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Impact of Exchange Rate Volatility on Trade Balance in Nigeria

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ABSTRACT

This study explored the relationship between exchange rate volatility and trade balance in Nigeria using annual time series from 1981 to 2020. The study focused on the impact of exchange rate volatility on Nigeria's balance of trade account, imports, and exports. Exchange rate volatility was measured using GARCH (1,1) variance series derived from the real effective exchange series. Other explanatory variables considered were inflation rate and interest rate, while balance of trade account, imports, and exports were the dependent variables. Error correction models were adopted for the analyses and estimated by the ordinary least squares technique. The findings revealed that exchange rate volatility positively impacts on the balance of trade account, imports and exports in Nigeria with about a very close magnitude. In addition, inflation was very responsive in reducing trade account balance, imports and exports. Although it reduced exports more than it reduced imports. On the other hand, interest rate did not impact on balance of trade and imports but showed a positive impact on exports in Nigeria.

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It was recommended, amongst others, that monetary authority should monitor and limit the activities of illegal exchange of foreign currencies, particularly the United States dollars.

1. Introduction

According to the Encyclopedia Britannica, "International trade is the sale and purchase of consumer or capital goods and services, raw materials, securities or gold across national borders. Such transactions may be accomplished by barter or more typically, through an exchange of national currencies". Simply put, international trade is the exchange of goods and services across international borders. Historically speaking, international trade is as old as civilization. From ancient times, authors and scholars alike deemed international trade to be a catalyst for industrial productivity and overall economic growth and development. Since no nation is a pariah state, they all depend on one another for goods and services that are produced more efficiently elsewhere.

International trade consists of import and export trades. Basically, the volume of exports in Nigeria hovers around a mono-product, i.e. crude oil. In 1996, there was a gradual but progressive increase in the volume of Nigeria's export. The price of oil reached the historic high amounting to 115 USD per barrel by mid-2008 (IFS, 2015). This continued unabated following the adoption of a democratic dispensation in 1999 and peaked in 2012. There was a downward slide after 2012, which lasted till about 2015. After 2015, it increased again and made consistent leaps that lasted till 2018 and beyond. In international trade, there is a common denominator affecting the quantum of export proceeds and amount spent on total imports, i.e., the rate at which a country's currency is traded against that of the other. This refers to the exchange rate of one currency note to the other. Exchange rates are never static. The supply and demand of significant currencies fluctuate over time. Thus, exchange rate volatility refers to the tendency for foreign currencies to appreciate or depreciate in value, thus affecting the profitability of foreign exchange trades. Okechukwu et al. (2019) found high and persistent volatility in the Nigerian stock market returns.

Volatility is the measurement of the number of rate changes and the frequency of such changes. There are many instances when exchange rate volatility occurs, including business dealings between parties from two different countries and international investments. Volatility in such circumstances is difficult to avoid. Exchange rate volatility explains a fluctuation in the economy's exchange rate. In Nigeria, there has been a persistent fluctuation in the exchange rate. The major factors contributing to the exchange rate fluctuation include interest rate, inflation, the balance of payment, and government intervention.

From 2010 to date, volatility rates have been quite unpredictable. Though Nigeria has been engaged in foreign trade for many decades, she has been persistently marginalized, and her level of participation and share in global trade is deficient (Osuegbu, 2019). This may not be unconnected with our low level production, dependence on primary products and adverse exchange rate volatility. This research is, therefore, set to ascertain the impact of exchange rate volatility on international trade in Nigeria.

1.2 Statement of the Problem

According to Udeh (2016), one of the biggest challenges Nigeria faces as a nation is how to reduce import dependence and implement export led-growth policies. From the agricultural collapse to the current oil-led growth, the Nigerian economy has been on a crossroad and is in dire need of diversification. From the early 70s, choice of exchange rate regime was based on monetary policy target devoid of any balance of payment (BOP) considerations – how exchange rate fluctuations affect trade

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flows was not the regime's concern.

According to Osuegbu (2019), Nigeria has been engaged in foreign trade for many decades, and yet it was persistently marginalized, with a significantly low degree of participation and share in global trade. Nigeria failed to exploit the full potentials of international trade for high productivity and rapid economic transformation. The issue of exchange rate volatility is partly contributing to this lopsidedness in international trading activities. Nigeria's economy is import dependent and operates on the float managed exchange rate system. We would expect that exchange rate volatility should be a topical issue that could help in determining the country's balance of payment position.

However, a prime concern today for most policymakers is how to capitalize on international trade. Recent trends in international trade and globalization prompted the policy debate over the pros and cons of different exchange rate systems. One of the issues in the discussion is the trade effect of exchange rate volatility. Proponents of fixed exchange rates have long argued that the risks associated with exchange rate volatility discourage economic agents from cross-border trading. Opponents have maintained that there are useful instruments to hedge against the exchange rate volatility, and hence the effect should be immaterial.

Several studies discuss the relationship between exchange rate volatility and international trade. The basic idea is that: if countries are risk-averse (or even risk-neutral), higher exchange rate uncertainty may lead to a reduction in the volume of trade because they may not want to risk their expected trade profits. Exchange rate volatility can affect international trade directly, through uncertainty and adjustment costs, and indirectly, through its effect on the structure of output and investment and on government policy (Brodsky, 1984). Udeh (2016), posits that different schools of thought have a diverse view of the relationship between exchange rate volatility and international trade performances. While some studies provide evidence indicating a negative relationship; others suggest there are positive effects of exchange rate volatility on international trade. This study seeks to identify the effects of exchange rate volatility on trade balance in Nigeria.

