Impact of Exchange Rate Movements on Foreign Portfolio Investment in Nigeria

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Abstract
This study investigates the dynamics between exchange rate volatility and foreign portfolio investment in Nigeria. This study is germane mostly now that exchange rate fluctuation is assumed to have affected all facets of economic activities in Nigeria. To achieve this, monthly data are obtained from Central Bank of Nigeria Statistical Bulletin, 2022, and analyzed by employing EGARCH and other finametric tools. The empirical results of the analysis found a significant relationship between exchange rate movements and foreign direct investment in Nigeria within the scope of the study. It was also found that shocks from exchange rate to stock prices are durable, implying that shocks from exchange rate to foreign portfolio investment last a long period before their effects fade. Therefore, the researchers recommend among others that sound foreign exchange rate management policies are designed and implemented vigorously to curb exchange rate volatility.

Keywords: *Exchange Rate, FDI, Stock prices, EGARCH*

1.1 Introduction

There are two major types of international private capital flows – Foreign Direct Investment (FDI), and Foreign Portfolio Investment (FPI). A third which has become important in recent years is remittances (World Bank, 2020; 2019). In driving accelerated economic growth and development in any economy, there is the need for adequate financing. The existence of a savings-investment gap, particularly in Nigeria as well as other developing countries, emphasizes the need for funding for growth (Adom & Elbahnasawy, 2014). The neoclassical theory of growth posits that capital is expected to flow from developed countries to developing countries. Foreign capital flows from one country to another in order to enhance the economic productiveness and development of the recipient country (Lucas, 1990). Foreign portfolio investment has become a popular concept in significant parts of the world economy over the past years and a crucial source of funding to support development and growth in developed and developing countries alike (Michael, 2014).

There are various determinants of foreign portfolio investment that vary according to the geographical location as well as the structure of any economy. The push and pull factors theory discusses the determinants of international flows to be categorized into those factors that push international flows from the giving economy and those other factors that pull (attract) flows into the receiving economy. Exchange rate is a very important macroeconomic variable to both

advanced and developing countries and hence plays a significant role in affecting general economic activity. It is the price of one country's currency in terms of another (Danladi & Uba, 2015).

Various scholars have studied the determinants of international capital flows in different countries, including Nigeria (see Taylor & Sarno, 1997; C¸ulha, 2006; Glauco & Kyaw, 2008a; Glauco & Kyaw, 2008b; Ogbulu & Paul, 2009; Isu, Ogbulu & Paul, 2009; Brana & Lahet, 2010; Forster,¨ Jorra, & Tillmann, 2012; Byrne & Fiess, 2015; Bogdan 2016; Grzegorz, Brzozowski & Sliwinski,´ 2017; Maghori, 2014; Obida & Abu, 2010; Ibrahim & Omoniyi, 2011; Essien & Onwioduokit, 1999; Okereke & Ebulison, 2016; Nwosa & Adeleke, 2017; Enisan, 2017; Nwokoye & Oniore 2017; Leonard, 2018). However, the causes of capital reversals in emerging economies, especially the role of exchange rate movements, are hardly examined, making it difficult to distinguish between policy actions that reverse or perpetuate outflows and policy actions that sustain or perpetuate inflows. More so, except for Leonard (2018) previous studies either aggregate net capital flows without considerations for the components or focused on one component only, mostly FDI. Except for Enisan (2017), previous studies for Nigeria did not account for capital outflow.

1.2 Statement of the Problem

There is a lack of consistent empirical finding on the nexus between exchange rate movement and foreign portfolio investment in Nigeria, as the lingering question on the practical linkage between the two variables remains somewhat unanswered. This, therefore, necessitates the need for further research using more recent data. Most studies conclude that the real factors that may affect FPIs into the country are external hence preventing the government from adopting policies that directly connect exchange rate movement and the inflow of portfolio investment into the country.

