International Journal of Advanced Studies in Business Strategies and Management | IJASBSM
ISSN Print: 2354-4236 | ISSN Online: 2354-4244
Volume 6, Number 1, August, 2018

Exchange Rate Volatility and its Impact on Foreign Trade in Nigeria

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Abstract

This study examined exchange rate volatility and its impact foreign trade in Nigeria using monthly time series data for the period of 1995 to the fourth month of 2018. We adopted a generalized seasonal unit root test technique called HEGY developed by Hylleberg, Engle, Granger, and Yoo (1990) which is capable of capturing a zero frequency unit root for the unit root test and Autoregressive Distributed Lag Model (ARDL) model in estimating the formulated model. Seasonal unit root test result confirmed that export, import, price and exchange rate indeed contained a unit root. The ARDL bound test results confirmed that the long run equations stated in models were empirically valid. Interestingly, domestic price level impacted positively on both export and import and the magnitude of these effects were almost the same on both export and import with only 0.33% unit difference. In the same fashion, exchange rate volatility impacted negatively on both export and import with a close magnitude of the effect of exchange rate volatility on both export and import. We therefore conclude that exchange rate volatility impacted negatively on foreign trade in Nigeria and we recommend that the monetary authority and the government should put in place exchange rate and trade policies that will promote greater exchange rate stability and trade conditions so that domestic production in the economy will be encouraged.

Keywords*: Exchange Rate Volatility, Foreign Trade, HEGY, ARDL*

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Background to the Study

The idea of international trade is rooted in the propounded theories of Adams Smith in his famous book 'The Wealth of Nations' in 1776 where he explained the importance of specialization and that of David Ricardo which elucidated the theory of comparative advantage. In the same vein, the recent embraced concept of globalization has left all countries with no other choice than to depend on each other for one thing or the other. Understanding this fact had also led to perpetual advent of suggestions from international organizations which includes World Bank and United Nations has to the reduction of various trade hurdles, measures to limit economic activities as well as and obtaining a noteworthy upsurge in trading activities among countries (Afonso, 2001).

Particularly from the theory of comparative advantage, the idea of international trade is imperative because of the differences in the natural resources, human capital, financial capital and technical capabilities bequest of nations. In fact, apart from this natural resources endowment, some countries are faced with the problem of managing and using their endowed resources to their advantage therefore limit their growth and development as well as the standard of living of their citizens (Adeleye et al 2015).

Hence, international trade talks about activities which encompass exchange of goods and services between nations (Adeleyeet al 2015). They maintained that, the summation of activities relating to trading between the traders across borders must involve minimum of countries should be involved in the activities. The evaluation of an economy in relations to level of growth and income level of individuals has been founded on the level of domestic production, consumption activities as well as its foreign activities on goods and services. Therefore, international trade plays a vivacious role in the reformation of economic and social characteristics of nations round the world, chiefly, developing countries (Adsuyi and Odeloye, 2013).

Hence, foreign trade is significant on the basis that, no country can produce all goods and services needed by their citizens as a result of differences in resources, technology, technical know-how as well as other constraints. Therefore, this trade association proposes that nations must carry across their boarder goods and services in which they have advantage for exchange of foreign currency which will empower them to bring in goods and services not producing by them to their country (Adeleyeet al 2015). These activities are possible through the exchange of one country's currency for another.

According to Obadan (2006), exchange rate is a monetary worth that connect the domestic value with international values of goods and services. It represents the price in which currency of one country is exchange for that of another country. It then means that, trading activities between countries can only ensue when currencies of countries can be exchange for one another, therefore, foreign exchange is bought and sold for the sole aim of international transactions (Adeniji, 2013). Given the function of exchange rate, its fluctuations weather appreciation or depreciation has a fundamental consequence on the economy(Obadan, 2006).

In a trifling economy which is not capable of influencing the general prices of transacted goods and services, an increase in the worth of domestic currency will drop the domestic prices of dealt goods, while decrease in the value of domestic currency raises domestic price of traded goods (Begg, 2003). In the same vein, on international trade, an increase in the value of domestic currency pull down the price of transacted goods, in so doing dropping the number of goods and services supplied and demanded locally leading to fall and rise in the number of goods bringing in and those going out. Conversely, decrease of the local currency increases the values oftrans acted goods thereby swelling the quantity supplied and dropping the quantity demanded locally making the quantity of goods going out of the country to rise, while the quantity coming in drops (Adeniji, 2013).

