1993 -2003; (daily basis)	GARCH EGARCH model	Stock exchange rate	The USA EXR volatile spillovers effect to Indian and Sri-Lanka, Japan to Pakistan
McKenzie and Mitchell (2002)	Time series; 17 high traded country 1986 – 1997; (daily basis)	Power GARCH model	EXR volatility	GARCH (1,1) support to the inclusion of leverage effects
Subanti et al. (2018)	Panel data; ASEAN countries; 2000 – 2016; (annual basis)	Pooled, Fixed, Random effect model	Real EXR, real GDP export, and relative price	Empirical evidence found that REX volatility has a negatory interference on export
Chit et al. (2010)	Panel data; East Asian countries; 1982 – 2006; (quarterly basis)	Cointegration analysis and GARCH model	GDP, exchange rate volatility, export, relative price, AFTA	VOL has a negatory impact on export
Aziz (2008)	Time series; Bangladesh; 1975-2005; (annual basis)	VECM, Causality	BOP, effective EXR	BOP positively influenced by Effective real EXR
Bilquees et al. (2010)	Panel data; South Asian Countries; 1960-2007; (annual basis)	VECM and GARCH model	exports, relative export prices, foreign income, and real EXR volatility	VECM found that Cointegration among variables and GARCH model demonstrate the Real EXR Vol negatory effect on export

From the above literature reviewed we found the research gap that is several exports and import model is never been query by other researchers by using ARCH, GARCH, EGARCH technique for Bangladesh. Here we also show that exchange rate volatility as an internal effect and other variables are external effects to measuring the impact on trade.

Methodology

Measuring the impact of exchange rate volatility on trade in Bangladesh, we have used time-series data to investigate our current objective. The secondary data are collected from International Financial Statistics (IFS), Bangladesh Bank (BB) and Federal Reserve Economic Data (FREED). The current study considers monthly basis data from 2013M01 to 2019M06. The variable details are presented in table 2.

Table 2. Detail of the Selected Variables

Variable name	Variable details	Data source
Expt	Trade of goods export Value of exports, free on board (FOB), US Dollars	International Financial Statistics (IFS)
Imp	Balance of payments, current account, goods and services, services, debit, (US Dollars, Millions)	(IFS)
Exv	Exchange rate volatility (foreign exchange rate, BDT to One U.S. Dollar, Monthly)	Federal Reserve Economic Data (FREED), Bangladesh Bank (BB)
Px	The relative price of export, (proxied by effective exchange rate), National currency per SDR, period average	(IFS)
Pm	The relative price of import (proxied by effective exchange rate), National currency per SDR, period average	(IFS)
CPI	Prices, consumer price index, all items. (US Dollars, units)	(IFS)

Basic Models

The impact of exchange rate volatility on trade is investigating two functional forms as export and import function. These functions are representing in following equations 1 and 4.

$$Expt = f(Exv, Px, CPI) \quad (1)$$

$$\text{Expt}_t = \beta_0 + \beta_1 Exv_t + \beta_2 Px_t + \beta_3 CPI_t + \varepsilon_t \quad (2)$$

Now, the econometric form of $Export$ Model by taking Log on both sides

$$LnExpt_t = \beta_0 + \beta_1 LnExv_t + \beta_2 LnCPI_t + \varepsilon_t \quad (3)$$

$$Imp = f(Exv, Pm, CPI) \quad (4)$$

$$Imp_t = \beta_0 + \beta_1 Exv_t + \beta_2 Pm_t + \beta_3 CPI_t + \varepsilon_t \quad (5)$$

Now, the econometric form of $Importport$ Model by taking Log on both sides

$$LnImp_t = \beta_0 + \beta_1 LnExv_t + \beta_2 LnPm_t + \beta_2 LnCPI_t + \varepsilon_t \quad (6)$$

Table 3. Model Structure

Control Variable	Exv	The endogenous factor of trade	For both export and import model
Variable of interest	Px, Pm, CPI	The exogenous factor of trade models	