This study distinguishes itself in two ways; first, it assesses the impact of exchange rate movement on the overall level of portfolio inflows to Nigeria while also identifying the specific nature of the relationship between the variables. Secondly, it builds on previous studies and endeavors to fill the gap in the literature on the nexus between exchange rate movement and foreign portfolio investments by narrowing the research to portfolio investment only and not foreign private investments (as a whole) in the country.

This study is significant in that most of the studies done majorly focused on the real component of foreign private investment, that is, FDI. Little or no attention is given to foreign portfolio investment to Nigeria, perhaps because foreign portfolio flows are a more recent development in the country's financial account. The findings of this study are also expected to provide useful information to policy makers in designing exchange rate policy and as tool for predicting and forecasting the level of foreign portfolio investment in the economy as well as its effects in order to ensure stability in the economy.

The following hypotheses will guide in the analysis of this study:

H_{O1}: There is no significant effect of exchange rate on Foreign Portfolio Investments (FPI) in Nigeria.

H_{O2}: Foreign Portfolio Investments do not respond significantly to the persistence level of exchange rate shocks in Nigeria.
H_{O3}: There is no significant effect of exchange rate volatility on FPI in Nigeria.
H_{O4}: There is no significant asymmetric leverage effect of exchange rate on FPI in Nigeria.

The remaining sections of this study are organized as follows; section two takes care of review of related literature; section three addresses the materials and methods of analysis adopted; section four analyses the data, results, and interpretation while section five handles conclusion and recommendations for policy making.

2. Review of Related Literature

2.1 Conceptual Framework

2.1.1 Exchange Rate: Definition and Measurements

Exchange rate is the price at which one currency is exchanged for another. It is the price of one currency in terms of another. It can also be defined as the rate at which one currency can be converted into another (Chamberlin and Yueh, 2006; Mishkin, 2004). However, according to Chamberlin and Yueh (2006), exchange rate can be interpreted through different perspectives. The two most common means of describing exchange rate are nominal exchange rate and real exchange rate.

(a) Nominal Exchange Rate:

Nominal exchange rate is an economic value expressed in monetary terms. It is expressed in terms of units of a country's currency. It is not determined by the change in worth of the goods and services that currency can purchase. It is 'nominal' because it measures only the numerical exchange value and is not affected by the purchasing power of that currency. Thus, changes in nominal value of a currency overtime happen due to a movement in the worth of the currency. According to Chamberlin and Yueh (2006), nominal exchange rate is expressed as a ratio of one currency to another showing how much one currency can be converted for a unit of another. One must be careful as to which way up this ratio is defined.

This work shall follow the definitions of nominal exchange rate by Mishkin (2004), Chamberlin and Yueh (2006), and in line with Penn World Table (PWT 9.0) which defined nominal exchange rate of a country as the ratio of national currency to foreign currency. This can be expressed as $NER_i = \frac{NCU_i}{FCU}$ where NCU_i = national currency of country i, FCU = foreign currency and NERi = nominal exchange rate of country i.
A rise in this term is called nominal depreciation of the currency while a fall is called nominal appreciation. In a fixed exchange rate policy, a reduction of this rate is called revaluation whereas an increase of the rate is called devaluation.

(b) Real Exchange Rate:

According to Bhalla (2008), there are two closely related definitions of real exchange rate. They are the primary definition which can also be called the external sector definition and the secondary definition which is called internal sector. The external sector is the ratio of the

wholesale price levels between two countries. The most commonly used ratio of wholesale price levels is the 'Penn World Data'. These data use the periodic International Comparison of Price (ICP) surveys of different countries to compare an intertemporal price level for individual countries. The ratio of price levels is presented in a common purchasing power parity (PPP) currency with respect to a trading partner's (for example the US) price level defined to be 100 in each year. This ratio is identically equal to the ratio of the exchange rates between each country (i) and the trading partner (example the US): it is the ratio of the current PPP exchange rate. This can be expressed as:

RER = ratio of country price level = $\frac{P_i}{P_{US}}$

or RER = ratio of exchange rate = $\frac{e_i}{e_{US}}$ where e_i is the exchange rate with respect to PPP dollar and e_{US} is the exchange rate with respect to US dollar.

