

# Exchange Rate Volatility and Foreign Direct Investment Flows: Evidence from Nigeria

Benjamin Ighodalo Ehikioya<sup>1</sup>

Department of Financial Studies, National Open University of Nigeria, Lagos,  
Nigeria

---

## Abstract

This study examines the influence of exchange rate volatility on foreign direct investment flows to the Nigeria economy. The study employs the ARCH, GARCH and EC models to analyze time series data for the period 1970 to 2016. The study established the stationarity of the data series and carried out the cointegration tests. The result of the study reveals that exchange rate volatility tends to persist throughout the study period. The findings of the study established empirical evidence to support the views that exchange rate volatility has a negative and significant influence on foreign direct investment inflows to Nigeria. The study demonstrates that increase in inflation exerts a negative effect on foreign direct investment inflows to Nigeria. The results of the analysis revealed that trade openness and interest rate have a positive influence on FDI in Nigeria. Thus, it is important for the government to muster the political will with efforts to create a stable environment to boost domestic production of export commodities and investment inflows. In addition, it is imperative for the government through its regulatory agencies to pursue a sound exchange rate regime with good policies and programs that would encourage investments in the economy.

**Keywords:** Exchange rate volatility, FDI, GARCH, Investment, Cointegration, Stationarity.

---

Cite this article: Ehikioya, B. I. (2018). Exchange Rate Volatility and Foreign Direct Investment Flows: Evidence from Nigeria. *International Journal of Management, Accounting and Economics*, 5(7), 498-515.

---

<sup>1</sup> Corresponding author's email: [benehikioya@gmail.com](mailto:benehikioya@gmail.com)

## Introduction

In the past few years, especially since the recent global economic meltdown, foreign direct investment (FDI) has become increasingly important for a number of countries around the world. Indeed, FDI is one of the key economic strategies and sources of inflows particularly for countries yearning to achieve economic growth. Foreign Direct Investment (FDI) is the flow of capital across the border from Multinational Corporation to its foreign affiliates. Apart from the capital transfer that is involved, FDI significantly enhances the host countries because of the knowledge, skills and technology transfer from the parent company through its local affiliates. However, in developing economies, the aspect of FDI that involves skills and technology transfer has not been very successful because of dearth in infrastructure and the lack of political will on the part of the government to support this mechanism and stimulate growth. This is also partly because of the unwillingness of foreign affiliates to allow skills and technology transfer in order to have a relevant ground for their business interest. Instead, what is common now is the use of FDI to move resources from developing countries to the countries where the parent company of the subsidiary is domiciled. This movement in resources is made easier for the foreign affiliate where trade agreements are orchestrated for resources to be used, instead of money, to settle goods and services provided.

Over time, the flow of FDI across the globe has increased, though without a commensurate improvement in poverty alleviation in developing countries. The FDI in 2016 rose to \$1.52 trillion, with \$600 billion of these inflows received by business entities within the developing economies. This shows that the FDI inflow in 2016 figure represents a drop of 13 percent from the 2015 figure of \$1.76 trillion. The FDI flows to advanced economies fell by 9% with European Union at the worse end from \$475 billion in 2015 to \$389 billion in 2016. However, a number of developing countries in Asia and Africa still benefited immensely from the flow of investment. In Africa, the FDI inflows rose from \$1.1 billion in the 1970s to \$54 billion in 2015 and then dropped to \$51 billion in 2016. In the Sub-Saharan Africa region, Nigeria is still one of the favoured and highest recipients of FDI inflows from the 1970s figure of \$91.3 million to \$4.7 billion as at 2014. This figure fell to \$3.4 billion in 2015, rose to \$4.4 billion in 2016 and dropped again by 21% to \$3.5 billion in 2017 (CBN, 2016; UNCTAD, 2011 & 2018). In the face of the increased flow of investment to developing countries, Africa is seen as behind other regions like Asia in attracting FDI. In fact, within the Africa region, the Sub-Saharan Africa (SSA) countries are still behind other regions in attracting the required foreign direct investment for economic growth. The investors' seemingly lack of interest to make sub-Saharan Africa the preferred choice for investment destination is partly due to the level of development in infrastructure, insecurity, uncertainty in government policies and programs among other challenges.

The movement of capital and other factors from one destination to another by Multinational Corporations through FDI activities can be influenced by the nature of risks and expected returns from investment in the host country. From a macroeconomic perspective, FDI activities are also influenced by the behaviour of real exchange rates, Gross Domestic Product (GDP), inflation rate and other factors. Normally, in the decision to invest abroad, parent companies would consider the behaviour of exchange rates in

order to determine the total amount of investment abroad and the countries of choice to make such investment. In addition to the behaviour of exchange rates, the effect of the volatility of exchange rates especially in developing countries is also an important consideration to both the host country and parent companies on FDI activities. Generally, in the scheme of activities, a stable exchange rate is significant not only for the host country, but also for other stakeholders of the economy. For instance, while the host countries are perceived to understand the importance of a stable exchange rate to attract the required investment for economic growth, the parent company is concerned about a stable exchange rate to protect investment and earn the expected returns.