ADF Unit Root Test

DF and ADF Technique

The simple unit root stochastic process follows the procedure

$$Y_t = \rho\, Y_{t-1} + \mu_t \quad where, \quad -1 \le \rho \le 1 \tag{7}$$

$$Y_t - Y_{t-1} = \rho\, Y_{t-1} - Y_{t-1} + \varepsilon_t \tag{8}$$

$$Y_t - Y_{t-1} = (\rho - 1)\, Y_{t-1} + \varepsilon_t \tag{9}$$

$$\delta Y_t = \varphi\,(Y_{t-1}) + \varepsilon_t \tag{10}$$

$$Where;\ \varphi = (\rho - 1)\ and\ \delta\ is\ the\ operator\ of\ 1st\ diffrence$$

$$if\ \varphi = 0\ then\ \rho = 1\ meaning\ that\ the\ series\ have\ unit\ root\ as\ the\ condition\ of\ H_0.$$

$$if\ \varphi = 0\ then;\ \delta Y_t = Y_t - Y_{t-1} = \varepsilon_t \tag{11}$$

Since, ε_t is an error term, describe it is stationary, meaning that the time series is stationary after taking the first difference. Now ADF test has the following equations:

$$\delta Y_t = \vartheta_1 + \vartheta_{2t} + \varphi(Y_{t-1}) + \alpha_t \sum_{i=1}^{f} \delta Y_{t-1} + \varepsilon_t \tag{12}$$

Where; ε_t is an error component and ADF δY_{t-1} is the lagged selection criteria.

Testing for Heteroscedasticity

The residual (Showing in Figures A1 and A2) comes from a derivation of simple OLS regression as export, import explained variable and exchange rate volatility as an explanatory variable. The corresponding mean equation and the moving average known as the variance equations create the residual series, it gives the necessary conditions to apply the autoregressive conditional heteroscedasticity (ARCH) family model (ARCH, GARCH, EGARCH). Engle (1982) introduced the ARCH-LM test to test heteroscedasticity. The conditional mean Equation is

$$\varphi_t = \theta_1 \varphi_{t-1} + \varepsilon_t + \vartheta_1 \varepsilon_{t-1} \tag{13}$$

The variance equation is

$$e_t^2 = \alpha_1 + \alpha_1 e_{t-1}^2 + \alpha_2 e_{t-2}^2 + \ldots . \alpha_q e_{t-q}^2 + \varepsilon_t \tag{14}$$

The ARCH-LM test assumes the task hypothesis that there is no ARCH effect until the optimum moving average process. The corresponding ARCH –LM test result is given in *Table A3* with considering one and five percent significance level.

The Generalized Autoregressive Conditional Heteroscedastic (GARCH) Technique

The GARCH model implements in the current study to measure the volatility clustering and investigate the situation of trade volume including both export and import. However, GARCH (p, q) conditional mean or autoregressive (p) process and conditional variance (q) procedure represent the following framework.

$$\sigma_t^2 = \omega_1 + \sum_{j=1}^{q} \alpha_j \varepsilon_{t-1}^2 + \sum_{i=1}^{p} \beta_i \sigma_{t-1}^2 \tag{15}$$

the lagged of σ^2 term represent p and lagged ε^2 represent q process

The mean equation $\theta_t = \mu + \varepsilon_t$ (16)

Variance equation $\sigma_t^2 = \omega_1 + \alpha_j \varepsilon_{t-1}^2 + \beta_i \sigma_{t-1}^2$ (17)

Where, $\omega > 0 \; and \; \alpha_1 \geq 0 \; and \; \beta_1 \geq 0$

$\theta_t = trade\ volume\ (export, import)\ at\ time\ t$

$\mu = average\ trade\ volume\ (export, import)$

$\varepsilon_t = residual\ impact\ \ (export, import)\ and\ \varepsilon_t = \sigma_t\ z_t$

Where, z_t standardized residual value

The EGARCH Technique

The Exponential Generalized Autoregressive Conditional Heteroscedastic (EGARCH) models were developed by Nelson (1991). The ultimate target of this model is to estimate the leverage effect of the volatility series. This model helps to make a sign based on the previous value. Let the EGARCH equation is

$$log\ (\sigma_t^2) = \alpha_0 + \left|\frac{\mu_{t-1}}{\sigma_{t-1}}\right| + \beta_1\ (\log \sigma_{t-1}^2) + \gamma_i\ \frac{\mu_{t-1}}{\sigma_{t-1}} \quad (18)$$

The γ_i a coefficient is typically negative or positive, a positive shock creates less volatility in the future and a negative shock creates more volatility in the next period based on the past volume series.

The mean equation is $\theta_t = \mu + \varepsilon_t$ (19)

The variance equation $log\ (\sigma_t^2) = \alpha_0 + \left|\frac{\mu_{t-1}}{\sigma_{t-1}}\right| + \beta_1\ (\log \sigma_{t-1}^2) + \gamma \frac{\mu_{t-1}}{\sigma_{t-1}}$ (20)

The EGARCH (1, 1) model will be a task with the mean and variance equations to measure the leverage effect in the current study.

