Exchange Rate Volatility and Foreign Direct Investment in Nigeria: An E-Garch Approach

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Abstract: This study seeks to examine the relationship between Foreign Direct Investment (FDI) and Real Effective Exchange Rate (REER) volatility in Nigeria. Using annual time series data from 1980 to 2016, the study adopted the Exponential GARCH model, Ordinary Least Squares (OLS) estimation technique and the Error Correction Mechanism. The major findings of the study reveal that there is a negative correlation between Nigeria's past and future REER, which further implies that negative shock has less effects on exchange rate volatility when compared with a positive shock. It also found that exchange rate has a very significant effect on FDI in Nigeria while there also exists a long-run relationship between them. The study therefore advocates for a strong foreign exchange policies by the CBN to attract FDI. It also suggests that CBN should be keen on monitoring the financial news in the economy as it could heighten exchange rate and financial market volatilities; which may not be good for the economy's overall growth and development in the long-run.

Keywords: Foreign Direct Investment; Exchange Rate; EGARCH Model; Nigeria.

JEL Codes: F21; F31; C32; N17.

INTRODUCTION

All over the world, various factors are known to increase economic growth while some others are known to stabilize the economy. One of such macroeconomic variables that researchers have found out over time is the foreign direct investment. Wikipedia has defined foreign direct investment as "an investment in the form of a controlling ownership in a business in one country by an entity based in another country. Talking of the importance of foreign direct investment, Okaro [1] found FDI inflows and rapid development in trade liberalization as factors that have contributed to Nigeria's economic growth in recent times. This is further buttressed by Ogunleye [2] who opined that FDI serves as a vital channel for resource flows between the industrial and growing Sub-Saharan African (SSA) countries, on one hand, and among the developing SSA countries themselves, on the other. Exchange rate, among other things, increases the inflow of FDI [3] In line with the aforementioned research outcomes in the time past, some other direct benefits of FDI are: transfer of technology from other countries to Nigeria, job creation, increased productivity etc. In order to further buttress the trend of FDI in Nigeria, Fig-1.1 below shows a graphical illustration of FDI inflows in Nigeria from 1970-2015.

However, as concretized by Oladapo and Oloyede [4], with the very important and significant roles performed by FDI and its inflows, so many factors decide the frequency and volume of its inflow. A typical of such factors, as posited, still, by Oladapo and Oloyede is the exchange rate. Exchange rate is the rate at which currency purchases another [5, 6]. Just like the foreign direct investment inflows in Nigeria has been increasing since 1970, Nigeria's currency exchange rate also has never been static for a relatively long time. This is partly due to the pattern of demand in Nigeria [7] as well its weakness in the international arena. Let us also show this movement graphically to buttress this point.
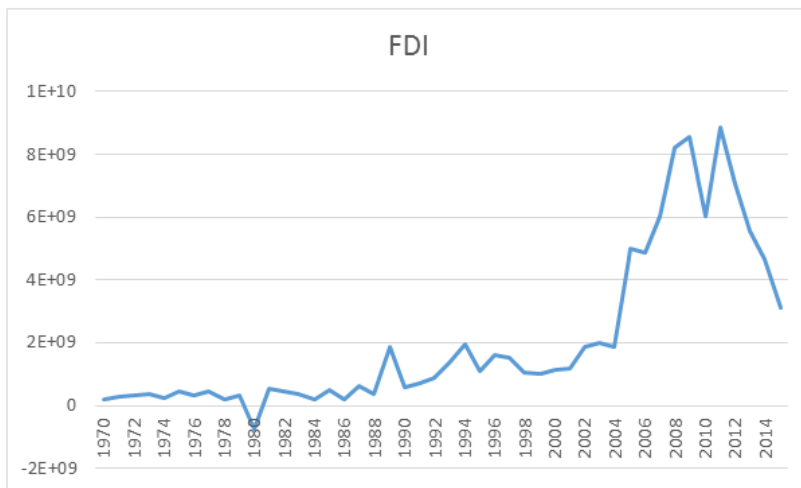
Fig-1.1: Trend of FDI Inflows in Nigeria from 1970-2015
Source: Researcher's Computation with Data from WDI 2016

The diagram above shows that FDI inflows in Nigeria has been an upward phenomenon for a long time now.
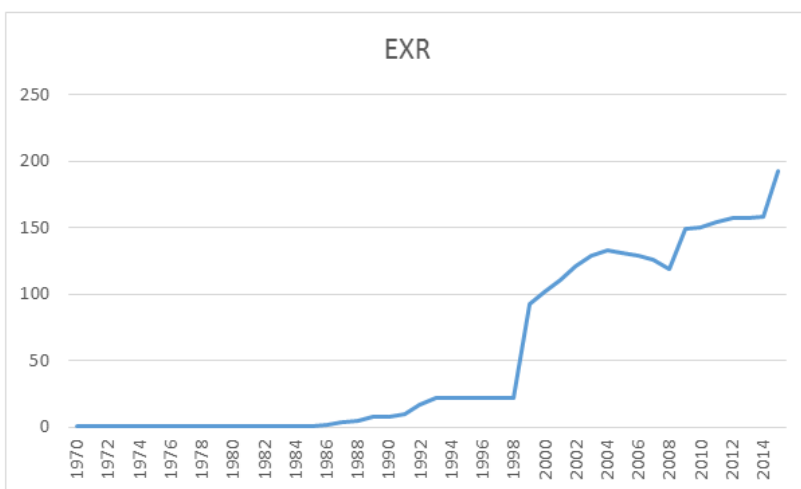