The main objective of the study is to investigate the relationship between exchange rate volatility and trade balance in Nigeria. The specific objectives are to:

i. Examine the effect of exchange rate volatility on trade account in Nigeria

ii. Determine the impact of exchange rate volatility on imports into Nigeria

iii. Ascertain the influence of exchange rate volatility on exports out of Nigeria

2. Theoretical Framework

2.1 The Mundell-Fleming IS-LM BOP Model

The theoretical framework that will be used for the basis of work is the Mundell -Fleming model also known as the IS-LM-BOP model. The Mundell-Fleming model is developed by extending the IS-LM model to the case of an open economy, where the capital and good market where internationally integrated and thus providing an understanding of how exchange rate is determined. The model is an extension of the IS-LM model, while the ISLM model deals with the closed economy, the Mundell - Fleming model tries to describe a closed economy, and this is the key difference between the IS-LM model and the Mundell - Fleming model. The Mundell- Fleming model is an economic model that integrates international trade and finance into macroeconomic theory. It was developed in the early 1960s by the Canadian economist Robert Mundell (winner of the 1999 Nobel Prize award in

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economics) and the British economist J. Marcus Fleming (1911-1976), they both belonged to the international monetary fund (IMF) research department.

The model is a close relative of the IS-LM model; both models assume that the price level is fixed and then shows what causes short-run fluctuations in aggregate income or equivalently, shifts in the aggregate demand curve. The Mundell – Fleming model shows the relationship between the nominal rate and an economy's output in the short run. Interest rate is the key component in making both the money market and the good market to be in equilibrium. Under the Mundell – Fleming framework of small economy, interest rate is fixed and equilibrium in both markets can only be achieved by a change in nominal exchange rate. According to the Mundell – Fleming model, an open economy can be described by four equations; the equations are represented as follows;

$$Y = C(Y - T) + I(r) + G + NX(\varepsilon)\ IS\ equation - - - - - - 1$$

$$e = \frac{(1 + i)Ee}{1} + i^{*})\ IRP\ equation - - - - - - - - - - - - 2$$

$$e = \frac{ep}{p_{*}}\ RER\ equation - - - - - - - - - - - - - - - - - 3$$

$$r = i - E\pi\ FISHER\ equation - - - - - - - - - - - - - - - - 4$$

The first equation shows the equilibrium in the goods market, the second equation describes the interest rate parity condition which describes equilibrium in the market for foreign exchange, the third equation states the definition of the real exchange rate, and the last equation is the fisher equation which states the relationship between the real interest rate, the nominal interest rate and the expected inflation. The four equations above determine the equilibrium values for the four endogenous variables which are income (Y), the nominal exchange rate (e), the real exchange rate (ε), the real interest rate (r). In explaining the Mundell – Fleming model, the type of exchange rate adopted is necessary because it can have completely different implications under different exchange rate regimes. The model shows that under a flexible exchange rate regime, fiscal policy does not have any power to affect output, while monetary policy is very effective. If the exchange rate is fixed, then monetary policy would become ineffective while the fiscal policy becomes very effective. The assumption that international capital markets are completely integrated plays a crucial role in determining these results.

2.2 Empirical Review

Udeh (2016), asserted that Nigeria's economy is import dependent and operates on a system of float managed exchange rate. Exchange rate volatility is a major issue in determining the country's equalization of payments position. It is these issues that the study investigated. The study follows a linear specification through partial adjustment approach using Distributed Lag Scheme (DLS) - autoregressive distributed slack model (ARDLM). The research, contrary to one-way directional impact (positive or negative) on BOP recorded in various literature, shows that the dynamism of the effect of exchange rate volatility on BOP, ranging from short-run (SR) to a very long run (VLR). In the short run, it has a negative impact on BOP, while in the long run (LR) it has a positive impact, which is reversed to negative in the very long run (VLR).

Danladi et al. (2015) conducted a study on the impact of exchange rate volatility on international trade in Nigeria. They tested stationarity of the variables by applying the Augmented Dickey-Fuller (ADF), this was followed by a cointegration test, then the granger causality and the Error Correction Model

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(ECM). The co-integration test indicated that the variables are co-integrated, indicating the existence of a long-run relationship between the variables. The granger causality test showed the presence of a causal relationship between international trade and exchange rate volatility. It was observed from the ECM analysis that exchange rate volatility negatively affects international trade. The study, therefore, recommends that the government should put in the place exchange rate and trade policies that will promote greater exchange rate stability and trade conditions promoting domestic production. In other to achieve this, the government should provide efficient infrastructural services like energy resources.

Alayande (2014) examined the relationship between exchange rate and its potential determinants using unit root test and granger causality test between1980 to 2013. The result showed a highly significant relationship between exchange rate and change in oil price, growth in money supply, foreign exchange reserves, interest rate, inflation rate and change in stock market. The study recommended that policy makers should study the effect of other variables before making future predictions on exchange rate. Serenis and Tsounis (2014) examined the effect of volatility on two small countries, Croatia and Cyprus, on aggregate exports during the period 1990 to 2012. ARDL methodology was adopted and results suggested that there is a positive effect of volatility on exports of Croatia and Cyprus.