Results and Discussion

***Descriptive Statistics of all Vari*ables**

The descriptive result consists of several criteria like as mean, median value, maximum, minimum, skewness, kurtosis and J-B value's both categories give the unique results for the robustness of the current study. The J-B test holds the task hypothesis is that the series is not normally distributed. The estimated results state that the series is normal with rejecting the H_0 that is representing in Table A1. These results are considered with one percent, and five-percent significance level.

ADF - Fisher Unit Root Test Results

ADF test employs to identify the optimum lagged selection of time series data. Table A2 represents that the variables are no stationary at the level when we take its first difference the all of the series are stationary. Here the variables assume in trend and intercept with the minimum value of SIC criteria. Dickey and Fuller (1981) imply the ADF test with the task hypothesis, the series have unit root and table showing the rejection process of the task hypothesis.

The Result of ARCH L-M test

The estimated residual manipulate the instance of heteroscedasticity is presented in Table A3. Here the ARCH L-M test rejected the nominal hypothesis for both export and import model. Rejecting the nominal inference look at the ARCH effect exists in the trade model. Figure A1 and Figure A2 show the volatility clustering of the residual series.

Estimation Results of GARCH (1, 1) Model

The estimated result of the GARCH (1, 1) export model present in Table A4, represents that two segments one is the mean equation it's represented in the upper portions and the second is variance equations it's represented in the lower portion of this table. In the first segment shows that constant and ARCH term significant at 1 % level and coefficient has a positive sign. The squire root of the ARCH term consists of a standard deviation that measures the risk of trade volume. This

study indicates that the export and import volume has risk in trade volume. The export model considers that, export as explained variable and EXR volatility used as the explanatory variable. The mean equation in the export model states that exchange rate volatility as the endogenous or internal effect to explain the export volume. The findings of econometric results demonstrate that the EXR volatility has a negatory impact on export volume. Kroner and Lastrapes (1993), Qian and Varangis (1994), Caporale and Doroodian (1994) found similar results of the GARCH (1, 1) model that, there is a significant and negatory sign associated with EXR volatility on trade volume both export and import. The positive and significant value of squire root of ARCH demonstrates an export volume is a risky event. The variance equation of in export model shows that there are two exogenous or external factors as like as the price of export goods and consumer price index have no significant impact on export and constant is insignificant. The GARCH term negatively significant with 6% level and ARCH term is insignificant.

The import models also show the risk of import volume in Table A5, the standard deviation or squire root of the ARCH term is quite significant. As the explanatory variable exchange rate volatility on imports shows a negative value to determine the import volume. The variance equation or import model explains that ARCH term significant with ten percent and GARCH term significant with one percent level. So the risk measurement implies that both export and import volume has risk due to the volatility of the exchange rate.

Diagnostic checking for both models implies the ARCH L-M test assumes that the nominal hypothesis as there is no additional ARCH effect in this model and the estimated result of the ARCH L-M test accepts the nominal hypothesis.

Estimation Results of EGARCH (1, 1) Model

The EGARCH empirical results in Table A6 demonstrate that the estimated coefficient value for each variable where the exchange rate volatility individually has an insignificant negatory leverage effect. The EGARCH model helps to measure the volatility trend or leverage effects of selected series where the leverage effect defines the past year's volatility creates the next volatility. The current study state the variance equation in an export model in Table A7, the ARCH term α negatively insignificant, the GARCH term ϵ has positively significant and both parameters are positively insignificant and significant respectively in import model in Table A8.

Now concentration on volatility parameter γ in both models, the estimated result shows the γ coefficient. The result is that the coefficient value is positive and significant with 6% and 1% level respectively. The results demonstrate past year's volatility of the EXR does not affect the next trade volume. The positive leverage effect supports the economic theory in the aspect of Bangladesh. Anson and Hudson-Wilson (2003), Harford et al. (2006), Acheampong (20014), Abdullah (2015) also found a similar result. Begum and Shamsuddin (1998), Manni and Afzal (2012), Mamun and Nath (2005), Sultan (2008), Ahamed and Tanin (2010) argue that the economic growth of Bangladesh in the last decade was still quite significant and effective. The volume of export, import in Bangladesh increases day by day.