Fig-2: Trend of Naira Exchange rate from 1970 -2015
Source: Researcher's Computation with Data from WDI 2016

The diagram above is a pure definition of exchange rate volatility. So many studies, therefore, have established a linkage between exchange rate volatilities and FDI. Even on a larger scale, Ogunleye [2] warned that exchange rate volatility could be disincentive to the choice of Sub-Saharan Africa (which, of course includes Nigeria) as FDI destination.

Having looked at the historical overview of Foreign Direct Investment (FDI), exchange rate and its volatility, this study seeks to critically analyse the impact of exchange rate (NGN/USD) and its volatility on the inflows of FDI into Nigeria. To do this, we employ the Ordinary Least Squares (OLS) Estimation technique as well as the Error Correction Model, which helps in analyzing the short-run dynamics of the variables of study.

The main research design of the work is summarized thus: the data on FDI inflows, exchange rate and other control variables will be collected on yearly basis from 1970-2015. Then, as has been mentioned earlier, using the OLS methodology, their relationships are ascertained after estimations. The study will also do justice to major concerns of the estimation process.

The progression of remaining part of the study is as follows: In section 2, literature is reviewed and discussed. Section 3 describes the data, and summarizes the exchange rate regimes of Nigeria since the introduction of the Structural Adjustment Programme (SAP) in 1986. The detailed methodology is discussed in section 4. In section 5, the results and interpretations are presented. Finally, section 6 summarizes the findings and concludes the study.

LITERATURE REVIEW

So many works have been done by many scholars to show the relationship between FDI and Exchange. Because of this seemingly unusual interest people have on this subject matters, it has become almost a truism to say that there is some form of relationship between them. However, of interest also has been the nature of this relationship and the causes of exchange rate volatilities. To this end, many researchers have come up with many submissions, interesting ones at that. It has been found that both exchange rate volatility and exchang rate level can have significant effects on FDI inflows Goldberg and Kolstad [8], and Markusen [9]. While high exchange rate volatility can lead to uncertain economic conditions for the host country and, therefore, it affects FDI inflows, exchange rate depreciation or appreciation makes the foreign investors fairly richer or poorer.

Exchange rate Level and Exchange Rate Volatility

The exchange rate between two currencies, as was explained in the introduction, is the rate at which one currency will be exchanged for another. It is also regarded as the value of one country's currency in relation to another currency. Exchange rates are determined in the foreign exchange market, which is open to different types of buyers and sellers, and where currency trading is continuous. The spot exchange rate is tha same as the current exchange rate. The forward exchange rate refers to an exchange rate that is quoted and traded today but for delivery and payment on a specific later date. In retail currency exchange market, different buying and selling rates will be quoted by money dealers. Most trades are to or from the local currency. The buying rate is the rate at which money dealers will buy foreign currency, and the selling rate is the rate at which they will sell that currency.

Suranovic [10] explained exchange rate volatility as the degree to which a country's exchange rate fluctuates with time. Since fixed exchange rates are not supposed to change-by definition-they have no volatility. A floating exchange rate may or may not be volatile, depending on how much it changes over time. However, since floating exchange rates are free to change, they are generally expected to be more volatile. Still according to Suranovic [10], volatile exchange rates make international trade and investment decisions more difficult because volatility increases exchange rate risk, which refers to the potential to lose money because of a change in the exchange rate. There have been a various studies on the relationship between exchange rate volatility and fdiinflows. Theoretically, the linkage between volatility and FDI has been divided into two views,

Production flexibility arguments and risk aversion arguments

These views are pioneered by Goldberg and Kolstad [8] For the production flexibility argument, the relationship between exchange rate volatility and FDI inflows is positive, indicating that the more volatile the exchange rate level is, themore FDI inflows into the host countries. This is possibly because firms can adjust the use of one oftheir factors following the realisation of a stochastic input into profits. This argument is based on theassumption that firms can adjust variable factors. The argument would not hold if factors were fixed.The risk aversion argument suggests that exchange rate volatility increase makes FDI decrease,indicating a negative relationship. The basic logic is that the investors require to be rewarded for therisk come from the volatility of exchange rate [8]. Higher volatility inexchange rate lowers the certainty of expected exchange rate, which is one of the factors to determinethe expected profits and losses in future periods. If exchange rates are highly volatile, the expectedvalue of the investment are reduced, and FDI inflows, therefore, reduces. Also using the argument offuture expected profits, Campa [11] extend thi claim to includes riskneutral firms.