In a country economic policies, the exchange rate is an important macroeconomic variable the government uses to stabilize the economy for growth. On the other hand, foreign direct investment is one of the instruments available for governments, especially in developing countries to grow the economy. Against this backdrop, the arguments around exchange rate volatility and foreign direct investment have gained considerable attention in the past few decades though with mixed remarks. Indeed, much less agreement exists in the literature about the precise connection between exchange rate volatility and foreign direct investment (Froot & Stein, 1991; Dhakal, Pradhan & Upadhyaya, 2010; Bhandari & Upadhyaya, 2008). For example, whereas Cushman (1985); Goldberg and Kolstad (1995) found evidence for a positive relationship between exchange rate uncertainty and FDI, Urata and Hiroki, 2000; Benassy-Quere, Fontagne and LahrEche-Revil, 2001 simply reported exchange rate volatility to have a negative impact on FDI. The mixed reports about the influence of exchange rate volatility on FDI could be because of several factors, such as the treatment of exchange rate volatility and the use of aggregate national and industry level data without proper harmonization before subjecting such data to any analysis. In addition, apart from the fact that macroeconomic variables such as GDP, inflation rate and exchange rate exhibit extreme volatility, the choice of statistical technique and sample period and variables without appropriate control mechanism may be a contributing factor to the conflicting results.

The level of economic activities and the disproportionate flow of FDI to Sub-Sahara Africa region in recent time with Nigeria in reference remained a cause for concern not only for the government, regulators and policymakers, but also for other stakeholders of the economy that needs investigation. Apart from the conflicting results in the literature on the issue of FDI and exchange rate volatility, the significance of FDI to the developing economies and the influence of exchange rate volatility in the determination of the amount and foreign location for investment provide the ground to investigate whether exchange rate volatility does matter to FDI inflows to Nigeria. Therefore, this paper aims to examine exchange rate volatility and its effects on foreign direct investment in Nigeria. The study used the annual time series data from 1970 to 2016 and the GARCH model to test for exchange rate volatility and error correction model (ECM) to examine the effect of exchange rate volatility on FDI. The effect of exchange rate volatility on FDI during the period of fixed and managed float regimes was examined. The findings of the study established empirical evidence to support the views that exchange rate volatility and inflation exerts a negative influence on foreign direct investment in Nigeria. On the contrary, the results of this study revealed that trade openness and interest rate have a positive influence on FDI in Nigeria. This result and the understanding of these variables

have helped to draw the conclusion on impact of exchange rate volatility on foreign direct investment inflows to Nigeria.

Following this introduction, Section 2 presents the theoretical and empirical review of related literature. In Section 3, the data and methodology employed in the study are discussed. Section 4 presents the estimation results and discussion and Section 5 concludes the study.

## Literature Review

The linkage between foreign direct investment and exchange rate volatility has continued to be a concern for both scholars and policymakers, particularly in developing economies. This concern is further exacerbated because of the ravaging effect of the recent global economic meltdown and the influence variables such as exchange rate and FDI have on economic growth. Macroeconomic variables such as exchange rate and interest rate are known to exhibit some level of volatility that affects trade and capital flows within and across the borders. Several studies have examined the effect of exchange rate volatility on macroeconomic activities and variables such as export, currency depreciation and growth (Adewuyi & Akpokodje, 2013; Kasman & Kasman, 2005; Doganlar, 2002). The influence of exchange rate volatility on developing economies is likely to continue in the mixed of a dynamic environment and dwindling revenue inflows. Given the importance of macroeconomic variables on economic growth and the investors' objective of profit making as a key motivation for investment in any location, several competing theories and empirical studies have attempted to examine the impact of exchange rate volatility on investment inflows. The theoretical propositions on the effects of volatility on investment have been argued from both the "risk aversion" and "production flexibility" arguments. Interestingly, each of these arguments provides different perspective and predictions about the effects of exchange rate volatility on foreign direct investment.

According to the risk aversion theory, returns on investment can be affected by certain additional risk introduced as a result of movement in the exchange rate, which would, therefore, require some compensation to lower the effect on investors. This is because higher exchange rate volatility lowers the degree of certainty equivalent expected exchange rate (Cushman, 1985). Goldberg and Kolstad, (1995) argued that for firms that make investment decision today with the optimism to realize returns in the future periods, the certainty equivalent levels is important in the expected profit function of the firm. In this instance and according to the risk aversion theory, in the event of a highly volatile exchange rate, the foreign direct investment and returns are expected to reduce. The risk aversion arguments are more convincing when it is evaluated under the effect of short-term exchange rate volatility since firms are unlikely to adjust the factors of production that are most likely to be fixed within the short run. Campa (1993) advanced the risk aversion theory to take into consideration the risk neutral firms and the future expected returns. Campa (1993) argued that as investors get more concerned about future expected returns, firms would prefer to delay investment decision as the exchange rate volatility increases. In this case, foreign direct investment is expected to drop since risk-neutral

firms will prefer the local market to foreign markets due to high volatility levels of the exchange rate.

Contrary to the risk aversion theory is the production flexibility theory. According to this theory, before making any foreign investment decisions, there is a need for producers to commit to investment capital and production costs to both the domestic and foreign capacity. By this arrangement, the influence of exchange rate movement on foreign investment decisions will now be as a result of the sunk costs in capacity, industry competitiveness and overall returns. The production flexibility theory asserts that increase in exchange rate volatility will lead to increase in foreign direct investment in the ex-ante phase since firms may have the ability to adjust the use of factors of production, particularly on the long run following the realization of profits (Goldberg & Kolstad 1995). On the other hand, the higher the volatility, the higher the potential excess capacity and production moving towards the ex-post phase (Reinert, Rajan, Glass & Davis, 2010; Chaudhary, Shah & Bagram, 2012). In the mixed of these arguments between the proponents of risk aversion arguments and production flexibility arguments, Goldberg and Kolstad (1995) argued for the need to take into consideration the differences between short-term exchange rate volatility and long-term misalignments of exchange rates when taking foreign investment decisions. While the risk aversion seems to be more appropriate under the short-run since factors of production could be fixed, the production flexibility arguments appear better under the long-term horizon since firms can adjust their use of variable factors.