The secondary definition is the ratio of prices of non-tradable goods to tradable goods. This is expressed as RER = $\frac{P_N}{P_T}$ where P_N is the price of non-tradable goods and P_T is the price of tradable goods.

According to Chamberlin and Yueh (2006), real exchange rate compares the price of foreign goods and services to domestic goods and services. It is the product of nominal exchange rate and the ratio of prices. This can be expressed as RER = NER* $\left[\frac{P^*}{P}\right]$ where NER is nominal exchange rate, P* is the foreign price of goods and services and P is the domestic goods and services.

This study therefore adopts the measure of nominal exchange rate by Mishkin (2004), Chamberlin and Yueh (2006), and in line with Central Bank of Nigeria (CBN) Statistical Bulletin (2021) for its analysis and also because data on nominal exchange rate is readily available in CBN and is the most widely used in Nigeria.

2.1.1 Foreign portfolio investment (FPI)

Baghebo and Apere, (2014) defined Foreign Portfolio Investment (FPI) to include investments by a resident entity in one country in the equity and debt securities of an enterprise, resident in another country which seek primarily capital gains and do not necessarily reflect a significant and lasting interest in the enterprise. The category includes investments in government bonds, notes, money market instruments and financial derivatives other than those included under direct investment or in other words, investments which are both below the 10 percent rule and do not involve affiliated enterprises.

In addition to securities issued by enterprises, foreigners can also purchase sovereign bonds issued by government. According to IMF (1996) Coordinated Portfolio Investment Survey Guide, the essential characteristics of instruments classified as Portfolio investment is that they are traded or tradable and fundamentally made of up of:

i) Equity securities: These have been defined in the Survey as instruments and records acknowledging after the claims of all creditors have been met claims to the residual values of incorporated enterprises (shares, stocks, mutual funds, and investment trusts.

ii) Debt securities: They include bonds and notes, money market securities (instruments such as treasury bills, commercial and finance paper, negotiable certificates of deposits with maturities of one year or less), and financial derivatives or secondary instrument, such as options.

2.2 Theoretical Review

This section focuses on the review of theories related to factors that influence capital flows into a given country.

2.2.1 Portfolio Theory (PT)

Developed by Michael B. Devereux and Makoto Saito in 2006, it presented a tractable model of international capital flows in which the existence of nominal bonds and the portfolio composition of net foreign assets is an essential element in facilitating capital flows between countries. National monetary policies make domestic and foreign currency denominated bonds differ in the degree to which they can hedge country specific consumption risk. This leads countries to have distinct composition of currency-denominated bonds in their national portfolios. By adjusting their gross positions in each currency's bonds, countries can achieve an optimally hedged change in their net foreign assets (or their current account), thus facilitating international capital flows. Moreover, the risk characteristics of optimal portfolios ensure that current account movements are sustainable - net debtor countries pay lower rates of return on their gross liabilities than they receive on their gross assets. This ensures that the distribution of wealth across countries is stationary.

2.2.1 The Flexible Accelerator Theory

This approach is sometimes referred to as the Capital Stock Adjustment model. Chenery, Goodwin, Koyck, and Junankar all contributed to the flexible accelerator theory, although Koyck's approach in his 1954 paper "Distributed Lags and Investment" is the most widely recognised. One of the fundamental flaws of the simple accelerator principle is that the capital stock is optimally changed without any time lag. This is addressed by the flexible accelerator hypothesis. There are lags in the adjustment process between the level of output and the level of capital stock in the flexible accelerator. It states that the wider the gap between existing and targeted capital stock, the higher a company's rate of investment. Firms plan to narrow a portion of the difference between the desired capital stock, K*, and the actual capital stock, K in each period, according to the theory. This results in a net investment equation that looks like this:

$I = K^* - 1 = \Delta k$

So

$I = \Delta K = k\Delta Y_t$

Where I denotes net investment, k denotes a change in capital stock, and Yt denotes a change in current production level, and k denotes the capital-output ratio.