Aloba and Abogan (2013), evaluated exchange rate volatility from the perspective of parametric measurement to find the trend and potential reasons for exchange rate volatility in Nigeria over the period 1986 to 2009. The study found exchange rate volatility in Nigeria given the fact that the standard deviation of the exchange rate has been curiously high and surprisingly low during that period. The parametric measure of exchange rate further confirmed a high degree of volatility, portraying a higher risk to a risk-averse economic agent. The study, therefore, recommends that the government should always track the frequent movement in the exchange rate to regulate it. The higher risks attached to a high degree of volatility may scare off both domestic and foreign investors.

Dickson and Ukavwe (2013) also applied the error correction and GARCH model to investigate the impact of exchange rate fluctuations on trade variations in Nigeria using annual time series data from 1970 to 2010. The results of the study showed that exchange rate volatility is not significant in explaining variations in import, but was found to be statistically significant and positive in accounting for variations in export. Nicita (2013), the author investigated the effect of exchange rate volatility and misalignment on international trade by examining whether exchange rate misalignment affects trade strategy choices. The methodological framework consisted of fixed effects relapses estimates on a detailed board data set comparing about 100 countries and covering a ten year period (from 2000 to 2009). The results indicate that exchange rate misalignment affects international trade flows in a substantial way. Cash undervaluation is found to promote exports and restrict imports, while the opposite holds for the situation of overvaluation. The investigation indicates that exchange rate volatility isn't most likely a significant concern. This is as a result of the increasing availability of financial instruments to fence against exchange rate dangers and to the increasing portion of intra-industry trade.

Danmola (2013), examined the impact of exchange rate volatility on full-scale financial variables in Nigeria using the Correlation Matrix, Ordinary Least Square (OLS) and Granger Causality test. The findings of the study show that exchange rate volatility impacts on Gross Domestic Product, Foreign Direct Investment and Trade Openness, but with negative influence on the inflationary rate in the country. It was suggested by the author; there is a need to improve the country's income base in terms of increasing number of items for export and decrease dependence on the petroleum sector. Petroleum is one of the vital inputs of almost every industry in the economy

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Elif-Nuroglu and Robert-Kunst (2012), did some work on the effect of exchange rate volatility on international trade flows, as well as on the effect of exchange rate volatility on international trade flows, evidence from panel data analysis and fuzzy approach. The aim was to analyze the effect of exchange rate volatility on international trade flows by using two different approaches the panel data analysis and fuzzy logic and also to compare the result. A panel with cross-section dimension of 91 pairs of EU15 countries and with time ranging from 1964 to 2003 was used. An extended gravity model of trade is applied in order to determine the effect of exchange rate volatility on bilateral trade flows of EU15 countries. The estimated impact is clearly negative which indicates that exchange rate volatility has a negative influence on bilateral trade flows.

Joseph (2011) used the GARCH model on annual time series data of trade flows in Nigeria from the year 1970 to 2009. This study indicated that a negative and statistically insignificant transmission existed between exchange rate volatility and aggregate trade. The negative result though from annual time series data is in pact with that of Aliyu (2010). Aliyu (2010) used the vector error correction and the VAR model to analyze the impact of exchange rate volatility on Nigeria's non-oil exports from 1986Q1 to 2006Q4. The result established a long-run stable and negative relationship between Naira exchange rate volatility and non-oil exports in Nigeria. In the alternative, the result was positive for the US Dollar exchange rate volatility and non-oil exports.

3. METHODOLOGY

3.1 Research Design

To ascertain the impact of exchange rate volatility on international trade in Nigeria, an ex-post facto research design was employed using data set from the CBN statistical bulletin. According to Onwumere (2015), a research design is a kind of blueprint that guides the researcher in his or her investigation and analyses. The research design adopted for this research is the ex-post facto research design. This is a kind of research in which the researcher cannot manipulate the data that is being used. Kerlinger (1970) describes the ex-post facto research design, which is also called causal comparative research, as a design used when the researcher intends to determine cause-effect relationship between the dependent and independent variables with a view to establishing a causal link between them, this also led to the adoption of this research design for this study.

3.2 Model Specification

Our study builds on the more recent time series study of Exchange-rate Volatility, Exchange-rate Regime, and Trade Volume, basically. In order to properly analyze the interrelationships among these non-stationary time-series variable, we elected to use ordinary least square (OLS) regression analysis for short-run estimates The model of the study is adapted from the works of Aristotelous (2017) on Exchange-rate Volatility, Exchange-rate Regime, and Trade Volume: Evidence from the United Kingdom-United States Export Function.

Model One for Objective One

The first specific objective of this study was to examine the effect of exchange rate volatility on trade account in Nigeria. The Equation 1 below, was hereby specified in econometric form to realize this objective.

$$TB_t = a_0 + a_1EXRTVOL_t + a_2INF_t + a_3INTRT_t + u_t \; 1$$

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Model Two for Objective Two

The second specific objective of this study was to determine the impact of exchange rate volatility on imports into Nigeria. The Equation 2 below, was hereby specified in econometric form to realize this objective.

$IMP_t = b_0 + b_1EXRTVOL_t + b_2INF_t + b_3INTRT_t + u_t$ 2

Model Three for Objective Three

The third specific objective of this study was to ascertain the influence of exchange rate volatility on exports out of Nigeria. The Equation 3 below, was hereby specified in econometric form to realize this objective.