Apart from the theoretical arguments, several opposing empirical studies attempt to explain the impact of exchange rate volatility on foreign direct investment but without any clear consensus. For example, Bailey and Tavlas (1991) examined the effect of exchange rate volatility on foreign direct investment under the managed floating regime and documented that there is no evidence to support the argument that increases in exchange rate volatility will impact on FDI. Also, Gorg and Wakelin (2002) investigated the linkages between exchange rate variation and the US inward or outward FDI and reported that there is no connection, except when there is a revaluation of the destination currency and appreciation of the US dollar. In a similar study, Crowley and Lee (2003) documented that below a certain level of exchange rate flexibility, exchange rate volatility is not seen as an important deciding factor of FDI. However, beyond this level and as the level of volatility increases, the relationship between the two variables is found to be healthy and important for consideration. Nyarko, Nketiah-Amponsah and Barnor (2011) in a study in Ghana reported exchange rates to have a little significant effect on FDI inflows. Also, Chong and Tan (2008) examined the connection between exchange rate volatility and macroeconomic variables in Southeast Asian from two perspectives, that is, in the short-run and long-run. They documented little evidence to support a connection between exchange rate volatility and macroeconomic variables in the short-run. But in the long-run, they established evidence for a connection.

In the opinion of Foad (2005), where there are increases in exchange rate volatility between the headquarters and the host country, the foreign affiliate can mitigate currency risk by an arrangement where it would need to avoid exports and serve the host country through a local production facility. In this case, a positive effect is possible between

exchange rate volatility and foreign direct investment. Stokman and Vlar (1996); Foad (2005) considered FDI as export substituting and argued that exchange rate volatility exerts a positive impact on FDI inflows to the host countries. In a related study, Gottschalk and Hall (2008) documented that exchange rate uncertainty has a positive effect on the outward FDI in Japan and US. In addition, Dhakal, et al (2010) studied the link between exchange rate uncertainty and FDI in some countries in East Asia and found that the increase in exchange rate uncertainty enhances the FDI. Nagubadi and Zhang (2011) examined this issue in US and Canada and documented exchange rate volatility to have a positive impact on FDI. Using the ARDL model, Ellahi (2011) examined the impact of exchange rate volatility on FDI in Pakistan and reported exchange rate volatility to have a negative and positive impact on FDI inflow in the short run and long run respectively. In Nigeria, Osinubi and Amaghionyeodiwe (2009) investigated the connection between the depreciation of the Nigeria Naira against the US dollar and the inward FDI, and reported a positive relationship between the two variables.

On the other hand, exchange rate volatility may negatively affect the flow of FDI into a country. For example, Dixit and Pindyck (1994) posits that where a country experiences a high degree of exchange rate volatility, the foreign direct investment there would have to be redirected to countries with stable exchange rates in a bid to mitigate a high degree of currency risk. In a study conducted in Nigeria, Obiora and Igue (2006) documented exchange rate volatility to have a negative and significant effect on Nigeria's exports to the US. In another study, Kyereboah-Coleman and Agyire-Tettey (2008) examined the impact of volatility of real exchange rate on foreign direct investment in Ghana and reported a negative influence of volatility on foreign direct investment. Udoh and Egwaikhide (2008) employed the GARCH model on time series data from 1970 to 2005 to investigate the impact of exchange rate volatility and other macroeconomic variables on FDI in Nigeria. Their results suggest that exchange rate volatility and inflation uncertainty have a negative effect on FDI. Also, Ogunleye (2008) used country-specific time series data and panel model estimation techniques to examine the nexus between exchange rate volatility and FDI in nine Sub-Saharan Africa countries and found that exchange rate volatility generally impairs FDI inflows to the region. Yousaf, Shahzadi, Kanwal & Hassan (2013) employed the OLS regression model and volatility analysis on time series data from 1980 to 2011 to examine the impact of exchange rate volatility on FDI in Pakistan. The results of the study revealed exchange rate volatility and inflation to constrain FDI.

## **Data and Methodology**

This study used annual data sourced from the Central Bank of Nigeria (CBN) Annual Report and Statement of Accounts and Statistical Bulletin of various issues to investigate exchange rate volatility and its effect on the foreign direct investment inflows to Nigeria. The data for FDI was supported with data sourced from the database of the United Nations Conference on Trade and Development (UNCTAD) and World Development Indicators database compiled by the World Bank. The sample data for the variables under consideration covers the period of 1970 - 2016. The study employed exchange rate data between the US Dollars and the Nigeria Naira to analyze the volatility during the study period. The study period is largely influenced by data availability for the relevant

variables and boom from crude oil. The consideration of periods with complete data availability is important to enhance the integration and analysis of the data. During this period under review, Nigeria experienced a boom in revenue inflows from crude oil and agricultural produce in the 1970s and in the early 1980s the country started to witness difficulty meeting the demand for foreign exchange due to drop in foreign earnings.

In order to ensure that the estimated results are not spurious, the study employs the Augmented Dickey-Fuller (ADF) test to check for the stationarity of the variables. The ADF test has a superior advantage in the series techniques for stationarity test due to its ability to control automatically for higher order connections and adjusts the test approach. Nevertheless, the study employed Philips-Perron (PP) test to confirm the results obtained with ADF test since it can moderate the error terms without adding lagged difference terms. The study employed the Johansen co-integration estimation technique to establish whether there is a relationship in the long run amongst the variables. As proposed by Akaike (1974), the study employed the Akaike Information Criterion (AIC) to select the optimal lag length.