The study hypothesises that as investors are concerned about future profits, fims will consider their decisions toenter the market as exchange rates become more volatile. As a result, firms will be deferred fromentering foreign markets when the exchange rate level is uncertain. Goldberg and Kolstad [8] also note that along with evaluating risk-aversion approaches, production flexibility approaches, it is crucial to consider short-term exchange rate volatility and long- term misalignments. It appears that risk-aversion arguments are more persuasive under short-term volatility, as in the short-term factors of production are likely to be fixed and this leads to firms being risk-averse to volatility in estimating their future expected profits or losses [12]. The production flexibility augments are more convincing in the long-run, as under the long-term firms can adjust the factors to their production. There has been no clear consensus exists in the existing literature on the effects of exchange rate volatility on FDI. This may be explained by those studies considering the relationship in different countries where the economic and politic conditions are highly different. Past studies on this relationship yield negative, positive and indeterminate effects. One reason why an increase in exchange rate volatility increases FDI inflows is export substitution. That is when multinational companies want to avoid trading uncertainties, including exchange rate risk, tariff, or transport costs. The more volatility the exchange rate is, more firms will choose to serve foreign markets through local production.

Foreign Direct Investment (FDI)

In line with the work of Ott [13], a foreign direct investment (FDI) is an investment in the form of a controlling ownership in a business in one country by an entity based in another country. It is thus distinguished from foreign portfolio investment by a notion of direct control. Jerker [14] contributed in explaining FDI as he wrote that broadly, foreign direct investment includes "mergers and acquisitions, building new facility, reinvesting profits earned from

overseas operations and intra company loans". In a narrow sense, foreign direct investment refers just to building new facility, a lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor. FDI is the sum of equity capital, other long-term capital, and short-term capital as shown in the balance of payments (BOP). FDI usually involves participation in management, joint-venture, transfer of technology and expertise. Stock of FDI is the net (i.e. outward FDI minus inward FDI) cumulative FDI for any given period. Direct investment excludes investment through purchase of shares.

FDI is one example of international factor movements. A foreign direct investment (FDI) is a controlling ownership in a business enterprise in one country by an entity based in another country. Foreign direct investment is distinguished from foreign portfolio investment, a passive investment in the securities of another country such as public stocks and bonds, by the element of "control".

Theories of Exchange
Before the contemporary studies on FDI and Exchange Rate, so many theoretical backings have been made by the originators of Economics. Most times, these theories form the framework for certain economic analyses. To this effect, let us now mention the theories of FDI and Exchange Rate. We will also have a brief explanation of the one that affect our work directly.

The theories of Exchange rate are:
- Production Cycle Theory
- The theory of Exchange rates on Imperfect capital market
- The Internalization Theory
- The Eclectic Paradigm

The theories of Exchange Rate are:
- The Asset Approach to Exchange Rate Analysis
- Sterilization
- Exchange Rate and Trade Balance
- Currency Substitution
- Marshall-Lerner Condition
- The Role of Good News on Exchange Rate Volatilities.

Because the last theory mentioned above affect our study directly since we are interested in the leverage effect and its contribution to exchange rate volatilities, it is explained briefly below.

The Role of Good News on Exchange Rate Volatilities
The real world is characterized by unpredictable shocks or Surprises. When some unexpected event takes place, we refer to this as news. Since interest rates, prices, and incomes are often affected by news, it follows that exchange rates too will be affected by news. By definition, the exchange rate changes linked to news will be unexpected. We find great difficulty in predicting future spot rates because we know that the exchange rate will be, in part, determined by events that cannot be foreseen. That the predicted change in the spot rate, as measured by the forward premium, varies less over time than the actual change does indicate how much of the change in spot rates is unexpected. Periods dominated by unexpected announcements or realizations of economic policy changes will have great fluctuations in spot and forward exchange rates as expectations are revised subject to the news. The news also has implications for purchasing power parity. Because exchange rates are financial-asset prices that respond quickly to new information, news will have an immediate impact on exchange rates. Prices of goods and services, however, will not be affected by the news in such a rapid manner. One reason is that goods and services are often contracted for in advance, so that prices are inflexible for the duration of the contract. A more basic and general reason is that financial assets, like foreign exchange, have long lives relative to the goods and services that are incorporated in national price indexes. This is important because longer-lived assets or durable-goods prices are more sensitive to changes in expectations than nondurable or relatively short-lived assets are. For this reason, during periods dominated by news, we observe exchange rates varying a great deal relative to prices, so that large deviations from purchasing power parity are realized. Thus, Volatile exchange rates simply reflect turbulent times.

Data
Model Specification
An economic model is a representation of the basic features of an economic phenomenon; it is an abstraction of the real world [15]. The specification of a model is based on the available information relevant to the study in question.

That is to say, the formulation of an economic model is dependent on the available information on the study as embedded in standard economic theory and other major empirical work, or else, the model will be non-theoretical.

In line with the objectives of this study, we will be employing three different econometric approaches and they include:
- The Ordinary Least Squares (OLS) estimation technique
- Error Correction Model
- The Exponential Generalized Autoregressive Conditional Heteroskedasticity (E GARCH) model

We now go ahead to specify and explain the underpinnings of the above-mentioned models.