$EXPT_t = c_0 + c_1EXRTVOL_t + c_2INF_t + c_3INTRT_t + u_t$ 3

Where

TB = Trade Account Balance

IMP = Growth rate of Imports

EXPT = Growth rate of Exports

EXRTVOL = Exchange Rate Volatility

INF = Inflation Rate

INTRT = Interest Rate

a_is, b_is, and c_is = Model parameters to be estimated

u = the error term assumed to be normally and independently and identically distributed with zero mean and constant variance. The addition of the error term or stochastic term in the model is to capture the effect of the other variables not included in the models.

A Priori Expectations

Exchange rate volatility has no clear cut expectations on the dependent variables because it could have a positive or negative relationship with trade balance, imports, and exports. Reason for this is based on the fact that exchange rate volatility implies fluctuation in the value of the domestic currency, Naira in this case, relative to a foreign currency, say, US Dollars. A deterioration or devaluation of the Naira, for instance, will lead to higher exchange rate which promotes exports, stifles imports, and supports the trade balance. On the flip side, an appreciation or overvaluation of the Naira will lead to low exchange rate which hinders exports, improves imports, and worsens the trade balance.

3.3 Sources of Data

This is a study based on time series data which data are secondary in nature. Therefore, the study intends to exploit annual time series data covering the periods 1981 to 2020. These data were obtained from the Statistical Bulletin of the Central Bank of Nigeria (CBN) 2021. Below is a summary of the measurements of variables used in this study.

Table 3.1: Definition and Measurement of Variables.

Variable	Measure	Source
Trade Account balance (TB)	Net Exports in Billions of Naira	CBN 2021

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Imports (IMP)	Growth in Total Imports in Billions of Naira	CBN 2021
Exports (EXPT)	Growth in Total Exports in Billions of Naira	CBN 2021
Inflation (INF)	Growth in Consumers' Price Index in percentages	CBN 2021
Interest Rate (INTRT)	Lending rate in percentages	CBN 2021
Exchange Rate Volatility (EXRTVOL)	GARCH(1,1) series of Real Effective Exchange Rate	CBN 2021

Source: Author's compilation.

3.4 Model Estimation Techniques

3.4.1 Unit Root Test

A stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed. If a time series is not stationary in the sense just defined, it is called a non-stationary time series. In other words, a non-stationary time series will have a time varying mean or a t Stationarity test will be done on all-time series properties of data employing the unit root test by Augmented Dickey- Fuller (ADF) test to avoid possible spurious regression. If it is assumed that the error term, ut, is uncorrelated, the DF test may be used. But in case the ut are correlated, Dickey and Fuller have developed a test known as the Augmented Dickey Fuller (ADF) test. The ADF test is used in this study as most tests of the DF type have low power. That is, they tend to accept the null of unit root more frequently than is warranted. The stationarity of the time series is important because correlation could persist in non-stationary time series even if the sample is very large and may result in what is called spurious or nonsense regression (Gujarati, 2012).

3.4.2 Engle and Granger Cointegration Test

Co-integration implies identifying the co-integrating or long-run equilibrium relationships. The methodology developed by Engle and Granger (1987) is used in explaining the co-integration test. This technique of cointegration testing is a two-step approach. The first step involves estimating a residual series from an ordinary least squares technique applied on a specified model. The second step is to test the generated residual series for unit root at levels. A cointegrating or long run relationship is said to exist among the variables of the model if the unit root test of the residual series is stationary at levels. Otherwise, no cointegration exists among the variable of the model. The central concept of cointegration is the specification of models that include the long-run movements of one variable relative to others. Co-integration implies the idea that linear combination of non-stationary series can be stationary, implying a long-run relationship, which shows that the relationship between the stationary linear combination of non-stationary variable exist.

3.4.3 Error Correction Model

The error correction model attempts to integrate economic theory useful in characterizing long run equilibrium with observed disequilibrium by building a model that explicitly incorporates behavior that would restore equilibrium. It is a one-period lagged value of the residual from a static model. The error correction model is very important in the sense that it ensures the reliability of the statistics, making the model suitable, reliable and appropriate for both control and prediction purposes (Hill et al 2008).

3.4.4 Method of Data Analysis

To ascertain the impact of exchange rate volatility on international trade in Nigeria, an ex-post facto

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research design will be employed and time series data set from the CBN statistical bulletin and other sources. While the Augmented Dickey-Fuller unit root will be used for preliminary test of stationary of the data in order to purge any trend in data set before the analysis; ordinary least square (OLS) regression analysis will be used for short-run estimates. A combination of Johansen Co-integration test, Vector Auto Regression analysis, and Granger causality test, Variance Decomposition, Impulse Response tests and the ARCH / GARCH modelling techniques will be used for long run estimation. All the tests will be done to confirm the integrity of the study model, i.e. if exchange rate volatility has a clustering effect on the proxies of international trade.

4. Presentation and Analysis of Results

4.1 Unit Root Test

Usually, in the analysis of macroeconomic phenomenon, researchers are often faced with the problem of deriving stationarity in the time series variables incorporated in the study of interest given the poor data collation technique in Nigeria. Thus, this prompts the relevance of conducting the unit root test to realize the stochastic process in the time series analysis. The table below presents the unit root results using the Augmented Dickey Fuller (ADF) tests.