Previous studies have relied on the standard deviation of monthly exchange rate changes to measure the volatility of exchange rate (Furceri and Borelli, 2008). However, the standard deviation as a technique for measuring volatility does not recognize the time-varying and clustering properties of assets. The standard deviation technique lacks the ability to account for the true strength of volatility in a system. In view of this challenge, this study resolves to measure exchange rate volatility using the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) developed by Bollerslev (1986) and favoured by some recent studies (Baillie & Morana, 2009; Bala & Asemota, 2013). The GARCH model is an improved version of the Autoregressive Conditional Heteroscedasticity (ARCH) model advanced by Engle (1982) and which adopts the variance of a time series. The GARCH model allows a variance of the error term to have a time-varying variance conditional on the past behaviour of the series and thus reflecting the actual volatilities as perceived. In addition, a GARCH (1, 1) specification that employs its own lag is significant to construct exchange rate volatility since it can capture well the problem of autocorrelation in time series variables. The GARCH (1, 1) model for this study is specified as follows;

$$\sigma_t^2 = \alpha_0 + \omega_i \varepsilon_{t-1}^2 + \beta_j \sigma_{t-1}^2 \dots\dots\dots (1)$$

Equation (1) can be expressed further as

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^p \omega_i \varepsilon_{t-1}^2 + \sum_{i=1}^q \beta_j \sigma_{t-1}^2 \dots\dots\dots (2)$$

In the model,  $\alpha_0$  represents the mean,  $\varepsilon_{t-1}^2$  is the ARCH term and  $\sigma_{t-1}^2$  is the GARCH term. According to Bollerslev (1986), the necessary condition to ensure stationarity of the

model is when  $\sum_{i=1}^p \omega_i + \sum_{i=1}^q \beta_j < 1$ . In order to investigate the effect of exchange rate



volatility on foreign direct investment inflows to Nigeria, the study developed the model below with the inclusion of interest rate, inflation and trade openness to augment and enhance its effectiveness. The inclusion of these variables is expected to control for other macroeconomic variables that can affect or explain the foreign direct investment inflows to Nigeria.

$$FDI = f(EVOL, INFL, TOPEN, INT) \dots\dots\dots (3)$$

Where:

FDI = Foreign Direct Investment inflow

EVOL = Exchange Rate Volatility

INFL = Inflation Rate

TOPEN = Trade Openness

INT = Interest rate

Equation (3) is expressed further in a time series form as

$$FDI_t = \lambda_0 + \psi_1 EVOL_t + \psi_2 INFL_t + \psi_3 TOPEN_t + \psi_4 INT_t + \mu_t \dots\dots\dots (4)$$

To check for the effect of a relationship among the variables, the study introduced to equation (4) the Error Correction term, which is the lag of the estimated error term and it is presumed to have a negative effect on the explained variable.

$$\Delta FDI_t = \lambda_0 + \psi_1 \Delta EVOL_t + \psi_2 \Delta INFL_t + \psi_3 \Delta TOPEN_t + \psi_4 \Delta INT_t + \psi_5 EC_{t-1} + \mu_t \dots\dots\dots (5)$$

Where  $\Delta$  is the log of the variable,  $EC_{t-1}$  is the lagged value of the error correction term and  $\mu_t$  is the error term. Considering the unstable nature of the Nigeria economic environment and inconsistencies in government policies, exchange rate volatility is assumed to persist over the study period and have a negative effect on foreign direct investment inflows to Nigeria. Other variables in the study are expected to go either direction.

## Results and Discussion

### *Unit Root Analysis*

This section commenced with the unit root analysis to establish if the variables are stationary or not. The unit root test is important in order to overcome any spurious results associated with time series data that are often non-stationarity over time with the mean and variance estimations. In other words, unit roots analysis would help to establish whether the variables are integrated of order zero 0(1) or order one 1(1). The study



employed Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root tests statistics to test the time series variables for stationarity. Where the variables have stationarity, the cointegration test is performed to determine the existence of a long run relationship. The summary of the unit roots test results is reported in Table 1. The unit roots test result shows that the variables were nonstationary in their levels, which means they are order zero 1(0). However, a further test of the variables in their first difference indicates that the variables have stationarity. This result is in tandem with Box and Jenkins (1978), who posits that nonstationary variables in their levels may be stationary when measured at their first differences. Therefore, the null hypothesis is rejected and it is sufficient to conclude that there is a presence of unit root test in the variables at first difference, which implies that the variables are integrated of order one, that is 1(1).

Table 1: Unit Root Test Results

Variable	ADF Test		PP Test	
	Level	First Difference	Level	First Difference
FDI	-3.1024	-6.4082**	-4.0945	-7.0074**
EVOL	-4.0283	-6.1931*	-3.8383	-7.1104*
INFL	-4.7470	-5.0002**	-3.6473	-5.7483*
TOPEN	-4.5263	-6.5522*	-3.0845	-3.4202**
INT	-3.5322	-4.0643***	-1.0021	-3.0756**

Note: Lags were automatically selected by the Akaike Information Criterion (AIC).  
 \*, \*\* and \*\*\* denote statistical significance at 1%, 5% and 10% levels respectively.

Given the level of stationarity of the time series data as reported in Table 1, the cointegration test was carried out using the Johansen's cointegration tests. This test is important to check if there is a long run equilibrium relationship or not between the variables in the model. The cointegration test results as reported in Table 2 for trace statistics and Table 3 for Maximum Eigenvalue are more than the critical values at the 0.05 level of significance. This result suggests that there is a long run relationship between foreign direct investment and other endogenous variables. Thus, the null hypothesis of no cointegration is rejected. Following this result, it is safe to proceed with the estimation of the GARCH model.