The Ordinary Least Squares Estimation Technique

Here, this study will adopt the multiple regression models, with a functional expression as well. The essence of this model is to capture the individual impact or effect of each independent variable on the dependent variable as well as determining the rate at which they (the independent variables) affect the dependent variable. In this study of basically the relationship between exchange rate and FDI in Nigeria, we will employ Exports, Real Interest Rate, inflation rate, GDP growth rate and Consumer price index as our control variables while real effective exchange rate is our core independent variable and FDI inflows is the dependent variable. Therefore, the functional form of the model can be specified as;

$$\text{FDI=f (REER, EXP, RIR, INF, GDP)} \qquad (3.1)$$

The mathematical form of the linear model can be specified as follows:
$$\text{FDI}_t = \beta_0 + \beta_1 \text{REER}_t + \beta_2 \text{EXP}_t + \beta_3 \text{RIR}_t + \beta_4 \text{INF}_t + \beta_5 \text{GDP}_t \qquad (3.2)$$

The econometric form of the model can be specified as;
$$\text{FDI}_t = \beta_0 + \beta_1 \text{REER}_t + \beta_2 \text{EXP}_t + \beta_3 \text{RIR}_t + \beta_4 \text{INF}_t + \beta_5 \text{GDP}_t + U_t \qquad (3.3)$$

Where,

FDI =Inflows of Foreign Direct Investment in Nigeria
REER=Real Effective Exchange Rate
EXP= Exports in Nigeria
RIR=Real Interest Rates
GDP=Growth Rate of GDP in Nigeria
INF=Inflation Rate in Nigeria
CPI= Nigeria's Consumer Price Index
B_0=Intercept term
β_1 to β_6= Estimators

U_t = stochastic error term.

U_t is an error term that captures all other unobserved factors not include as independent variable in the model but influence the Foreign Direct Investment (FDI).

The functional form model shows that relationship exists between FDI and the explanatory variables. The mathematical form of the model is an attempt to quantify the rate at which the independent variables explain the dependent variable. But the purely mathematical form of the model is of limited interest to this research work; for it assumes there is an exact or deterministic relationship between the rate of employment and the independent variables, but the relationship between economic variables are generally inexact. Thus the econometric form of the model proves useful, by including an error term (U_t) to capture other variables that could affect rate of employment but were not included in the model.

It is very important to point out at this point that before the estimation of the parameters, some pre-estimation tests such as Unit Root test for stationarity and Test for Correlation among the exogenous variables. The statistical tests of interest in this model are the t-test and the f-test. Then, in order to align our outcome with our objectives necessitating this model, we will also look at econometric correctness of our estimation. Such tests to capture this are: test for normality and hetroskedasticity.

Error Correction Model

This is a model used to check the short-run dynamics of the endogenous variable captured by the independent variables. This means that with the error correction model, the short-run relationship between the exogenous and the

endogenous variables are captured as against cointegration which talks about the long-run relationship only. Thus, with the Error Correction Mechanism or model, the time lag needed to correct the disequilibrium present in the dependent variable in the long term and the short term is ascertained [16].

In line with the thoughts of Hoang [17], the theory of that arises out the need to integrate short-run dynamics with long-run equilibrium. Brookes [18] claims that provided variables Y (dependent) and X (exogenous) are co-integrated, then there exist an error correction model.

$$\Delta Y_t = \beta_1 \Delta X_t + \beta_2 Y_{t-1} - \gamma X_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

Where Y is the dependent variable in equation (3.3), and X are the independent variables in equation (3.3)

The term $Y_{t-1} - \gamma X_{t-1}$ is called the error correction term. While β_1 describes the short-run relationship between the change in X and the change in Y. β_2 describes the speed of adjustment back to equilibrium.

The Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) Model
The Exponential GARCH (p, q) model, EGARCH (p, q) put forward by Nelson [25] provides a first explanation for the σ_t^2, which depends on both size and the sign of lagged residuals. It best captures the nature of exchange rate volatilities in the face of negative or positive news from the money market. The EGARCH model is the first example of asymmetric model of the GARCH family. It is fundamentally given as:

$$\ln \sigma_t^2 = \omega + \sum_{i=1}^{q} \alpha_i g(z_{t-i}) + \sum_{j=1}^{p} \beta_j \ln(\sigma_{t-j}^2) \ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

With $\alpha_1 = 1$ and $g(z_t) = \varphi z_t + \gamma(|z_t| - E|z_t|)$, where the parameters $\omega, \beta_i \text{ and } \alpha_i$ are not restricted to be non-negative.
- The process is strictly and covariance stationary if and only if $\sum_{j=1}^{p} \beta_j < 1$
- The components of g (z_t) are $\varphi z_t \text{ and } \gamma(|z_t| - E|z_t|)$, each with mean zero.
- g(z_t) allows for the conditional variance process (σ_t^2) to respond asymmetrically to rises and falls in stock price. Over the range $0 < z_t < \infty$, g(z_t) is linear in z_t with slope $\varphi + \gamma$, whereas over the range $-\infty < z_t \leq 0$, g(z_t) is linear in z_t with slope $\varphi - \gamma$,
- The term $\gamma(|z_t| - E|z_t|)$ represents a magnitude effect. If $\gamma > 0 \text{ and } \varphi = 0$, the innovation in $\ln(\sigma_{t+1}^2)$ is positive (negative) when the magnitude of z_t is larger (smaller) than its expected value. If $\gamma = 0$ and $\varphi < 0$, the innovation in conditional variance is now positive (negative) when returns on innovations are negative (positive).