2.3 Empirical Review

Onuorah and Akinjobi (2013) examined the impact which macroeconomic variables on FPI in Nigeria for the years 1980–2010 in order to examine the impact of macroeconomic variables and tended to also investigate long-run and short-run macroeconomic variables influencing Foreign Portfolio using the OLS model of estimation. It was shown that foreign investment in the country is driven primary by the size of the country's interest and exchange rates. It was also shown from the results that interest rate, inflation and exchange rates directly impact FPI, while GDP and money supply negatively affect the FPI in the country. In order to examine the direction of causality between FDI, FPI and exchange rate using Granger causality, it was revealed that there was no causal link between the two phenomena. Also, based on the Error Correction Model, the short-run regression estimate indicated no impact of exchange rate on capital flows in Nigeria for the period 1986–2011.

Nwosa and Amassona (2014) carried out a study on capital inflows and exchange rate in Nigeria which covered 1986 to 2011 with the use of both granger causality and error correction modeling techniques. The study found that foreign portfolio inflows had little positive impact on exchange rate.

Idowu (2015) in her study on foreign portfolio investment determinants in Nigeria with the use of time series data between 1970-2010 using the Granger causality test, Johansen co-integration and the error correction mechanism estimation test concluded that change in real exchange rate had no effect on the inflow of foreign portfolio investment in this period.

Using EGARCH, Marcin, Robort and Krzystof (2013) examined foreign direct investment and foreign portfolio investment in the contemporary globalized world and concluded that exchange rate and its volatility have no significant effect on foreign portfolio investment.

Omororunwa and Ikponnwosa (2014) researched on exchange rate volatility and foreign portfolio investment in Nigeria between 1980-2011.They employed Augmented Dickey-Fuller (ADF) test for stationarity, Engle and Granger two-step cointegration procedure and error correction model (ECM). The study found that exchange rate volatility has a very weak effect on FPI in the short run and a strong positive effect on the long run analysis.

Ololade and Ekperiware (2015) researched on foreign portfolio investment and Nigeria bond market with the use of primary data and multiple regression analysis. They found out that exchange rate was statistically significant and positively related to foreign portfolio investment in Nigeria.

Guglielmo, Faek, and Nicola (2013) examined the impact of exchange rate uncertainty on different components of portfolio flows. They studied Australia, Japan, Uk, Canada and Sweden over a period of 1988 to 2011.They employed GARCH-BEKK model and observed negative relationship in some countries and positive relationship between exchange rate volatility and portfolio investment.

3.Materials and Methods

This section deals with explanation of the various processes involved in obtaining, analyzing and interpreting data to yield information appropriate for valid conclusions for this research

paper and policy recommendations. In this section, we examine the source of data, method of data analysis and model specification.

3.1 Sources of Data.

In carrying out this study, we made use of time series secondary data. The secondary data were obtained from Central Bank of Nigeria Statistical Bulletin (2021). The study used monthly data which covered the period 1990-January to 2021-December.

3.2 Analytical Framework of the Model

The autoregressive restrictive heteroskedastic (Curve) model previously presented and utilized by Engle (1982) and speculation Curve presented by Bollerslev (1986) are models famously utilize to quantify unpredictability. In any case, these models have principal disadvantage which incorporates (I) their failure to catch the awry reaction of unpredictability to news or data. (ii) they expect that there is a negative relationship or connection amongst present and future unpredictability; (iii) it puts limitations on the boundary that are many times disregarded by assessed coefficients which may unduly ruin or confine the elements of the contingent change process; at long last (iv) it is difficult to decipher regardless of whether shocks to restrictive difference endure in the GARCH. This is on the grounds that the standard estimating tirelessness frequently disagree.