Table 4a: Results of Unit Root Tests

Variables	ADF Statistics (level)	MacKinnon Critical Values at 5%	ADF Statistics (1st Difference)	MacKinnon Critical Values at 5%	Order of Integration
Trade Balance (TB)	1.549125	-1.952910	-5.355316	-1.954414	I(1)
Exchange Rate Volatility (EXRTVOL)	1.670586	-1.949609	-5.640479	-1.949856	I(1)
Imports (IMP)	3.125839	-1.949319	-2.706973	-1.949856	I(1)
Exports (EXPT)	2.541258	-1.949319	-5.371401	-1.949609	I(1)
Inflation (INF)	-0.627269	-1.949856	-7.188035	-1.949856	I(1)
Interest Rate (INTRT)	0.066995	-1.949319	-5.842402	-1.949609	I(1)

Source: Author's compilation from E-views 9.

The table above shows the result of the unit root test for the variables, using the ADF test. Given the above result, the ADF test proves that all the variables in the model are not stationary at level but at first difference. Therefore, we say that they are all integrated of order one. That is, they are all stationary after first differencing. It is important to state that the exchange rate volatility series followed the generalized autoregressive and conditional heteroskedasticity GARCH (1,1) process from E-views 9 software.

4.2 Analysis of Regression Results

4.2.1 Model I: The Impact of Exchange Rate Volatility on Trade Balance in Nigeria.

Table 4b: Long-Run Regression Result

Dependent Variable: LOGTB – The Log of Trade Balance

Variable	Coefficient	Std. Error	t-Stat.	Prob.	REMARK
Constant	2.588	2.873	0.901	0.375	Not statistically significant
LOGEXRTVOL	**1.699**	0.246	6.909	0.000	**Statistically significant**

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LOGINF	**-0.922**	0.386	-2.388	0.000	**Statistically significant**
LOGINTRT	1.656	1.142	1.450	0.158	Not statistically significant
R^2 72% Adjusted R^2 69% F. Statistic 23.97 F. Statistic (Probability value) 0.00 Durbin-Watson statistic 1.380					

Source: Author's compilation from E-views 9

Since both the dependent variable and independent variables are integrated of order one, there tend to be suspicion of a long-run relationship amongst the variables. Thus, the two step Engel-granger cointegration test was conducted and the result shows that the residual (from the output of objective one long-run regression result) is stationary at level at the 5% level of significance.

Table 4c: Engle-Granger Cointegration Test

Variables	ADF Statistics (level)	MacKinnon Critical Values at 5%	ADF Statistics (1st Difference)	MacKinnon Critical Values at 5	Order of Integration
ECM(-1)	-3.340554	-1.952910	-	-	I(0)

Source: Author's compilation from E-views 9

The table above shows that the error correction term [ECM(-1)] is stationary at level. Having confirmed the presence of long-run relationship; an error correction model (ECM) was conducted, which is statistically significant at 5% level. The error correction model shows how the deviation in the error term influences its short-run dynamics. According to Gujarati and Porter (2009), given that the deviations of the long-run and short-run component of the model have been corrected, the regression result will not be considered as spurious.

Table 4d: Short-Run Error Correction Model

Dependent Variable: D(LOGTB) – The first difference operator of the log of Trade balance

Variable	Coefficient	Std. Error	t-Stat.	Prob.	REMARK
Constant	**0.290**	0.141	2.054	0.051	**Statistically significant**
D(LOGEXRTVOL)	-0.080	0.337	-0.235	0.816	Not statistically significant
D(LOGINF)	-0.195	0.199	-0.979	0.337	Not statistically significant
D(LOGINTRT)	0.673	0.859	0.784	0.441	Not statistically significant
ECM1(-1)	**-0.285**	0.116	-2.454	0.012	**Statistically significant**
R^2 26% Adjusted R^2 12% F. Statistic 1.12 F. Statistic (Probability value) 0.37 Durbin-Watson statistic 2.09					

Source: Author's compilation from E-views 9

The D operator represents first difference of the variables.

Table 4b and Table 4d shows the long-run model and short-run model respectively. The R squared shows the goodness of fit of the model. In the long-run model, it shows that about 72% of the variations in the dependent variable are explained by the independent variables. The F test shows the overall performance of the regression model. The F. statistic (Probability value) of 0% is significant because it is less than 5%. Therefore, we conclude that the model is well specified and adequate for policy analysis. The Durbin-Watson statistics is rather weak and shows a suspicion for the presence of

autocorrelation in the model. The test of significance will be following the 2–*t* rule of thumb, which states that a *t* value greater than two (2) in absolute term is statistically significant as long as the sample size is more than 30 (Gujarati & Porter, 2009).

Therefore given the above satisfaction, we interpret the long-run and the short-run result simultaneously. The constant coefficient is positive and significant in the long-run and not statistically significant at 5% level in the short-run. This interpretation does not have much relevance but rather for pedagogical purpose.

In the long-run, the coefficient of exchange rate volatility is positive and statistically significant. This means that holding all other variables constant, a one percent increase in the volatility of exchange rate will increase trade balance (or balance of trade by) by 1.7 percent in Nigeria. However, in the short-run, exchange rate volatility is not statistically different from zero. Therefore, there is no need for further interpretation.

The coefficient of inflation in the long-run shows a negative relationship with trade balance and also statistically significant. This means that holding the influence of other variables constant, a one percent increase in inflation will reduce the trade balance by 0.92 percent in Nigeria. However, in the short-run, inflation is not significant at the 5% level of significance. Therefore, no further interpretation is needed.

Interest rate with the coefficient of 1.7 and 0.7 for the long-run and short-run respectively are both not statistically different from zero. This suggests no interpretation.