$E|z_t| = \sqrt{2/\pi}$ given that $z_t \sim NID(0,1)$.

(2) For z_t distributed as a standardized Student t distribution with v degree of freedom, we have

$$E|z_t| = \frac{2\sqrt{v-2}\Gamma(\frac{v+1}{2})}{(v-1)\Gamma(\frac{v}{2})\sqrt{\pi}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.6)$$

(3) For a generalized error distribution (GED) with fat-tiredness parameter v, analyzed by Nelson [19], we have

$$E|z_t| = \lambda 2^{\frac{1}{v}} \Gamma\left(\frac{2}{v}\right) \Gamma\left(\frac{1}{v}\right), \text{ where } \lambda = \left[2^{-\frac{2}{v}}\Gamma(\frac{1}{v})\Gamma(\frac{3}{v})\right]^{1/2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.7)$$

In order to simply state the stationarity conditions, we write the EGARCH (p, q) model as:

$$\left(1 - \sum_{i=1}^{p} \beta_i L^i\right) \ln(\sigma_t^2) = \omega + \sum_{i=1}^{q} \alpha_i L^i g(z_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.8)$$

Graphical Representation of the Trend of the Core Variables
Here, we present the trend of Foreign Direct Investment (FDI), Real Effective Exchange Rate and Inflation Rate graphically.
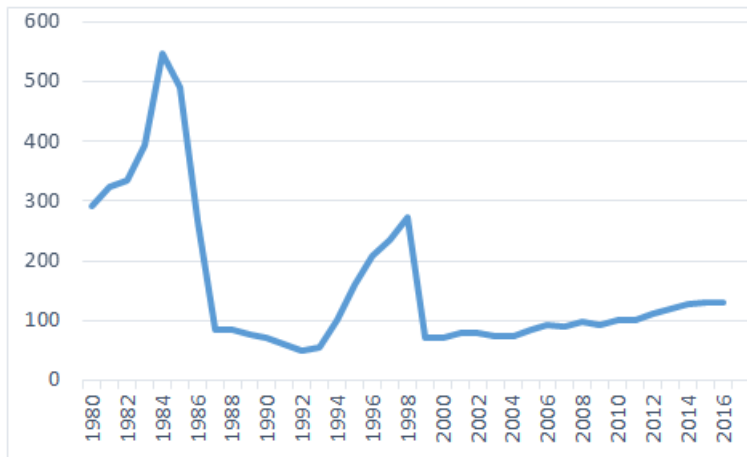
Fig-1: Real Effective Exchange Rate (REER) in Nigeria from 1980-2016
Source: Researcher's Computation with Data from CBN Bulletin, 2016
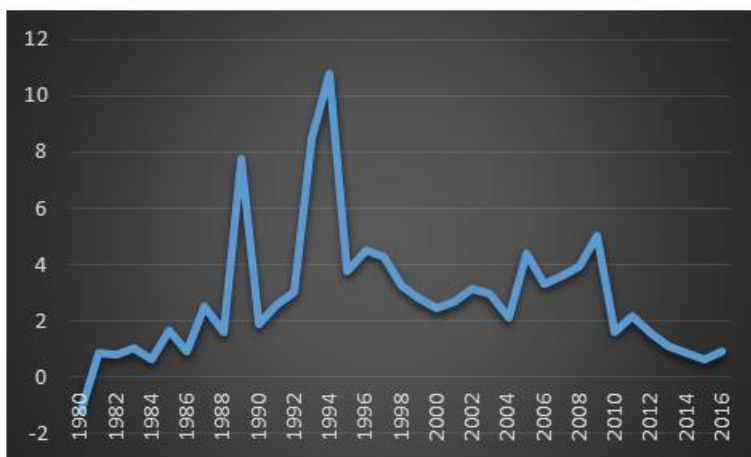

Fig-2: FDI (as a percentage of GDP) in Nigeria from 1980-2016
Source: Researcher's Computation with Data from WDI 2016

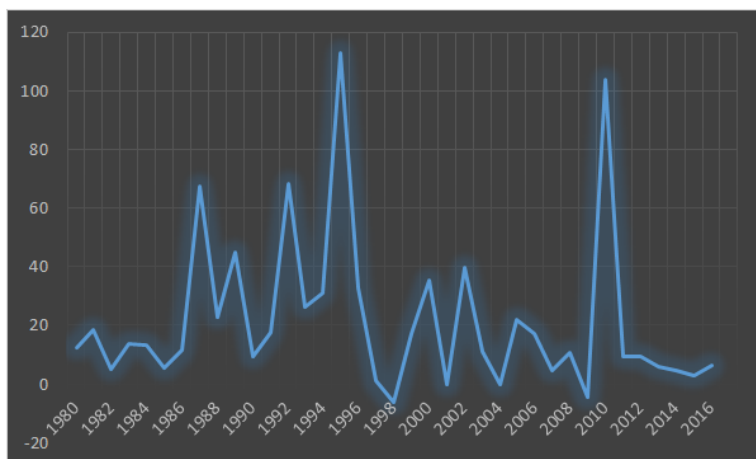**Fig-3: Inflation Rate from 1980-2016**
Source: Researcher's Computation with Data from CBN Statistical Bulletin, 2016

Other Control Variables
Exports by FDI Sectors
        This is the annual value of exports by foreign affiliates in Nigeria from 1980 to 2016. The data is collected from the World Bank Development Index for Nigeria. This variable represents the ability of the foreign investors to export.