To defeat these difficulties of the Curve and GARCH models, EGARCH model is utilized. EGARCH model was first proposed by Nelson in 1991 to catch skewness and lopsidedness.

3.3 Model Specification

EGARCH model is therefore stated as follows:

Model

$$FPI_t = \alpha_0 + \alpha_1 EXR_t + \alpha_2 INR_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

$$\log\left(\sigma_t^2\right) = \psi_1 + \sum_{j-1}^{2} \gamma_j l\,\text{og}\left(\sigma_{t-j}^2\right) + \sum_{j-1}^{2} \phi_j \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} - E\frac{\left(\varepsilon_{t-1}\right)}{\sigma_{t-1}} \right| + \sum_{j=i}^{n} \partial \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \ldots\ldots.(2)$$

Where equation 1 is the mean equation. FPI is foreign portfolio investment, EXR represents the exchange rate, INR is the interest rate which serves as a control variable, αi where i = 1 and 2 are the parameters to be estimated. The persistence of volatility implied by equations 2 is measured by γ. If volatility persists over a long time, γ will be large and significant. The leverage effect is modeled by the parameter ∂_j. Finally, ϕ_j measures the size effect of an innovation in the system.

3.4 Unit Root Test

To fully explore the data generating process, we first examined the time series properties of the variables of the model with the use of the Augmented Dickey- Fuller (ADF) unit root rest. The ADF equation is stated below:

The ADF test regression equations with constant are:

$$\Delta FPI_t = \alpha_0 + \alpha_1 FPI_{t-1} + \sum_{j=1}^{k} \alpha_j \Delta FPI_{t-1} + \mu_t \text{.....(3)}$$

$$\Delta EXR_t = \alpha_0 + \alpha_1 EXR_{t-1} + \sum_{j=1}^{k} \alpha_j \Delta EXR_{t-1} + \mu_t \text{.....(4)}$$

$$\Delta INR_t = \alpha_0 + \alpha_1 INR_{t-1} + \sum_{j=1}^{k} \alpha_j \Delta INR_{t-1} + \mu_t \text{.....(5)}$$

where Δ is the first difference operator, μ_t is random error term that is independently identically distributed, k = no of the variable. The unit root test is then carried out under the null hypothesis α = 0 against the alternative hypothesis of α < 0.

$$ADF_t = \frac{\hat{\alpha}}{SE(\alpha)} \text{.....(6)}$$

Once a value for the test statistics is computed we shall compare it with the relevant critical value for the Augmented Dickey-Fuller Test. If the test statistic is greater (in absolute value) than the critical value at 5% or 1% level of significance, then the null hypothesis of α = 0 is rejected and no unit root is present. If the variables are non-stationary at level form and integrated of the same order, this implies evidence of co- integration in the model

3.5 Co Integrated Equation

We employed Johanson (1988) co-integration procedure to determine the number of co-integrating vectors in the model. We adopted this approach because it does not suffer normalization problem and it is robust to departure from normality (Gujarati, 2003). The procedure requires all series in the model to exhibit same order of integration. The cointegration equation is stated thus:

$$Y_t = A_1 Y_{t-1} + ... + A_p Y_{t-p} + BX_t + \varepsilon_t \text{.....(7)}$$

Where Y t is a vector of non-stationary *I*(1) variables; X_t is a vector of deterministic variables and t and ε_t is a vector of innovations. We may rewrite this as in VAR form as:

$$\Delta Y_t = \psi Y_{t-1} + \sum_{i=1}^{p-1} \delta_i Y_{t-p} A_p Y_{t-p} + BX_t + \varepsilon_t \text{.....(8)}$$