Resulting from the above, it can be deduced instabilities in exchange rate affect greatly the country's balance of payment stands, therefore exchange rate policy is geared towards how equilibrium can be maintained in the country's balance of payment account. Hence, exchange rate policy attempts to achieve this by manipulating the relative price arrangement in the local currency terms between transacted goods and non-transacted goods as well as general level of local prices (Adeniji, 2013).

In the same vein, from the Theoretical perspectives, exchange rate instability has been found to have some impact on the export of an economy. Hooper and Kohlhagen (1978) maintained that a hike in exchange rate risk have negative impact on trade. However, in the view of De Grauwe (1988) who proposed that as trade instability is based on peoples' level of risk repugnance, therefore, exchange rate risk exert positive impact on export of goods and services. More specifically, by means of goods and money markets, Dincer and Kandil (2011) established theoretically and maintained that, exchange rate risk affects export in the two ways. Firstly, surprising appreciation in domestic currency against foreign currency will increase the prices of export, while import becomes inexpensive in terms of the good market. These conditions greatly reduce countries' local production ability when dependent on foreign resources for its production. Secondly, from the money market activities, apositive surprise to the domestic currency can decrease local production output (Nyeadi et al 2014).

Form the theoretical perspectives, there is said to be an equivocal association amid exchange rate risk and foreign trade in terms of the former stimulating or hindering growth in the later (Cote, 1994; Odili, 2014). Empirical evidences have also often revealed three different forms of results; those authors that their study showed negative relationship between exchange rate risk and foreign trade volume are (Cushman, 1983; 1986; Caballero and Corbo, 1989; Chowdhury, 1993; Caporale and Doroodian, 1994; Doroodian, 1999; Arize et al 2000; Saucer and Bohara, 2001; Grier and Smallwood, 2007; Baum and Caglayan, 2009; authors that found positive relationship between exchange rate fluctuation and foreign trade volumes are (Klein, 1990; Franke, 1991; Sercu and Vanhulle, 1992; Zilberfarb, 1993; Dellas and Zilberfarb 1993, Baum, et. al., 2004; Baum and Caglayan, 2010; Naseem and Hamizah, 2009); while, countless practical works have futile result on the significant relationship between exchange rate risk and the volume of

foreign trade among these works are; (Hopper and Kohlhagen, 1978; IMF, 1984, Baily et el 1986; De Grauwe. 1988; Assery and Peel 1991, Bahmani-Oskooee 1991, Viaene and De Vries, 1992 and Gagnon, 1993). It then means that, further studies on the influence of exchange rate risk is highly imperative to be carried out in a country like Nigeria. Therefore, this paper is divided into five sections, following this introduction is section two which deals literature review. Section three presents the methodology, while section four discusses the analysis and results interpretation. Finally, chapter five presents conclusion and recommendations from the study.

Literature Review

There exists a surfeit of empirical evidence on the impact of exchange rate volatility on trade both in developing and developed countries. Account of some of these studies are presented as follows; Abba and Zhang (2012) examined the relationship between exchange rate volatility, trade flows and economic growth of the sub-Saharan African countries with exclusive reference to Nigeria which is considered as small open economy. They used time series data over the period of 1970 – 2009 and the model was analyzed using vector autoregressive (VAR) approach. The findings from the study revealed that, there is significant effects of exchange rate volatility on trade flows and economic growth of Nigeria for the period of study.

Pickard, (2003) uses stochastic coefficients econometric modeling to forecast real exchange rate volatility and examine how expected and unexpected volatility affect bilateral trade flows of certain steel products between Canada, Mexico and the United States using monthly data for the seven-year period 1996-2002. The results of the model indicate that the effects of exchange rate volatility on bilateral trade flows for this sector are relatively minor, where sustained changes in the spot exchange rate, sectorial economic growth, and the price of goods being traded all exert more significant influence on trade levels than exchange rate volatility. However, the model results also tend to indicate that as exchange rate volatility increases, the well-developed U.S.-Canadian forward currency exchange market may present economic agents with profit opportunities through risk-portfolio diversification, resulting in a positive correlation between volatility and trade. For the less developed U.S.-Mexican forward currency market, the model results indicate that the relationship between trade and volatility, both expected and unexpected, is weak and predominantly negative.