Inflation Rate

This the rate of growth of the prices of goods and services over time. It is an annual data collected from the data bank of Index Mundi, a research organization. Its scope is 1980-2016.

Real Interest Rate

This is the annual interbank rate in Nigeria from 1980 to 2016. The data is collected from the Central Bank of Nigeria (CBN) Statistical Bulletin

GDP growth Rate

This measures the annual GDP growth in Nigeria in percentage from 1980 to 2016. The data is collected from the World Bank Development Indicator (WDI

METHODOLOGY AND ANALYSIS
Introduction to Analysis

As was mentioned in the previous section, some models estimated in this study will help us to capture our objectives. Thus, the major techniques adopted in this work which their results will be analyzed in this section are:

- The Ordinary Least Square Estimation Technique, used to ascertain the relationship between FDI and Real Effective Exchange Rate.
- The Error Correction Mechanism, used to ascertain the short-run dynamics of FDI and exchange rate.
- The Exponential GARCH model, used to study the leverage effect or the effect of news on exchange rate fluctuations or volatilities.

However, it is pertinent to say here that we will equally make comments on the level of correlation between variables with the use of the correlation matrix.

Correlation Matrix

Here, we have, in a matrix, the level of correlation between the variables employed in the study: endogenous and exogenous variables alike. This is shown in table 4.1 below:

Table-4.1: Correlation Matrix

	FDI	REER	EXPORTS	GDPGR	INFR	RIR
FDI	1.000000					
REER	-0.382444	1.000000				
EXPORTS	-0.155835	-0.454683	1.000000			
GDPGR	0.046318	-0.337552	0.591505	1.000000		
INFR	0.186497	-0.209353	-0.117392	-0.217009	1.000000	
RIR	-0.090818	0.033263	0.249890	0.364645	-0.940119	1.000000

Source: Researcher

From our correlation table above, we have the strength of the relationship between the different variables. However, of interest to us is the correlation between Real Interest Rate (RIR) and Inflation Rate. The result shows a very strong and negative correlation between them. However, since it is not a threat to our estimation as multicollinearity is not approached as to whether it exists (for it must surely exist) but to what degree it does exist, we will toe the line of Olivier Blanchard [20] and hence, we will "do nothing".

Test for Stationarity of Variables

Since we are carrying out an OLS estimation in this study, this is one of the most important pre-estimation diagnostic tests. With this, our aim is to ascertain if the variables under consideration are stationary at level form. In other words, such stationary variables could be said to be integrated of order zero (0), i.e., I(0). If the variable(s) are not stationary at level form, it means they could be integrated of any other order but not order zero. Let us now see a table that shows if our variables are stationary or not.

Table-4.2: Test for Unit Root or Stationarity

Variable	Order of Integration	Level of Significance
FDI	I(0)	5%
REER	I(1)	5%
EXP	I(1)	5%
RIR	1(0)	5%
INFR	I(0)	5%
GDPGR	I(0)	5%

Source: Researcher

Note that the technique employed for the aforementioned test is the Augmented Dickey-Fuller (ADF) test for Unit. It is obvious to see from the table that all our variables are integrated of order zero, we will still go ahead to check if the variables are cointegrated in the long-run. This leads us to the Johansen test for cointegration.

Johansen Test for Cointegration

The level of long-run association between the variables of interest is shown in the table below, adopting the Johansen Cointegrstion approach.

Table-4.3: Johansen Cointegration Test

Hypothesized No of Cointegrating Equations (CEs) (Null Hypotheses)	Probability	Conclusion
None	0.0001	There is cointegration
*At most 1	0.0912	At least 1 CE exists.
At most 2	0.0169	At least 2 CEs exist
At most 3	0.0433	At least 3 CEs exist
At most 4	0.2114	At most 4 CEs exist
At most 5	0.1988	At most 5 CEs exist
At most 6	0.0521	At most 6 CEs exist

Source: Researcher

The table above reveals that even though some of our variables are non-stationary at level form, there is some form of long-run association between variables. This cointegration could be between just one variable and another but would certainly not exceed 6 variables, given that it is the number of variables included in the study. Therefore, since we have established that the variables are cointegrated, we can now go ahead to present the main OLS regression result to ascertain the relationship between Real Effective Exchange Rate (REER) and FDI, with other variables as control.