Where

$$\psi = \sum_{i=1}^{p} A_{t-1,} \quad \delta_i = -\sum_{j=i+1}^{p-1} A_p + BX_t + \varepsilon_t \text{ .....(9)}$$

If the coefficient matrix ψ has reduced rank r < k, then there exist k < r, matrices α and β each with rank r such that ψ = αβ and βYt is I(0) (Granger 1987). r is the number of co-integrating relation (the co-integrating rank) and each column of β is the co- integrating vector. Johansen's method is to estimate the ψ matrix from unrestricted VAR and to test whether the rejection implies by the reduced rank ψ

4. Data Analysis and Interpretation of Results

4.1 Descriptive Statistics

The descriptive statistics of the series was carried out to examine the behavioural pattern of the series.

Table 4.1: Summary of the Descriptive Statistics of the variables

	FPI	EXR	INR
Mean	7959334	12.0769	1.560797
Median	160927.2	10.67914	1.467522
Maximum	1.22008	32.33829	2.707550
Minimum	-7336787	0.645146	1.089098
Std. Dev.	22885365	9.826920	0.269737
Skewness	3.065476	0.845417	1.865390
Kurtosis	11.87648	2.628390	7.240123
Jarque-Bera	1862.088	4795219	5103579
Probability	0.000000	0.00000	0.00000
Sum	3.060009	4649.354	599.3462
Observation	384	384	384

Source: Authors' computation

From the table 4.1 above, there is evidence of significant variation in the trends over the period of consideration. This is shown by the large difference between the minimum and maximum values of the series. With respect to the statistical distribution of the series FPI, EXR and INR are positively skewed which entails a positive asymmetry of the distribution of the series around the Kurtosis that measures the peakedness or flatness of the distribution of the series. If the kurtosis is above 3, the distribution is peaked or leptokurtic relative to normal, but if the kurtosis is less than 3, the distribution is flat or platykurtic relative to normal. From table 4.1 above, the values for FPI and INR are greater than 3, therefore it is peaked or leptokurtic. The value for EXR is less than 3 which entails that the series is flat or platykurtic.

Jarque-Berra is a test statistic to test for normality in the distribution of the series. From the results, FPI, EXR and INR are not normally distributed since the p-values are less than 0.05.

4.2 Graphical Presentation of the Presence of Volatility in the series

We proceed to plot the series for visualization, as shown in the figure 1.