The error correction term {ECM(-1)] in the error correction model {ECM(-1)] is negative and significant at the 5% level of significance. This shows that about 29% of the short-run disequilibrium between the dependent and independent variables will be adjusted within the period of one year.

The key independent variable of concern is the exchange rate volatility and since it is a volatility series, it is indeterminate and has no direction in economic theory. Therefore, there will be no a priori economic expectation.

The error term of the model is normally distributed; there is no serial correlation and no heteroskedasticity as shown in the appendix. More so, this is shown below:

Table 4e: Residual Diagnostic Test

TEST	TEST STATISTIC		CONCLUSION
Normality	Jarque-Bera (Prob.)	0.74	Normally distributed
Serial correlation	Chi-square	0.51	No serial correlation
Heteroskedasticity	Chi-square	0.12	Homoskedastic (equal spread)

Source: Author's compilation from E-views 9

4.2.2 Model II: The Impact of Exchange Rate Volatility on Imports in Nigeria.

Table 4f: Long-Run Regression Result

Dependent Variable: LOGIMP – The Log of Imports

Variable	Coefficient	Std. Error	t-Stat.	Prob.	REMARK
Constant	**4.452**	1.900	2.342	0.025	**Statistically significant**
LOGEXRTVOL	**1.621**	0.139	11.66	0.000	**Statistically significant**
LOGINF	**-0.608**	0.293	-2.074	0.045	**Statistically significant**
LOGINTRT	1.055	0.739	1.428	0.162	Not statistically significant

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R^2 83% Adjusted R^2 81% F. Statistic 56.78 F. Statistic (Probability value) 0.00 Durbin-Watson statistic 1.56

Source: Author's compilation from E-views 9

As noted earlier, there is a suspicion for cointegration. Therefore, the two step Engel-granger cointegration test was conducted and the result shows that the residual (from the long-run model) is stationary at level at 5% level of significance. This is presented below:

Table 4g: Engle-Granger Cointegration Test

Variables	ADF Statistics (level)	MacKinnon Critical Values at 5%	ADF Statistics (1st Difference)	MacKinnon Critical Values at 5	Order of Integration
ECM2	-2.575951	-1.949609	-	-	I(0)

Source: Author's compilation from E-views 9

The table above shows that the error correction term (ECM2) is integrated of order zero. Therefore, the presence of long-run relationship exists. Thus, an error correction model (ECM) was conducted, and the error correction term is statistically significant at 5% level. The error correction model shows how the deviation in the error term influences its short-run dynamics. Therefore, going by Gujarati and Porter (2009), our long-run model is useful for this study and can be adequately interpreted.

Table 4h: Short-Run Error Correction Model

Dependent Variable: D(LOGIMP) – The first difference operator of the log of Imports

Variable	Coefficient	Std. Error	t-Stat.	Prob.	REMARK
Constant	**0.178**	0.058	3.068	0.004	**Statistically significant**
D(LOGEXRTVOL)	0.114	0.148	0.773	0.445	Not statistically significant
D(LOGINF)	0.062	0.084	0.735	0.468	Not statistically significant
D(LOGINTRT)	0.128	0.383	0.334	0.741	Not statistically significant
ECM(-1)	**-0.113**	0.053	-2.160	0.048	**Statistically significant**
R^2 23% Adjusted R^2 13% F. Statistic 1.33 F. Statistic (Probability value) 0.28 Durbin-Watson statistic 2.34					

Source: Author's compilation from E-views 9

The D operator represents first difference of the variables.

Table 4f and Table 4h shows the long-run model and short-run model respectively. The R squared shows that about 83% of the variations in the dependent variable are explained by the independent variables. The F. statistic (Probability value) of 0% is significant because it is less than 5%. Therefore, we conclude that the model is well specified and adequate for policy analysis. The Durbin-Watson statistics is rather weak and shows a suspicion for the presence of autocorrelation in the model. The test of significance will be following the 2–*t* rule of thumb, which states that a *t* value greater than two (2) in absolute term is statistically significant as long as the sample size is more than 30 (Gujarati & Porter, 2009).

Therefore given the above satisfaction, we interpret the long-run and the short-run result simultaneously. The constant coefficient is positive and significant in the long-run and short-run at 5%

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level. This interpretation does not have much relevance but rather for pedagogical purpose.

In the long-run, the coefficient of exchange rate volatility is positive and statistically significant. This means that holding all other variables constant, a one percent increase in the volatility of exchange rate will increase imports by 1.6 percent in Nigeria. However, in the short-run, exchange rate volatility is positive but not statistically significant. Therefore, there is no need for further interpretation.

The coefficient of inflation in the long-run shows a negative relationship with imports in Nigeria. This means that holding the influence of other variables constant, a one percent increase in inflation will reduce the imports by 0.61 percent in Nigeria. However, in the short-run, inflation is not significant at the 5% level of significance. Therefore, no further interpretation is needed.

Interest rate with the coefficient of 1.06 and 0.13 for the long-run and short-run respectively are both not statistically different from zero and hence no further interpretation.

The error correction term {ECM(-1)] in the error correction model {ECM(-1)] is negative and significant at the 5% level of significance. This reveals that there is 11% speed at which the dependent variable returns/adjust to equilibrium after a change in the independent variables, which is usually in one year, considering the annual data frequency.