Bahmani – Oskooee and Kovyryalova (2008) explored the impact of exchange rate volatility on international trade of 177 commodities traded between the United States (US) and the United Kingdom (UK) for the period of 1971 - 2003. Using co-integration and error-correction techniques, the results exposed that the volatility of the real bilateral dollar – pound rate has a short – run significant effect on imports of 109 and exports of 99 industries, while there is reduction in the number of significant of exchange rate volatility in the long run with imports of 62 and exports of 86 industries. Their conclusion was a negative effect of exchange rate volatility on international trade as supported by the proponents of floating rates.

Hsing (2008) surveyed US trade with seven South African trading partners over the last 20 or 30 years according to the studied countries and showed that a J-curve existed for Chili, Ecuador and Uruguay while a lack of support was found for Argentina, Brazil, Colombia and Peru. These findings therefore suggested that the conventional wisdom of pursuing real exchange rate depreciation in order to improve the trade balance may not apply in some countries.

Broda and Romalis, (2003) studied the relationship between trade and exchange rate volatility using foreign trade data for a large number of countries for the period 1970-1997. The findings revealed robust results supporting the prediction that trade inhibits exchange rate volatility. Similarly, some few empirical studies on the relationship between globalization and trade were examined.

Todani and Munyama (2005) investigated the impact of exchange rate variability on aggregate South African exports to the rest of the world including goods services and gold exports using ARDL bounds testing procedure on quarterly data for the period 1984-2004. GARCH (1,1) as a measure of volatility was captured using the moving average standard deviation. Hence, the result revealed that depending on the measure of variability employed, either there existed no statistically significant relationship between South African exports and exchange rate volatility or when such significant relationship existed, it was positive.

Chen (2003) in his study, explain that an increase in price rigidity in the event of the uncertainty is caused by exchange rate volatility (i.e. firms becomes unwilling to change their prices due to the possibility of later reversion to exchange rate). Apart from this, volatility would account for much of inability of purchasing power parity (PPP) in cross-country analyses and decrease the speed of mean adjustment towards PPP. By testing for speed of convergence, the author discovered a positive significant coefficient for exchange rate volatility, the stickier the prices are.

Bah and Amusa (2003), studied the effect of real exchange rate volatility on South African exports to the US for the period 1990-2000 using ARCH and GARCH models. They found that the Rand's real exchange rate volatility exerted a significant and negative impact on exports both in the long and short-run.

Wang and Barrett, (2002) analyzed the effect of exchange rate volatility on international trade flows by studying the case of Taiwan's exports to the United States from 1989-1999. They found that real exchange rate risk has insignificant effects in most sectors, although agricultural trade volumes appear highly responsive to real exchange rate volatility.

Tenreyo (2003), utilized a gravity equation similar to that of Rose (2000) for a broad sample of countries using annual data from 1970 to 1979. The measure of volatility is the same as that employed by Rose, except that the standard deviation of the log change in monthly exchange rates was measured only over the current year. Her main objective

was to address several estimation problems in previous studies of the effect of volatility on trade. When these problems were not addressed and ordinary least squares were used, she founds a small effect: reducing volatility from its sample mean of about 5 percent to zero resulted in an increase in trade of only 2 percent. When the more appropriate method was used, but without taking account of endogeneity, eliminating exchange rate uncertainty led to an estimated 4 percent increase in trade. However, when endogeneity was taken into account through the use of instruments, volatility had an insignificant effect on trade, a result that was robust on the choice of instruments.

On the study of the relationship between exchange rate volatility and trade flows in Nigeria, Umoru and Oseme (2013) investigated the relationship between trade balance and real exchange rate depreciation adopting the J-curve effect study approach. Using time series data and employing vector error correction model (VECM), the result revealed that, there is cyclical feedback between the trade balance and the real exchange rate depreciation of the Naira and that, there is no empirical proof in favour of the short-run deterioration of the trade balance as implied by the J-curve hypothesis, but there was cyclical trade effect of exchange rate shocks. The implication of this is that, real exchange rate shock would initially improve, then worsen and then improve the country's aggregate trade balance which when correlated with real depreciation provided no support for the J-curve hypothesis in the Nigerian trade balance. Hence, the short run predictions of the J-curve were not observable in Nigeria.