Table 2: Johansen co-integration test results (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.9082	82.8403	64.9064	0.0000
At most 1	0.8166	70.6666	56.9830	0.0000
At most 2	0.7880	57.6084	51.0900	0.0001
At most 3	0.5882	29.3307	31.0034	0.00014

Trace test indicates three cointegrating equations at the 0.05 level  
 \* denotes rejection of the hypothesis at the 0.05 level  
 \*\*MacKinnon-Haug-Michelis (1999) p-values

Table 3: Johansen co-integration test results (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None*	0.9082	78.7843	72.0964	0.0000
At most 1	0.8166	62.6758	49.0732	0.0000
At most 2	0.7880	51.5582	54.9573	0.0043
At most 3	0.5882	31.3984	32.0843	0.0031
Max-eigenvalue test indicates two cointegrating equations at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

### ARCH and GARCH Analysis

To ensure the suitability of our model to investigate exchange rate volatility using time series data, the study used the ARCH Lagrange Multiplier (LM) model to carry out the test for conditional heteroscedasticity. This was followed by a diagnostic check using the Correlogram Squared Residuals statistics. The result of the test for conditional heteroscedasticity as presented in Table 4, shows that probability value of 0.0301 is less than the 0.05 for the sample periods, which implies that there is no autocorrelation in the variables. This result indicates that periods of high (low) volatility has been followed by periods of high (low) volatility over time with respect to the US Dollars. Also, the results from the Correlogram Squared Residuals statistics as presented in Table 5 confirms the earlier result from heteroscedasticity test as presented in Table 4 and the results of the Autocorrelation (AC), Partial Autocorrelation (PAC) and Q-stat showed that the probability values are all zeros for the sample periods. The result shows that there is no autocorrelation in the residual. With this result, it is safe now to proceed to estimate the GARCH model for exchange rate volatility modelling.

Table 4: ARCH Lagrange Multiplier (LM) Test

Heteroskedasticity Test: ARCH	
Statistics	Full Sample Period
F-statistic	1.0853834
Obs*R-squared	1.083327
Prob. F (1,189)	0.0411
Prob. Chi-Square(1)	0.03013

Table 5: Correlogram of Standardized Residuals Squared

Lags	AC	PAC	Q-Stat	Prob.
1	0.085	0.085	0.1485	0.000
2	0.074	0.073	0.985	0.000
3	0.598	0.598	0.947	0.000
4	-0.739	-0.738	1.674	0.010
5	-0.563	-0.561	2.487	0.000

6	-0.548	-0.546	4.009	0.050
7	0.431	0.430	4.563	0.001
8	0.362	0.365	4.774	0.001
9	-0.101	-0.103	4.908	0.000
10	0.038	0.039	4.992	0.000

The results of the test of volatility with GARCH model is presented in Tables 6. As shown in Table 6, the result of the GARCH (1, 1) test indicates that the shock in the volatility of the variable persists at 5% level of significance. This result suggests that shocks to volatility persist throughout the study period irrespective of the exchange rate regimes that may have been in place. In this instance, the GARCH model shows that variances are volatile and the persistence of this volatility may likely remain so, and previous exchange rate volatility will continue to have an influence on the current volatility for a long period. In other words, the result shows that there is a positive relationship between the past variance and the current variance. This means that the persistence of high volatility of foreign exchange market in Nigeria will remain a concern for foreign investors, who display this attitude towards investment into the country. Exchange rate volatility can influence the amount and choice of location of foreign direct investment, especially for investors driven by risks and returns. The persistence of exchange rate volatility in Nigeria also influences local businesses and consumption that depends largely on imported materials, goods and services.

Table 6: Estimation of Exchange Rate Volatility with ARCH/GARCH Model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Mean equation				
C	0.046795	0.01025	4.56543	0.0100
Variance equation				
C	0.112347	0.07836	1.43373	0.0401
ARCH(1)	0.208153	0.04388	4.74369	0.0067
GARCH(1)	0.458364	0.07144	6.41607	0.0008
R-squared	0.0858	Mean dependent var	0.0051	
Adjusted R-squared	0.0758	S.D. dependent var	0.1881	
S.E. of regression	0.1808	Akaike info criterion	-9.1048	
Sum squared resid	5.9538	Schwarz criterion	-9.06407	
Log likelihood	32.198	Hannan-Quinn criter.	-9.2004	
F-statistic	8.0372	Durbin-Watson stat	2.0632	
Prob(F-statistic)	0.0002			

Note: \*, \*\* and \*\*\* denote statistical significance at 1%, 5% and 10% levels respectively

### *Effect of Exchange Rate Volatility on Foreign Direct Investment*

To begin the empirical analysis, the study presents three sets of panels, the full sample period and the sub-sample periods, which are the fixed and the managed float exchange

rate regimes to benchmark the analysis using the error correction technique. In addition, the study employs exchange rate volatility data for a one-year period to capture the effect of volatility on the explained variable over a short-run period. This segmentation is important to check the consistency of the signs and significant values of the explanatory variables under a common technique and at different periods, that is short-run and long run. The main thrust of this study is to investigate the impact of exchange rate volatility on foreign direct investment. Table 8 presents the results of the estimation with column 1, depicting the results for the full sample and column 2 and 3 reporting the sample for the fixed and managed float sample periods.

The result of the R-squared indicates that 67.42%, 64.34% and 71.02% respectively of the variation in the foreign direct investment, which is the explained variable, have been accounted for by the explanatory variables. In other words, it represents the percentage of the variance in foreign direct investment that is explained by exchange rate volatility, inflation, trade openness and interest rate. The results of the adjusted R-squared for the full, fixed and managed float sample periods respectively suggests that 63.02%, 61.68% and 66.02% of the study model is of good fit to explain the variability of the data from its mean position. The Durbin-Watson statistic of 2.0182, 1.8103 and 1.9037 for the three sample periods indicates that there is no evidence of autocorrelation amongst the variables in the study. Given the F-statistic of 4.7202, 3.0922 and 6.0938 and p-value of 0.0000, 0.0000 and 0.0001 for the three samples, it is safe to conclude on the overall significance of the model for this study. Also, this result implies that the explanatory variables have a joint significant effect on foreign direct investment inflows to Nigeria.