The error term of the model is normally distributed; there is no serial correlation and no heteroskedasticity as shown in the appendix. More so, this is shown below:

Table 4i: Residual Diagnostic Test

TEST	TEST STATISTIC		CONCLUSION
Normality	Jarque-Bera (Prob.)	0.45	Normally distributed
Serial correlation	Chi-square	0.43	No serial correlation
Heteroskedasticity	Chi-square	0.81	Homoskedastic (equal spread)

Source: Author's compilation from E-views 9

4.2.3 Model III: The Impact of Exchange Rate Volatility on Exports in Nigeria

Table 4j: Long-Run Regression Result

Dependent Variable: LOGEXPT: The Log of Exports

Variable	Coefficient	Std. Error	t-Stat.	Prob.	REMARK
Constant	3.7678	2.007	1.878	0.069	Not statistically significant
LOGEXRTVOL	**1.533**	0.147	10.44	0.000	**Statistically significant**
LOGINF	**-0.739**	0.310	-2.386	0.022	**Statistically significant**
LOGINTRT	**1.685**	0.780	2.160	0.038	**Statistically significant**
R^2 80% Adjusted R^2 78% F. Statistic 49.11 F. Statistic (Probability value) 0.00 Durbin-Watson statistic 1.57					

Source: Author's compilation from E-views 9

Since both the dependent variable and independent variables are integrated of order one, there tend to be suspicion of a long-run relationship amongst variables. Thus, the two step Engel-granger cointegration test was conducted and the result shows that the residual (from the output of objective one long-run regression result) is stationary at level at 5% level of significance.

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Table 4k: Engel-granger Cointegration Test

Variables	ADF Statistics (level)	MacKinnon Critical Values at 5%	ADF Statistics (1st Difference)	MacKinnon Critical Values at 5	Order of Integration
ECM(-1)	-2.513013	-1.949609	-	-	I(0)

Source: Author's compilation from E-views 9

Table 4k shows that the error correction term (ECM3) is stationary at level. Therefore, there is the presence of cointegration in the model. To that effect, an error correction model (ECM) was conducted, which shows how the deviation in the error term influences its short-run dynamics and its speed of adjustment. The error correction model which is also the short run model is shown below.

Table 4l: Short-Run Error Correction Model

Dependent Variable: D(LOGEXPT) – The first difference of the log of exports.

Variable	Coefficient	Std. Error	t-Stat.	Prob.	REMARK
Constant	**0.204**	0.069	2.943	0.006	**Statistically significant**
D(LOGEXRTVOL)	-0.051	0.176	-0.288	0.775	Not statistically significant
D(LOGINF)	-0.045	0.102	-0.438	0.664	Not statistically significant
D(LOGINTRT)	0.532	0.456	1.170	0.250	Not statistically significant
ECM3(-1)	**-0.172**	0.060	-2.874	0.007	**Statistically significant**
R^2 20% Adjusted R^2 10% F. Statistic 0.91 F. Statistic (Probability value) 0.47 Durbin-Watson statistic 2.06					

Source: Author's compilation from E-views 9

The D operator represents first difference of the variables.

Table 4j and Table 4l displays the long-run and short-run model respectively. The R squared reveals about 80% of the variations in the dependent variable being explained by the independent variables. The F. statistic (Probability value) of 0% is significant. Therefore, we conclude that the model is well specified. The Durbin-Watson statistics shows more strength in this model than the previous. Therefore, the suspicion for autocorrelation in the model tends to gradually vanish in this case.

Thus, we interpret the long-run and the short-run result simultaneously. The constant coefficient is positive both in the long-run and short-run. In the long-run, the constant coefficient is not significant going by the 2-t rule of thumb. Therefore, it is not suitable for interpretation based on the stated rule.

In the long-run, the coefficient of exchange rate volatility is positive and statistically significant. This means that holding all other variables constant, a one percent increase in exchange rate volatility will increase exports by 1.5 percent. However, in the short-run, exchange rate volatility is negative and not statistically significant. Therefore, there is no need for further interpretation.

The coefficient of inflation in the long-run shows a negative relationship with exports in Nigeria. This means that a one percent increase in inflation will reduce the exports by 0.74 percent in Nigeria, holding the influence of other variables constant. However, in the short-run, inflation is not significant at the 5% level. Therefore, no further interpretation is needed.

Interest rate coefficient is positive and statistically significant on exports in Nigeria. This means that a one percent increase in interest rate will increase the value of exports by 1.69 percent in Nigeria,

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holding the influence of other variables constant. However, in the short-run, interest rate is not significant on exports in Nigeria. Therefore, it lacks merit for further interpretation.

The error correction term {ECM(-1)] in the error correction model {ECM(-1)] is negative and significant at the 5% level of significance. This reveals that there is 17% speed at which the dependent variable returns to equilibrium after a change in the independent variables after one year.

The overall error term of the model is normally distributed; there is no serial correlation and no heteroskedasticity as shown in the appendix. This is shown below:

Table 4m: RESIDUAL DIAGNOSTIC TEST

TEST	TEST STATISTIC		CONCLUSION
Normality	Jarque-Bera (Prob.)	0.46	Normally distributed
Serial correlation	Chi-square	0.75	No serial correlation
Heteroskedasticity	Chi-square	0.62	Homoskedastic (equal spread)

Source: Author's compilation from E-views 9

4.3 Evaluation Of Research Hypotheses Of The Study

Based on our findings from the regression results, the hypotheses for this study are evaluated below:

H_{01}: Exchange rate volatility has no significant impact on trade account balance in Nigeria.