Ibikunle and Akhanolu(2011) also investigated the impact of exchange rate volatility on trade flow in Nigeria for the period of 1970-2009, using Generalized Autoregressive conditional Heteroskedasticity (GARCH) model, the result revealed an inverse and statistical insignificant relationship between aggregate trade and exchange rate volatility in Nigeria.

Abolagba et al (2010) examined the effects of exchange rate, export volume and domestic saffron production on price of saffron in Iran as the main non-oil export goodin the country. Using Autoregressive Distributed lag (ARDL) model, the result showed that, increase in value of exchange rate had statistical significant negative impact on export price of saffron while there was no significant relationship between export price and domestic production of saffron in the long-run.

Isitue and Igue (2006), examined the effects of exchange rate volatility on US – Nigeria trade flows using GARCH modeling, co-integration, error-correction and variance decomposition on data for the period 1985 to 2005. These authors found that exchange rate volatility had a negative and significant effect on Nigeria's goods exported to the US. In line with the theoretical expectation, US GDP exerted a positive effect on Nigeria's exports but curiously, the effect was not significant in the export function. Hence, scarcity and inconsistent result from the findings of studies particular to Nigeria as well as capturing the happenings in the current period of high exchange rate hike, the study of the impact of exchange rate volatility on international trade is imperative.

Methodology

Model Specification

This seeks to empirically analyze the influence of exchange rate risk on foreign trade in Nigeria. Therefore, functional relationship between variables that is expected to answer the stated research questions are developed following the study of Abba and Zhang (2012) and Umoru and Oseme (2013). Their model is adapted with modification and we have our models as thus;

$$dlogEXR_t = \alpha_0 + \alpha_1 dlogEXR_{t-1} + v_t \quad (3a)$$

$$v_t \sim N(0, \sigma_t^2) \quad (3b)$$

$$\sigma_t^2 = v_t^2 \quad (3c)$$

$$logEXP_t = \alpha_0 + \alpha_1 logCPI_t + \alpha_2 logv_t^2 + \mu_t \quad (3d)$$
$$logIMP_t = \alpha_0 + \alpha_1 logCPI_t + \alpha_2 logv_t^2 + \pi_t$$

Where;
dlogEXR is the exchange rate returns, *EXP* is total exports during the period of study, *IMP* is total imports, *CPI* is domestic consumers price index, v^2 is the exchange rate volatility which will be used to capture exchange rate risk in the study.

Estimation Techniques

Data for the models stated above are in monthly frequency and are available from 1995 to the fourth month of 2018. The data is sourced from the central bank of Nigeria statistical database. Due to the frequency nature of the variable, it may be wrong to adopt the common unit root test technique such as Augmented Dickey-Fuller and Phillips-Perron unit root test. The study adopted a generalized seasonal unit root test technique called HEGY developed by Hylleberg, Engle, Granger, and Yoo (1990). This test is capable of capturing a zero frequency unit root and hence the justification of its perusal. A curious reader is advice to consult the reference provided for a better exposition. The model equations above are estimated in two steps. We first estimate equation 3a in order to generate equation 3c which is used as the filtered exchange rate volatility. The filtered exchange rate volatility is hence plugged into equation 3d and equation 3e. Equation 3d and equation 3e are the possible export and import long run equation, and in order to circumvent the problem of autocorrelation, heteroskedasticity, and spuriosity, we estimate these two equations from the ARDL long run model.

Data Analyses and Empirical Findings

Before we pursue the formal unit root tests, we plot the time series under study as it may help reveal the stationarity or integrating nature of the variable. The major four variables used in this study are log-transformed (the small case variables are in log form) before using for estimation purpose and are examined graphically as depicted in figure 1below. It can be shown from the figure 1 below that the logs of the variables show a visible pattern of trend and seasonal variations in both import and export. This implies that there

is a tendency for the variables' means and variances not to be constant over time. In a unit root language, we may say that the logs of the variables are not stationary over the sample periods. However, no numerical fact can be derived from the graphical inspection; based on this, we employed the HEGY unit root tests to investigate numerically the stationarity properties of variables.