The result as reported in Table 8 reveals that exchange rate volatility exerts a negative and significant relationship with foreign direct investment inflows to Nigeria. The result in Column 1 revealed that exchange rate volatility is statistically significant at 5% with a coefficient value of -0.0971, t-statistic of -1.9423 and a probability of 0.0010. The result suggests that an increase (a decrease) in the level of exchange rate volatility will influence the level of foreign direct investment into the country to drop (rise) by 09%. This finding clearly aligns with previous empirical studies by Udoh and Egwaikhide (2008). The implication of this result is that the extent of government commitment and indeed the political will of the political class to design and implement policies and programs aimed at creating a stable economic environment are encouraged to foster foreign direct investment and economic growth in Nigeria.

This result reveals the need for the government to proactively evolve efficient foreign exchange management strategies on the one hand, and on the other hand, create the enabling environment that would encourage the production and consumption of local materials in order to reduce the pressure on foreign exchange and lessen the level of volatility and its effect on FDI. A quick look at this result from another perspective suggests that a drop in foreign earnings from crude oil and agricultural produce, particularly when the country introduced managed float exchanged rate regime may have influenced the negative sign of the coefficient of FDI. As earlier mentioned, in the early 1980s, Nigeria experienced a situation where the demand for foreign exchange was more than the supply due to a drop in the price of crude oil at the international market. Having the political will to develop policies and programs for the interest of all has been a major

ban on economic stability and growth in Nigeria. A number of government leaders design policies that are skewed towards their personal interest or the interest of a particular group at the expense of the overall economic growth. This characteristic was very pronounced in recent time when the government of the present administration came up with different exchange rates for a different interest group in the country, thus creating more speculations and uncertainties in the system.

In Table 8, the results of the fixed and managed float exchange rate periods are not significantly different from the full sample period. The exchange rate volatility is found to have an adverse impact on foreign direct investment. However, the result in a fixed period is found to be statistically insignificant at the 5% level. Although exchange rate volatility is found to persist throughout the study period, the insignificant effect of exchange rate volatility on foreign direct investment during the period of the fixed regime was perhaps due to government efficient management of a stable economic environment. Also, the result may have been influenced by the performance of other macroeconomic variables that may have suppressed the influence of exchange rate volatility. Finally, it is likely that the sign of the coefficient of FDI in this study is influenced by the kind of FDI inflows to Nigeria, just like other sub-Sahara Africa countries, which is resource driven and market-seeking FDI (Bala and Asemota, 2013).

Furthermore, the study examined the behaviour of other variables such as inflation, trade openness and the interest rate on foreign direct investment. The result in Table 8, Column 1, 2 and 3 shows that inflation is negatively and statistically significant with foreign direct investment at 1% and 5% level of significance. This result is in line with the previous study by Kriljenko and Habermeier, (2004). In Table 8, Column 1 and 2, the coefficient (and probability) of inflation rate is found to be -0.2428 (0.0010) and -0.0425 (0.0050). The result indicates that inflation rate has a negative effect on foreign direct investment inflow to Nigeria. This suggests that investors coming to Nigeria would like to know or take into consideration how the level of inflation in the country will affect the value of their investment. It means that foreign direct investment is lower in periods with a higher level of inflation, which in turn may lead to shocks in the economy. Also, it suggests that an increase (decrease) in the level of inflation rate will bring about 24.28% reductions (addition) in the level of foreign direct investment inflows to Nigeria.

The influence of interest rate on foreign direct investment was examined as well, though it was not the main focus of this study. The result of the study indicates a positive linkage between interest rate and foreign direct investment and it is significant at 5% level in the full sample as well as in the sub-periods sample. The coefficients of interest rate in the full sample and managed float exchange rate period are 0.5210 and 0.2151 respectively. This suggests that an increase in the level of interest rate can exert an upward trend in the foreign direct investment into the Nigeria economy, particularly when investors can cash into the system to take advantage of the high returns on capital invested. With high-interest rate, investors may be interested in providing direct funding to local businesses at a rate that is slightly lower than the market price but above their borrowing rate at the parent office. However, this phenomenal may create another round of problem for the local businesses that may not have the privileges to borrow from the foreign lender at a rate lower than the prevailing rate.

The evaluation of trade openness against foreign direct investment suggests a statistically significant positive relationship at 5% and 1% level of significance for the full and fixed samples respectively. Specifically, trade openness has a coefficient and p-value of 0.0730 (0.0050) and 0.1377 (0.0010) for the full sample and fixed exchange rate regimes respectively. Also, the managed float exchange rate has a coefficient and probability of 0.0886 and 0.0050. Given these results, it means therefore that the ability of the government to create a stable environment with good policies and programs will further improve on trade and foreign direct investment into the country. This finding confirms the previous report by Offiong and Atsu, (2014), who documented the existence of a relationship between FDI and openness of the economy.