Conclusion: From the regression result in table 4b, using the 2 *t* rule of thumb, exchange rate volatility is positive and statistically significantly different from zero. Therefore, we reject the null hypothesis and conclude that exchange rate volatility has a significant impact on the balance of trade account in Nigeria.

H_{02}: Exchange rate volatility has no significant impact on imports in Nigeria.

Conclusion: The second regression result as shown on Table 4f shows that exchange rate volatility has positive impact on imports in Nigeria, using the 2 *t* rule of thumb. Therefore, we reject the null hypothesis and conclude that exchange rate volatility has a significant impact on imports in Nigeria.

H_{03}: Exchange rate volatility has no significant impact on exports in Nigeria.

Conclusion: The last model as shown in table 4j shows that exchange rate volatility has positive impact on exports in Nigeria, using the 2-*t* rule of thumb. Therefore, we reject the null hypothesis and conclude that exchange rate volatility has a significant impact on exports in Nigeria.

5. Summary, Recommendations and Conclusion

The primary objective of the study was to examine the impact on exchange rate volatility on international trade in Nigeria. Balance of trade and trade balance were synonymously used in this study. Aside the general objective, the researchers specifically addressed the impact of exchange rate volatility on trade balance, imports and exports as these are the basic international trade components in Nigeria and the world over.

The study utilized the classical linear regression model (CLRM) within the ordinary least square (OLS) estimation framework. To capture exchange rate volatility, the study used the GARCH (1,1) model. Although the basic limitation to this study was its inability to utilize a more higher data frequency like daily, weekly or monthly data due to its dearth nature. The GARCH model as shown in the appendix indicated that the past values of exchange rate has a strong predictive ability on the current exchange

rate. This is one of the recipes or characteristics of a volatile variable. After the estimation of the basic GARCH (1,1) model, the GARCH variance series was derived which formed our exchange rate volatility series.

Using the OLS estimation techniques, the study had three equations to capture the three objectives. In order to make our model more robust, we included two other control variables consisting of inflation and interest rate. This was based on their support on the dependent variables according to the literature.

The findings revealed that exchange rate volatility positively impacts on the balance of trade account, imports and exports in Nigeria with about a very close magnitude. In addition, inflation was very responsive in reducing trade account balance, imports and exports. Although it reduced exports more than it reduced imports. On the other hand, interest rate did not impact on balance of trade and imports but showed a positive impact on exports in Nigeria.

5.2 Policy Implications and Recommendations

Conventionally, a volatile variable has no specified or expected directional movement and therefore, such variable becomes indeterminate. This, however, is not void of implications. The direction from the regression result tends to imply or suggest where the weight of such swings or volatility (positively or negatively) has been mostly felt on, overtime. Since exchange rate volatility has positive impacts on trade balance, imports and exports, it therefore implies that the shocks accruable from its variance have not been too detrimental to the Nigerian economy. More so, it could suggest that there might be illegal channel that facilitates foreign exchange outside the official channel. This could have detrimental consequences of the price of imported products and consequently, inflation. Secondly, the level of inflation is rather affecting the balance of trade and its components. The positive effect of interest rate on exports does not depict sound economic reasoning as regards literature in this study.

Based on the findings from the study (given the period under investigation) and the observed implications, the following are the policy recommendations.

1. The monetary authority should monitor and limit the activities of illegal exchange of the dollar, which is as it is today, the vehicle currency. This is seen by the positive impact it has on trade, knowing fully well that volatility does not suggest a particular direction in economic theory.
2. Foreign currencies should be readily available to rightful merchants so as to keep facilitating trade.
3. Sequel to the adherence of the above points, the exchange rate should be more fixed so as to arrest any unhealthy uncertain situation that might arise.
4. Inflation needs to be controlled. This is to ameliorate its downward strength it has on international trade. This is because, when it reduces its strength of the components of international trade, it will further affect the country's foreign reserves.
5. Exports, as an international trade component is a very good activity for any developing nation. However, the level of inflation needs to be curtailed so as to increase the value of exports. This, aside increasing the foreign reserve, will further lead to a positive balance of trade which is healthy and desirable to any nation.

5.3 Conclusions

The study investigated the impact of exchange rate volatility on international trade. International trade was specifically seen as trade balance, imports and exports. This study is situated in Nigeria and covered the period 1981 to 2020 (a period of 40 years). The study used the classical linear regression

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model (CLRM), within the ordinary least square (OLS) method of estimation. Also, cointegration was detected and an error correction model (ECM) was carried out to correct the long-run error of the model in the short-run.

Volatility of variables does not suggest any direct path as such variables are full of uncertainties. Therefore, the effect of such variable on other economic variables will be seen from the direction of the shock it carries, whether positive or negative. In the long run, exchange rate volatility was found to increase the balance of trade and trade components in Nigeria. This suggests that the shock has a positive component. However, inflation was seen to reduce balance of trade and other trade components in Nigeria. Exchange rate is a very viable instrument used in international trade and international trade is also affected by inflation as proven in this study. Therefore, this study has shown that there is a positive shock component of the volatile exchange rate which is not directly observed in affecting international trade. This could be implied from the activities of the black market in the exchange of currencies in facilitating more trade aside the official channel. Also, it is recommended among other things for the level of inflation to be monitored by financial bodies so as not to let exports and imports go haywire.

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