The probability values for the unit root tests in table 1 below prompt us to accept the alternative hypothesis at first difference, hence we may conclude that the variables in question are indeed first order integrated variables at zero frequency. This implies that estimating our equation in difference form may be highly spurious and will lead to losses of long-run information; we may, therefore, need to test for cointegration among the variables. Interestingly, the stationarity nature of the variables had been suggested earlier by their graphical inspection in figure 1.

Figure 1.

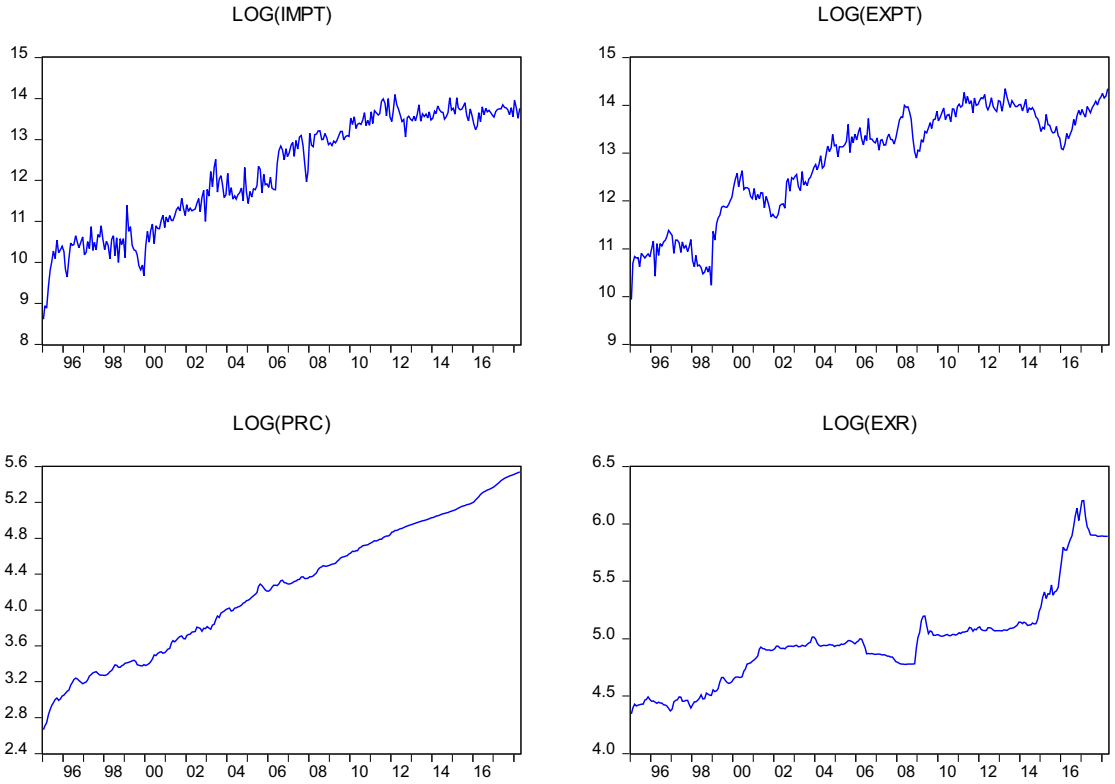

Table 1: HEGY seasonal unit root test result

	HEGY @ LEVEL	HEGY @ 1DIFF
Export	-2.05[0.46642]	-4.86[0.0000]***
Import	-1.17[0.85762]	-6.80[0.0000]***
Price	-2.77[0.12097]	-4.77[0.0000]***
Erate	-1.96[0.52747]	-4.01[0.0020]***

Source: Author's computation
Note: Constant + trigonometric terms + trend are included in the test equation.
*P-values are obtained via a surface regression.