Table 8: Estimation Results for  $\Delta$ FDI and other Variables

Variable	Full Sample Period Jan. 1970 – Dec. 2016			Fixed Exchange Rate Regime Sample Period Jan. 1970 – Aug. 1986			Managed Exchange Rate Regime Sample Period Sept. 1986 – Dec. 2016		
	Coefficient (Std. Error)	t-Stat	Prob.	Coefficient (Std. Error)	t-Stat	Prob.	Coefficient (Std. Error)	t-Stat	Prob.
C	0.5752 (0.10803)	5.3244	0.0000	0.6437 (0.1410)	4.5654	0.0011	0.2287 (0.0501)	4.5654	0.0001
$\Delta$ EVOL	-0.0971 (0.0500)	-1.9423	0.0010	-0.1469 (0.0535)	-2.7436	0.0310	-0.2455 (0.0794)	-3.0921	0.0000
$\Delta$ INFL	-0.2428 (0.0853)	-2.8462	0.0010	-0.0425 (0.0352)	-1.2063	0.0050	-0.0406 (0.0134)	-3.0274	0.0024
$\Delta$ TOPEN	0.0730 (0.0362)	2.0174	0.0050	0.1377 (0.0735)	1.8730	0.0010	1.0886 (0.3520)	3.0927	0.0050
$\Delta$ INT	0.5210 (0.1036)	5.0293	0.0032	2.8277 (0.8360)	3.3824	0.0052	0.2151 (0.0720)	2.9872	0.0026
$\Delta$ EC(-1)	-0.3704 (0.1263)	-2.9330	0.0034	-1.6204 (0.5290)	-3.0632	0.0039	-0.1712 (0.0364)	-4.7027	0.0010
R-squared	0.6742			0.6434			0.7102		
Adjusted R-squared	0.6302			0.6168			0.6602		
Durb – Wats Statistics	2.0182			1.8103			1.9037		
F-statistic	4.7202			3.0922			6.0938		
Prob (F-statistic)	0.0000			0.0000			0.0001		

Notes: \*, \*\* and \*\*\* denote statistical significance at 1%, 5% and 10% levels respectively. Standard errors are in parentheses.

Furthermore, the results of this study demonstrate that exchange rate volatility does not have any statistically different effects on foreign direct investment when distinguished between exchange rate regimes on the one hand and between periods of short-run and a long run on the other hand. The coefficient of the error correction term (EC), which is the lag of the estimated error term of the model is found to be -0.3704 for the full sample and

it is statistically significant at 1%. This result suggests the significance of the endogenous variables to explain foreign direct investment in Nigeria. In addition, it, therefore, implies that there is the presence of a long-term relationship between foreign direct investment and the endogenous variables that influence its short run movements, which means such disequilibrium, can be adjusted and restored on the long run. This further confirms the results of possible cointegration of the variables in the study as reported in the preliminary analysis.

## Conclusion

The exchange rate and foreign direct investment are two important macroeconomic variables at the disposal of the government to stabilize and grow the economy. A favourable environment guarantees stable exchange rate and attracts investments from other parts of the world. Thus, this paper investigates the impact of exchange rate volatility on foreign direct investment in Nigeria. The study employs the GARCH and EC models to analyze the time series data from 1970 to 2016. After checking for stationarity of the variables and periodicity effects, the results of the study show that exchange rate volatility is persistent throughout the period under review. Also, the results suggest that exchange rate volatility has a negative and significant relationship with foreign direct investment inflows to Nigeria. Furthermore, the study revealed that while inflation is negatively and statistically significant with foreign direct investment, interest rate and trade openness exerts a positive relationship with foreign direct investment. It suggests, therefore, that increase in inflation will reduce foreign direct investment. On the other hand, it suggests that an increase in the level of interest rate and good policies and programs will lead to an upward trend in the foreign direct investment into the Nigeria economy.

In the light of the findings in this study, it is imperative for the government to pursue vigorously a stable exchange rate regime by adopting sound exchange rate management system and policies that would help to restore investors' confidence and increase in domestic production of export commodities that would bring about the desired economic growth. Additionally, the government would need to advance policies and programs that would help to stabilize the environment and improve on inflation, interest rate and trade openness to attract foreign investment inflows. Technically, this study has established the significance of exchange rate stability on the inflow of foreign direct investment. Foreign direct investment is one of the macroeconomic variables that exert growth on the economy. Thus, it is important to explore the connection between exchange rate volatility and other macroeconomic variables. It is also important to examine the strategic measures being used by both the private and public sectors to mitigate with the effect of exchange rate volatility.

## References

- Adewuyi, A. O., & Akpokodje, G. (2013). Exchange rate volatility and economic activities of Africa's sub-groups. *The International Trade Journal*, 27(4), 349–384.

- Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control*, 19(6), 716-723.
- Bailey, J.M., & Tavlas, S.G. (1991). Exchange rate variability and direct investment. *Annals of the American Academy of Political and Social Sciences*, 16(1), 106-116.
- Baillie, R. T. C. & Morana, C. (2009). Modelling long memory and structural breaks in conditional variances: An adaptive FIGARCH approach. *Journal of Economic Dynamics and Control*, 33(8), 1577-92.
- Bala, D. A. & Asemota, J. O. (2013). Exchange-rates volatility in Nigeria: Application of GARCH models with exogenous break. *CBN Journal of Applied Statistic*, 4(1), 89-116.
- Benassy-Quere, A., Fontagne, L., & LahrEche-Revil, A. (2001). Exchange-rate strategies in the competition for attracting foreign direct investment. *Journal of the Japanese and International Economics*, 15(2), 178-198.
- Bhandari, R. & K. P. Upadhyaya. (2008). Panel data evidence of the impact of exchange rate uncertainty on private investment in South-east Asia. *Applied Economics*, 42(1), 57-61.
- Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics* 31(3), 307-327.
- Box, G.P.F. & Jenkins, G. M. (1978). *Time Series Analysis: Forecasting and Control*. 3rd Edition., Holden Day, San Francisco, U.S.A.
- Campa, J. M. (1993). Entry by foreign firms in the United States under exchange rate uncertainty. *The Review of Economics and Statistics* 75(4), 614-622.
- Central Bank of Nigeria (2017) *Annual report and Statement of Accounts*. Retrieved from [www.cbn.org.ng](http://www.cbn.org.ng)
- Central Bank of Nigeria (2017) *Statistical Bulletin*. Retrieved from [www.cbn.org.ng](http://www.cbn.org.ng)
- Chaudhary, G.M., Shah, S.Z.A., & Bagram, M.M.M. (2012). Do exchange rate volatility effects foreign direct investment? Evidence from selected Asian Economies. *Journal of Basic and Applied Scientific Research*, 2(4), 3670-3681.
- Chong, L. L., & Tan, B. H. (2008). Exchange rate risk and macroeconomic fundamentals: Evidence from four neighboring Southeast Asian economies. *International Research Journal of Finance and Economics*, 16, 88-95.
- Crowley, P., & Lee, J. (2003). Exchange rate volatility and foreign investment: International evidence. *The International Trade Journal*, 17(3), 227-252.