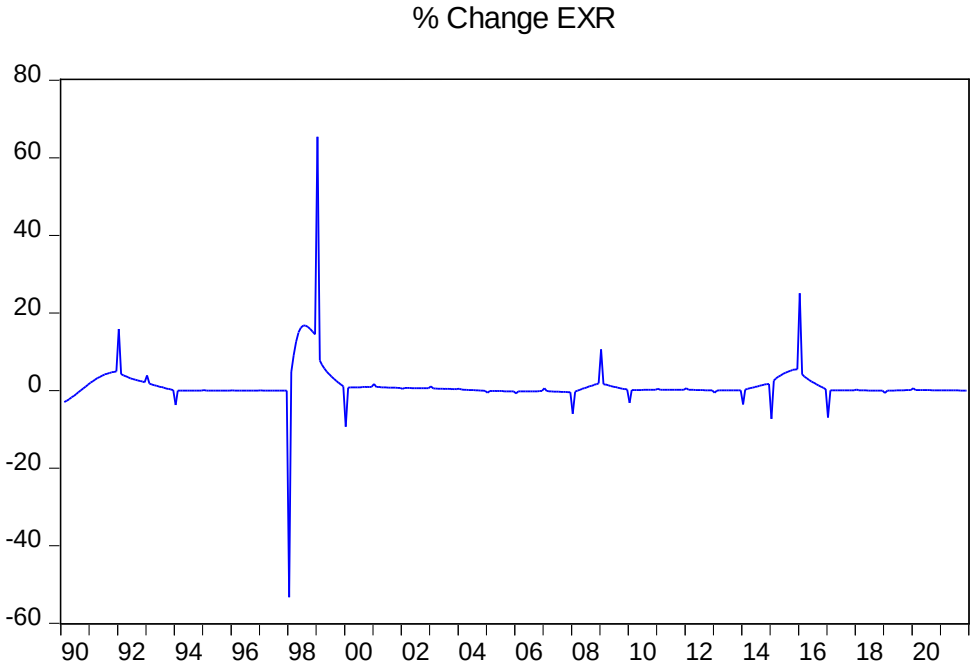

Fig. 1: Graphical Presentation of EXR Series

Figure 1 shows that volatility exists in the series and proof of volatility clustering in the series is one of the ARCH family models' quiet facts. We can see from the figure that the series exhibit mean reversion. Although the series exhibits significant volatility in its movement, it eventually returns to its mean. We may determine the presence of volatility in the model from the graph above where tiny (big) changes are followed by huge (small) changes. In addition, we evaluated for stationarity to establish the order of integration of the series.

4. 3 Unit Root Test

The ADF unit root test was conducted to ascertain whether the variables in the model are stationary. This is necessary as it helps to avoid spurious regression results. The summary of ADF results is detailed in the table below:

Table 4. 3: Summary of ADF test results at 1%, 5% and 10% critical value

Variables	Level	1st Diff.	1%	5%	I (d)	Remark
FPI	3.2727	-3.118*	-3.4478	-2.8691	I (1)	Stationary
EXR	-0.1610	-4.627*	-3.4478	-2.8691	I (1)	Stationary
INR	-2.7474	-9.020*	-3.4478	-2.8691	I (1)	Stationary

Authors' computation. *signifies stationary at 5%*

The results of table 4.1 show that all of the variables are non-stationary in level form because their ADF statistic in absolute values is less than the critical value of 5%. The null hypothesis of no unit root was accepted for all variables, but we rejected the null hypothesis after the first difference. As a result, the variables under examination became stationary after the first difference and are thus integrated of order one, (I(1)).

4.2 Co-integration Test Result

The integration of the variables in the same order is a necessary but not sufficient requirement for the co-integrating test (Granger, 1986). The Johansen co-integration test consists of two statistical tests: the trace test and the maximum Eigen-value test. The hypotheses of no co-integrating relation, one co-integrating relation, and so on are tested in the first row of table 4.4 against the alternative of complete rank of co-integration. The outcomes are shown in table 4.2 below.

Table 4.4: Co-integrating Test Result between NSEC and EXR

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.067701	36.47171	29.79707	0.0073
At most 1	0.025609	9.902980	15.49471	0.2883
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.067701	36.47171	29.79707	0.0073
At most 1	0.025609	9.902980	15.49471	0.2883

Authors' computation

The probability and maximal Eigen-value statistics in table 4.4 indicate evidence of a co-integrating equation at the 5% significance level. This suggests that the exchange rate (EXR) and foreign private investment (FPI) are co-integrated. These results suggest that the null hypothesis of no co-integration is rejected. As a result, the findings indicate that there is long-run link between the exchange rate (EXR) and foreign portfolio investment (FPI).

4.5 Estimation of the Presence of Volatility

The ARCH-GARCH (1,1) technique is used to test for the presence of volatility and its transmission effect in the exchange rate-foreign portfolio investment relationship. The first step in analyzing volatility is to determine whether the residuals in the exchange rate-foreign portfolio investment model have any ARCH influence (Ogbulu, 2018). The heteroskedasticity test results in a strong ARCH effect in our model, as shown in Table 4.5. That is, the variances of the residuals do not remain constant across periods, confirming the presence of strong volatility in the series. The ARCH-GARCH (1,1) technique is used to test for the presence of volatility and its transmission effect in the exchange rate- foreign portfolio investment relationship. The first step in analyzing volatility is to determine whether the residuals in the exchange rate- foreign portfolio investment model have any ARCH influence. The heteroskedasticity test results in a strong ARCH effect in our model, as shown in Table 4.5. That is, the variances of the residuals do not remain constant across periods, confirming the presence of strong volatility in the series.