Table-4.4: Regression Result

Variable	Coefficient	t-stat	Prob.
REER	-0.008956	-2.5748	0.015
EXP	-1.32E-09	-2.5759	0.015
RIR	0.070744	0.9335	0.358
INFR	0.044717	0.9878	0.331
GDPGR	0.035487	0.5745	0.570
C	4.930722	3.2449	0.003

R-Squared=0.32
Adjusted R-Squared=0.21
S.E of Regression=2.07
Sum of Squared Residuals=132.78
Log Likelihood=-76.14
F-Statistic=2.92
Prob(F-Statistic)=0.03
Durbin-Watson=1.67

Source: Researcher

The coefficients of variables obtained above could be fixed into the regression equation specified in the previous section thus:

$$FDI_t = 4.93 - 0.009REER_t + \beta_2 EXP_t + 0.0707RIR_t + 0.045INFR_t + 0.035GDP_t + U_t \ldots\ldots \ (3.3)$$

It is equally very important to point out that from our table, the individually significant variables are: our intercept term, our core and most important variable, REER and of course, exports. Worthy of mention also is the fact that the Coefficient of Determination, R^2, shows that the exogenous variables are only able to explain about 32% of the variations in FDI. Even though this may be adjudged not good enough but the truth remains that, as Fonta [15] put it, it is very close to the realities of time series research, especially as it has to do with Nigeria. The F-Statistic also shows that the exogenous variables are jointly significant as regards changes in FDI.

Error Correction Model

Here, we will ascertain whether any of the exogenous variables has a short-run relationship with FDI as well as the percentage of discrepancy between exchange rate in the long-run and exchange rate in the short-run that could be corrected in one year.

Table-4.5: The Error Correction Model

Variable	Coefficient	t-stat	Prob.
D(REER)	-0.001	-0.16	0.88
D(EXP)	-6.45E-10	-0.85	0.40
D(RIR)	-0.111	-1.75	0.09
D(INFR)	-0.082	-2.14	0.04
D(GDPGR)	-0.025	-0.48	0.64
U(-1)	-0.282	-2.36	0.18
C	-0.162	0.42	0.68
R-Squared=0.25			
Adjusted R-Squared=0.09			
S.E of Regression=2.24			
Sum of Squared Residuals=1140.07			
Log Likelihood=-73.92			
F-Statistic=1.55			
Prob(F-Statistic)=0.20			
Durbin-Watson=2.54			

Source: Researcher

From the table above, we have that only the inflation rate has a short-run relationship with the FDI. Furthermore, with the coefficient of the lagged "U", we say that about 28% of the discrepancies between REER in the short-run and long-run could be explained in one year.

The Exponential GARCH model

Our interest here is to ascertain the leverage effect on Nigeria's Real Effective Exchange Rate. In other words, we are investigating the contributions of positive shock (news) or negative news (shock) on exchange rate volatilities. However, our choice of model will be justified on two grounds:
- Analysis of the trend of the residual distribution of the real effective exchange rate in Nigeria
- Check to know if there is ARCH effect in the residual of REER.

Residual Distribution of REER in Nigeria

The graph below reveals the trend of the residuals of real effective exchange rate in Nigeria from 1980 to 2016.
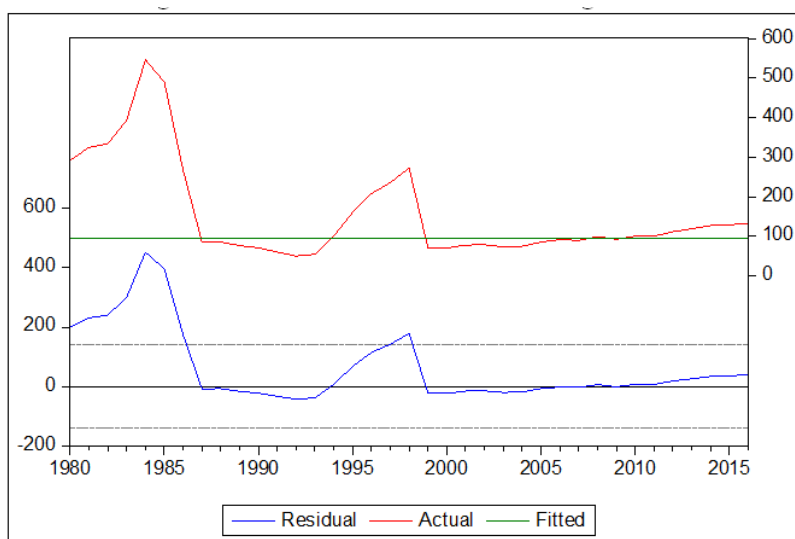

Fig-4: Residual Distribution of REER in Nigeria from 1980-2016
Source: Researcher's Computation

The residuals presented in the graph above reveal that from 1980-1984, period of high volatilities has been followed by another period of high volatilities. Furthermore, from 1985 to about 1994, period of low volatility has been followed by another period of low (small) volatility. Again, from 1995 to 1999, we also see that period of high volatility has been followed by period of high volatility. Finally, from 2000 to 2016, there has been, continually, a low volatility on the residual distribution of real effective exchange rate. Thus, because of the occurrences explained above, we have the justification to carry out our study using the EGARCH model of the GARCH family.