- Cushman, D. (1985). Real exchange rate risk expectations and exchange rate risk during the floating period. *Review of Economics and Statistics*, 67, 302-307.
- Dhakal, D., Nag, R., Pradhan, G. & Upadhyaya, P.K. (2010). Exchange rate volatility and foreign direct investment: Evidence from East Asian Countries. *International Business & Economics Research Journal*, 9(7), 121-128.
- Dixit, A. K., & Robert S. P. (1994). *Investment under uncertainty*. Princeton University Press, Princeton, NJ.
- Doganlar, M. (2002). Estimating the impact of exchange rate volatility on exports: Evidence from Asian countries. *Applied Economics Letters*, 9(13): 859-63.
- Ellahi, N. (2011), Exchange rate volatility and foreign direct investment behaviour in Pakistan: A time series analysis with auto regression distributed lag application. *Africa Journal of Business Management*, 5(29): 11656-11661.
- Engle, R. F. (1982). Autoregressive conditional heteroskedasticity with estimates of the variance of United Kingdom inflation. *Econometrica* 50(4), 987-1007.
- Foad, H. S. (2005). *Exchange rate volatility and export oriented FDI*. Emory University, Atlanta, GA.
- Froot, K. A., & Jeremy C. S. (1991). Exchange rates and foreign direct investment: An imperfect capital markets approach. *Quarterly Journal of Economics* 106(4), 1191-1217.
- Furceri, D., & Borelli, S. (2008). Foreign direct investment and exchange rate volatility in the EMU neighbourhood countries. *Journal of International and Economic Studies*, 1(1), 42-59.
- Goldberg, L. & Kolstad, C. (1995), Foreign direct investment and demand uncertainty, *International Economic Review*, vol. 36(4), 855-73.
- Gorg, H., & Wakelin, K. (2002). The impact of exchange rate volatility on US direct investment. *The Manchester School*, 70(3), 380-397.
- Gottschalk, S., & Hall, S. (2008). Foreign direct investment and exchange rate uncertainty in South-East Asia. *International Journal of Finance and Economics*, 13(4), 349-359.
- Kasman, A. & A. Kasman. (2005). Exchange rate uncertainty in Turkey and its impact on export volume. *METU Studies in Development*, 32(6), 41-58.
- Kriljenko, J.C & Habermeier, K. (2004). *Structural factors affecting exchange rate volatility: A cross-section study*. IMF Working Paper WP/04/147, Washington, DC: International Monetary Fund.

- Kyereboah-Coleman, A. K. & Agyire-Tettey, F. (2008). Effect of exchange rate volatility on foreign direct investment in Sub Saharan Africa, *The Journal of Risk Finance*, 9(1), 52-70.
- Nagubadi, V.R., & Zhang, D. (2011). Bilateral foreign direct investment in forest industry between the U.S. and Canada. *Forest Policy and Economics*, 13(5), 338-344.
- Nyarko, A.P., Nketiah-Amponsah, E., & Barnor, C. (2011). Effects of exchange rate regimes on FDI inflows in Ghana. *International Journal of Economics and Finance*, 3(3), 277-286.
- Obiora, K.I. and Igue, N.N. (2006), Exchange rate volatility and U.S. - Nigeria trade flows: An econometric appraisal of the evidence. *Paper Presented at the 11<sup>th</sup> Annual Conference of the African Economic Society*, 5<sup>th</sup> – 7<sup>th</sup> July. Dakar, Senegal.
- Offiong, I. A. and Atsu, I. A. (2014), Determinants of Foreign Direct Investment in Nigeria. *International Review of Management and Business Research*, 3 (3), 1538-1550.
- Ogunleye, E.K. (2008), Exchange rate volatility and foreign direct investment inflows in selected Sub-Sahara African Countries, 1970-2005. Ph.D. Thesis, University of Ibadan, Nigeria.
- Osinubi, T.S. & Amaghionyeodiwe, L.A. (2009), Foreign direct investment and exchange rate volatility in Nigeria, *International Journal of Applied Econometrics and Quantitative Studies*, 6(2): 84-115.
- Reinert, K.A., Rajan, R.S., Glass, A.J., & Davis, L.S. (2010). *The Princeton Encyclopedia of the World Economy*. New Jersey. Princeton University Press.
- Stokman, A., & P. Vlar. (1996). Volatility, international trade and capital flows. *Financial and Monetary Policy Studies* 32, 115-132
- Udoh, E. & Egwaikhide, F. O. (2008), Exchange rate volatility, inflation uncertainty and foreign direct investment in Nigeria. *Botswana Journal of Economics*, 5(7), 14-31.
- United Nations Conference on Trade and Development (UNCTAD). (2011 - 2017). *World Investment Report*. New York: United Nations.
- Urata, S., & Hiroki, K. (2000). The determinants of the location of foreign direct investment by Japanese SMEs. *Small Business Economics*, 15(2), 79-103.
- World Bank (2017). *World Development Reports*. New York: Oxford University Press.
- Yousaf, S., Shahzadi, I., Kanwal, B. & Hassan, M. (2013). Impact of exchange rate volatility on FDI in Pakistan. *IOSR Journal of Business Management*, 12(1), 79-86.