It is necessary to select the optimal lag for the ARDL model to be estimated because; the subsequent tests and the dynamic information needed will be based on the model selected for estimation. Estimation of too much parameter will lead to useful information loses and also, selection of too much lag will reduce the available data for estimation and less degree of freedom will be available thereby making the result shaky. We use Schwarz information criterion (due to its parsimonious selection nature) to select the optimal lag for the estimated ARDL model. ARDL (6, 0, 0) model is selected for the export model while ARDL (2, 1, 2) model is selected for the import model by the Schwarz information criterion respectively.

The two tables below show the ARDL bound test for both the export and import model. The calculated F-statistics for the two models are greater than the conventional critical values and we may conclude that the long run relationships between export and import and their respective regressors are empirically valid (referring to equations 3d & 3e).

Table 2: ARDL F-bound test result
Null Hypothesis: No levels relations relationship
Model: export

Test Statistic	Value	Signif.	I(0)	I(1)
F-stat	3.481	10%	2.630	3.350
d.o.f (k)	2	5%	3.100	3.870
Sample Size Used	274	1%	4.130	5.000

Source: Author's computation using E-views

Table 3: ARDL F-bound test result
Null Hypothesis: No levels relations relationship
Model: import

Test Statistic	Value	Signif.	I(0)	I(1)
F-stat	5.430	10%	2.630	3.350
d.o.f (k)	2	5%	3.100	3.870
Sample Size Used	277	1%	4.130	5.000

Source: Author's computation using E-views

Table 4: Long run parameters derived from ARDL (6, 0, 0) estimated parameters
Dependent variable: export
Adjusted sample: 1995M07-2018M04 (274 observations)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
price	1.333774	0.177360	7.520169	0.0000***
volatility	-0.096096	0.051966	-1.849220	0.0655*
constant	6.424795	0.928395	6.920323	0.0000***

Source: Author's computation
* (**) (***) denotes significance at 10%, 5% and 1% respectively

In table 4 above, we show the estimated long-run parameters for the export model. The two variables accumulated (long-run) effects on export are both significant statistically at conventional levels. The result shows that the accumulated (long-run) effect of general domestics' price on export is positive while the accumulated (long -run) effect of exchange rate volatility on export is negative respectively. Also, one percent increase in the general domestics' price level leads to 1.33% increase in export while one percent increases in exchange rate volatility lead to 0.096% decrease in export in the long run respectively.

Table 5: Long run parameters derived from ARDL (2, 1, 2) estimated parameters
Dependent variable: import
Adjusted sample: 1995M04-2018M04 (277 observations)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
price	1.664124	0.106803	15.58122	0.0000***
volatility	-0.076011	0.042724	-1.779125	0.0763*
constant	4.431101	0.636589	6.960699	0.0000***

Source: Author's computation
* (**) (***) denotes significance at 10%, 5% and 1% respectively

Table 5 above shows the estimated long-run parameters for the import model. In the same spirit with the export model, the two variables accumulated (long-run) effects on import are both significant statistically at conventional levels. The result shows that the accumulated (long-run) effect of general domestics' price on import is positive while the accumulated (long -run) effect of exchange rate volatility on import is negative respectively. Also, one percent increase in the general domestics' price level lead to 1.66% increase in import while one percent increases in exchange rate volatility lead to 0.076% decrease in import in the long run respectively.

Conclusion

Volatility of exchange rate makes international trade and investment decisions more difficult because volatility increases exchange rate risk. Separate models for export and import are setup and a model for exchange rate volatility is also setup in order to achieve the major objective of this work. Seasonal unit root test result confirmed that export, import, price and exchange rate indeed contained a unit root. The ARDL bound test results confirmed that the long run equations stated in equations 3d and 3e are empirically valid. Interestingly, domestic price level impacted positively on both export and import and the magnitude of these effects are almost the same on both export and import with only 0.33% unit difference. In the same fashion, exchange rate volatility impacted negatively on both export and import. In fact, the magnitude of the effect of exchange rate volatility on both export and import are too close with the absolute difference of 0.02%. Conclusively, based on our empirical findings, we were able to show that exchange rate volatility impacted negatively on foreign trade in Nigeria. Based on our findings in the study, we recommend that the monetary authority and the government should put in place exchange rate and trade policies that will promote greater exchange rate stability and trade conditions so that domestic production in the economy will be encouraged.

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