Conclusion

This study has examined the impact of exchange rate volatility on trade in Bangladesh. The study considers the monthly basis data from 2013M01 to 2019M06 and the exchange rate considers the value in terms of the US dollar. This study considers the generalized autoregressive conditional heteroscedastic (GARCH) model and the Exponential generalized autoregressive conditional heteroscedastic (EGARCH) model. The GARCH (1, 1) model implies volatility and risk measure of EXR volatility on trade volume in several exports and import models. Those models state that the EXR volatility has a negatory shock on trade volume and empirical results also found that export,

import market has risk. Hassan and Tufte (1998), Arize et al (2000), Ahmed (2009), Francois and Manchin (2006) found a similar result in their studies.

The EGARCH (1, 1) model explains the positive leverage for the trade volume in the long term or sustainable development. The past year or the volatility trend does not impact on future trend but the GARCH (1, 1) state the risky event. In a general sense, it's quite true for the Bangladesh economy. The solution can recommend that government or regulatory institutional needs take the necessary step. Khan (1999), Francois and Manchin (2013), Ahmed et al. (2014) and most of the researchers or domestic economists state that lack of institutional quality and corruption exist in the export and import market. If the authority takes the necessary step then the trade volume will be increased and it opens a new door as a growing economy. As a developing country, Bangladesh already achieved significant economic growth and industrialization increase with respect to time. The export-oriented industrial sector like as leather industry, readymade garments, jute and jute product, fisheries, IT industry and drogue industry, etc. makes a positive change in the export sector in Bangladesh. Import oriented industries are also taken a position in the economy.

The contribution of this study will be added new value in existing literature and support to shell a new door to domestic investment and foreign investment as known as a foreign direct investment (FDI) and policy implementation in the relevant field. This Study supports the future economy of Bangladesh based on trade and industrialization to increase FDI, export volume and import substitute industrializations with fulfilling the current objective.

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Appendix

Table A1. Descriptive Statistics of the Selected Variables

Variables	LNEXPT	LNCPI	LNEXV	LNIMP	LNPX
Mean	7.977097	4.855072	1.506415	9.253588	4.736176
Median	7.811653	4.84902	1.485071	9.225562	4.741204
Min.	5.70298	4.791862	1.470921	9.013608	4.664929
Max.	9.184673	4.944596	1.569643	9.5626	4.804935
Std.D	0.567352	0.035218	0.040767	0.177324	0.041713
Skewness	0.429003	0.629956	0.65956	0.567412	-0.08992
Kurtosis	6.626113	2.966985	1.51936	2.048546	1.472986
Sum Sq. Dev.	22.85405	0.088062	0.117996	2.232512	0.123539
J-B	41.65462***	4.765401*	11.79711***	6.579269**	7.09235**
Note: The Results are statistically significant at 1% (5%) (10%) level and it's mentioned by *** (**) (*) respectively. H_0 the series are not normally distributed					

Table A2. ADF - Fisher Unit Root Test

Variables	Lnexv	Inexp	Lnimp	lnpx	lncpi	lnpm
At Level						
ADF - Fisher Chi-square	-1.31	-2.75	-3.10	-1.70	-2.12	-1.70
At 1st Difference						
ADF - Fisher Chi-square	-8.56***	-9.17***	-8.02***	6.77***	-8.82***	6.77***
Notes: Here this study ensures that all the variables are performed in trend and intercept for the series. SIC used to identify the optimum lagged length. Here this test assumes that "data series has a unit root" as a null hypothesis. These results are statistically significant to reject H_0 at 1% (5%) (10%) level and it's mentioned by *** (**) (*) gradually.						

Table A3. ARCH-LM Test for Residuals of Export and Import Series

ARCH test and ARCH-LM Test for Residuals of Export Series			
ARCH test	**Coefficient**	**Pro.**	**Significance Level**
F-stat	19.96***	0.00	1%
Obj R Squire	8.96***	0.00	1%
ARCH-LM Test			
F-stat	43.82***	0.00	1%
Obj R Squire	40.54***	0.00	1%
ARCH test and ARCH-LM Test for Residuals of Import Series			
ARCH test	**Coefficient**	**Pro.**	**Significance Level**
F-stat	90.07***	0.00	1%
Obj R Squire	42.01***	0.00	1%
ARCH-LM Test			
F-stat	208.73***	0.00	1%
Obj R Squire	66.02***	0.00	1%
Note: H_0: There are no ARCH effects in the residual series. and These results are statistically significant at 1% (5%) (10%) level and it's mentioned by *** (**) (*) gradually.			