Test for ARCH Effect on the Residual

In order to further establish the correctness of the EGARCH model, we will test for the presence or absence of the ARCH effect on the residuals of the analyzed variable, REER:

Table-4.5: Test for ARCH Effect

OBSERVED R^2	PROB(CHI-SQUARE)	DECISION
16.37204	0.0001	We Reject H_0 and hence, conclude that there is ARCH effect in the residuals

Source: Researcher

The null hypothesis for the test above is that there is no ARCH effect in the residuals. However, since the probability is less than 0.05 (i.e. Prob<0.05), we reject the null hypothesis and therefore, conclude that there is ARCH effect, which necessitates the use of the EGARCH model.

We will now go ahead to present the values of interest in the actual EGARCH model. Note that the EGARCH model result has two components: the first part, called the mean equation, and the second part, called the variance equation.

Table-4.6: The Mean Equation of the EGARCH model

Variable	Coefficient	z-statistic	Prob.
C	93.3830	23.768	0.0000

Source: Researcher

The table above shows that keeping every other variable and factor constant, the mean value of the real effective exchange rate is #93.4. Note that the standard world currency which is the US Dollar has been the point of reference throughout this study. The residual obtained from the mean equation is now used to get the variance equation below.

Table-4.7: The Variance Equation of the EGARCH model

Variable	Coefficient	z-statistic	Prob.
C(2)	0.0123	0.0073	0.9942
C(3)	0.8381	1.4558	0.1455
C(4)	0.0650	0.0803	0.9360
C(5)	0.7874	4.4751	0.0000

Source: Researcher's computation

The actual equation for the table above, which forms the main exponential GARCH equation is given as follows from the analysis:

$$LOG(GARCH) = C(2) + C(3)*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(4)*RESID(-1)/@SQRT(GARCH(-1)) + C(5)*LOG(GARCH(-1))........(4.1)$$

Since it is our interest to identify the leverage effect on the real effective exchange rate (REER), we give a working definition of the leverage effect here. From table 4.7 above, leverage could be found when the coefficient C (4) is negative and significant. However, from our model, C(4) is positive and not significant, thus, signaling that there is no leverage effect in our model. This further means, economically, that there is no negative correlation between past values of REER and future exchange rate (REER) volatilities. The dependent variable, Log (GARCH) in equation 4.1 above is the actual exchange rate volatility or conditional variance. To further explain the analysis, we say that when exchange rate goes down at current time, it does not lead to increase in the future volatilities of exchange rate. Thus, we can also say that Nigeria's REER does not face a very high risk of volatility. With this, we can now conclude by saying that negative shock (news) has less effect on the conditional variance of exchange rate volatilities compared with positive shock or news.

Policy Recommendations, Summary and Conclusion
SUMMARY AND CONCLUSION

This study examined the impact of the Nigeria's exchange rate level on Foreign Direct Investment Inflows in Nigeria. The study further analyzed the leverage effect on exchange rate volatilities or the contributions of positive or negative shocks in the economy on the both current and future fluctuations in exchange rate. The short-run dynamics of exchange rate and FDI was further analyzed. The study also used OLS estimation method to investigate the first objective mentioned above, employed the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) model to study the second objective and also used the Error Correction Mechanism to check for the third objective. However, as earlier stated, there have been a lot of controversies in economic research on the impact of exchange rate on FDI. At one extreme end are those who argue that exchange rate has a positive impact. At the other extreme are those who dispute that and thus, say otherwise. Empirical results on this issue, however have reached no unanimity and hence, have not helped in resolving the dichotomy. This study involved time series annual data spanning from 1980 to 2016. The study found that in the long-run, the real exchange rate has a significant impact on FDI inflows, but in the short-run, the impact is not significant. The study further revealed that negative shock (news) has less effect on the conditional variance or exchange rate volatilities compared with positive shock or news in Nigeria.

POLICY RECOMMENDATION

No matter how an average economist sees it, the truth remains exchange rate plays a very important role in an economy's investment power, especially Nigeria's nascent economy. Thus, to help Nigeria make rational economic policies in consideration of exchange rate levels, exchange rate volatilities and FDI, the following policy recommendations are worth emphasizing:

Because of the significant impact exchange rate, the Central Bank should always be careful enough to ensure that financial and foreign exchange policies do not inadvertently shoot the country's exchange rate, thus, endangering possible Foreign Direct Investments. Also, the country's level of exports from FDI-financed sectors plays a significant role in the inflows of FDI, effort should be made by the government to ensure that such funds and other forms of FDI are judiciously utilized, as failure to do this will still bounce back on the economy negatively.

Secondly, since inflation rate plays a significant role in determining the inflows of FDI into Nigeria in the long-run, the financial institutions headed by the central bank should instill thorough regulation of this macroeconomic variable to avoid possible and potential economic mishaps.

Lastly the Nigerian government should make sure that exchange rate volatility is seriously checked and that news in the economy are also monitored to avoid spilling over to the exchange rate leading to its volatility, which will further reduce FDI inflows, which will still lead to a reduction in economic activities, which further trickles down to low GDP.

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