Table A4. Estimation Results of GARCH (1, 1) Export Model

Variables	Coefficient	Std. Error	T-Statistics	Prob.	ARCH-LM test	
					statistics	prob.
SQRT(GARCH)	0.24**	0.12	2.05	0.03	0.0277	0.868
C	9.90***	0.12	81.74	0.00	0.0285	0.865
LNEXV	-1.42***	0.08	-18.27	0.00		
Variance equation model					Selection Criteria	
C	-0.64	0.75	-0.85	0.39	AIC	-0.745
RESID(-1)^2	4.39	4.07	1.08	0.28	SIC	-0.460
GARCH(-1)	-0.13*	0.07	-1.88	0.06	HQC	-0.632
LNPX	0.13	0.17	0.68	0.49		
LNCPI	0.02	0.01	1.05	0.2 9		

Note: H0 for ARCH LM test is, There is no ARCH effect in this model
These results are statistically significant at 1% (5%) (10%) level and it's mentioned by *** (**) (*) gradually.

Table A5. The Estimation GARCH (1, 1) Result of Import Model

Variables	Coefficient	Std. Error	T-Statistics	Prob.	ARCH-LM test	
					Statistics	prob.
SQRT(GARCH)	1.15***	0.358	3.23	0.00	1.21	0.27
C	10.23***	0.455	22.50	0.00	1.23	0.26
LNEXV	-0.77***	0.293	-2.64	0.00		
Variance equation model					Selection Criteria	
C	0.05	0.095	0.48	0.63	AIC	-1.54
RESID(-1)^2	0.56*	0.340	1.63	0.10	SIC	-1.29
GARCH(-1)	0.57***	0.190	2.99	0.00	HQC	-1.44
LNPM	-0.01	0.021	-0.42	0.68		
LNCPI	0.00	0.023	-0.03	0.98		

Note: H0 for ARCH LM test is, There is no ARCH effect in this model
Statistically significant at 1% (5%) (10%) level and it's mentioned by *** (**) (*)

Table A6. EGARCH (1, 1) Result for Selected Variables

EGARCH (1, 1) result for selected variable						
Variables	Constant	Arch	GARCH	Vol	ARCH-LM test	
					Statistics	Prob.
Lnexv	1.473***	-3.47***	3.14	-0.28	0.67	0,41
Lnpx	4.76***	3.66**	2.09	-2.25	0.28	0.59
Lnexp	7.82***	0.35***	-0.16	0.21	0.003	0.95
Lncpi	4.827***	-4.32***	2.96	0.3	1.57	0.21
Lnpm	4.76***	3.66**	2.09	-2.25	0.28	0.59

Significant level at 1% (5%) (10%) level and it's mentioned by *** (**) (*)

Table A7. EGARCH (1, 1) Result for the Export Model

Variables/Coefficient	Coefficient	Std. Error	T-Statistics	Prob.	ARCH-LM test	
					statistics	prob.
A ω	13.42	0.00	5521.19	0.00	0.30	0.58
LNEXV	-3.76	0.00	-2688.91	0.00	0.31	0.57
Variance equation model					Selection Criteria	
α	-2.58	51.39	-0.05	0.96	AIC	-0.05
ϵ	1.83	0.33	5.49	0.00	SIC	0.20
γ	1.33	0.32	4.23	0.00	HQC	0.05
β_2	-0.26	14.82	-0.02	0.99		
β_3	0.00	8.00	0.00	1.00		

Note: H_0 There are no ARCH effects in the residual the model

Table A8. EGARCH (1, 1) Result for Import Model

Variables/Coefficient	Coefficient	Std. Error	T-Statistics	Prob.	ARCH-LM test	
					statistics	prob.
ω	13.19	0.10	121.38	0.00	0.32	0.57
LNEXV	-2.63	0.07	-36.99	0.00	0.33	0.56
Variance equation model					Selection Criteria	
α	58.75	47.0	1.24	0.21	AIC	-1.19
ϵ	1.87	0.51	3.67	0.00	SIC	-0.95
γ	0.13	0.45	0.30	0.76	HQC	-1.09
β_2	-22.43	6.69	-3.35	0.00		
β_3	9.81	7.45	1.31	0.18		

Note: H_0 There are no ARCH effects in the import model

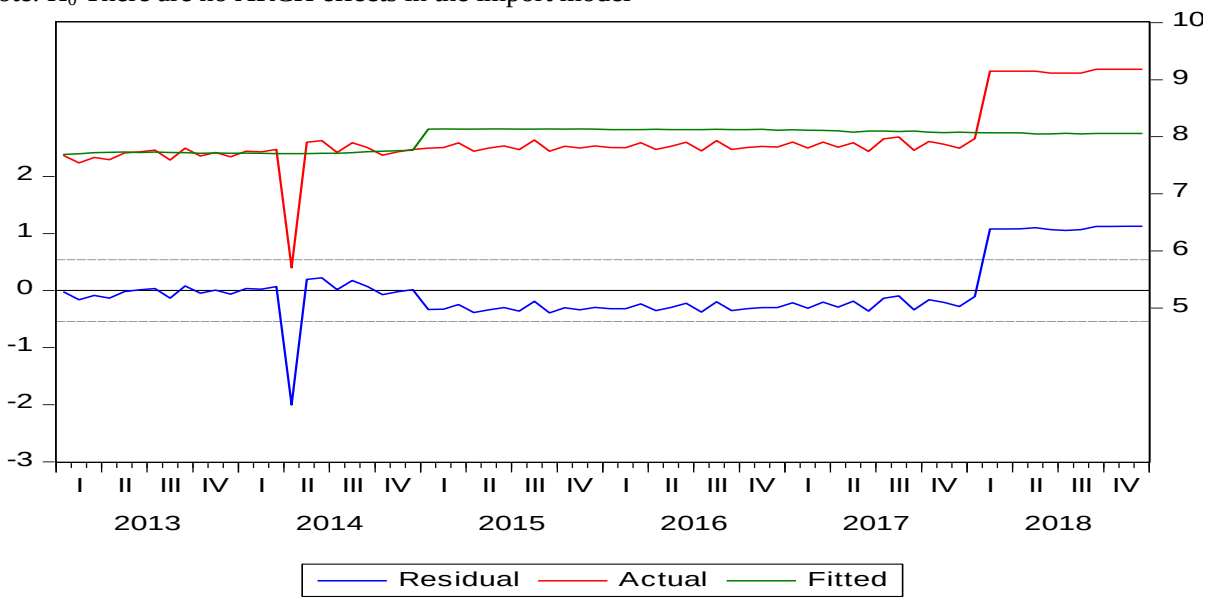

Figure A1. Residual from the Export Model

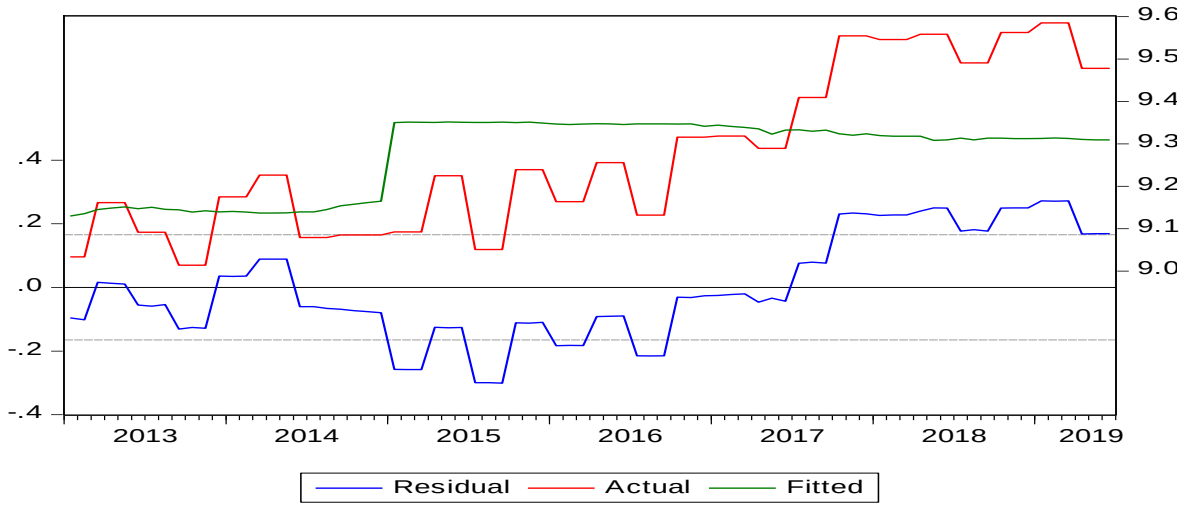

Figure A2. Residual from Import Model