Table 4.5: Heteroskedasticity Test: ARCH

Heteroskedasticity Test: ARCH			
F-statistic	0.019531	Prob. F(1,381)	0.0000
Obs*R-squared	0.019632	Prob. Chi-Square(1)	0.0000

Table 4.5 shows that the probability value of the F-statistic and Chi-square (1) are significantly less than 0.05, indicating that there is strong evidence of the ARCH impact. The homoscedasticity null hypothesis is rejected. This result validates the adoption of the EGARCH model for estimation; hence, we proceed to investigate the nature and extent of the volatility relationship between the variables using exponential generalized autoregressive conditional heteroscedasticity (EGARCH), as shown in table 4.6 below:

Table 4.6: EGARCH Test Result

Variables	Coefficient	Standard Error	z-Statistics	Probability
Panel A	Mean Equation			
Constant	-3495506.	4086148.	-0.855453	0.3923
LNEXR	362949.6	337882.3	1.074189	0.2827
INR	2831608	2360759.	1.199449	0.2304
Panel B	Variance Equation			
C(4)	26.18749**	0.882210	29.68395	0.0000
C(5)	0.212712**	0.086189	2.467974	0.0136
C(6)	0.735922**	0.081903	8.985323	0.0000
C(7)	0.161286**	0.025057	6.436670	0.0000
R^2 (Adj R^2)	0.897 (0.883)			
Panel C	Diagnostic Test			
J-B Test		7657.11**		

*Authors' computation. **and * signify stationary at 1% and 5% respective*

The EGARCH result in panel A reveals that the exchange rate has a positive and significant influence on foreign portfolio investment, meaning that depreciation of the exchange rate raises the foreign private investment. This result verifies Michael B. Devereux and Makoto Saito (2006)'s portfolio model, according to which tractable model of international capital flows in which the existence of nominal bonds and the portfolio composition of net foreign assets is an essential element in facilitating capital flows between countries. This conclusion backs up the findings of Onuorah and Akinjobi (2013) in Nigeria.

In the variance equation (panel B), the coefficient of C (5) is positive and significant. This suggests that shocks sent from exchange rate to foreign portfolio investment are durable, implying that shocks transmitted from exchange rate market to FPI last a long period before their effect fades.

The fact that the coefficient of C (6) is positive and significant suggests that the international market economy is very sensitive to volatility in the exchange rate market, meaning that high volatility in FPI is caused by high volatility in the exchange rate market. The gamma coefficient (C (7)), which measures the leverage effect, is also positive and extremely significant, indicating that good news in the foreign exchange rate market causes greater volatility than bad news in the international market. This result suggests that good news (exchange rate

appreciation) may have a greater impact on international market as the stock value of many multinational corporations' shareholders decreases because a rise in local currency or a decrease in foreign currency may result in a decline in share values for those companies.

The coefficient of determination and its adjustment indicate a satisfactory model fit. In specific terms, variations in the foreign exchange rate explain approximately 90% of the variation in FPI.

4.7: Evaluation of Hypotheses

Hypothesis 1

H_O: There is no significant effect of exchange rate on FPI in Nigeria.

From table 4.6 above (panel A), the probability value for exchange rate is less than 0.05. Since the p-value is less than 0.05, we reject Ho and conclude that there is statistically significant effect of change rate on foreign portfolio investment in Nigeria.

Hypothesis 2

H_O: FPI do not respond significantly to the persistence level of exchange rate shocks in Nigeria.

From table 4.6 above (panel B), the probability value for C (5) is less than 0.05. Since the p-value is less than 0.05, we reject Ho and conclude that FPI responds significantly to the persistence level of exchange rate shocks in Nigeria

Hypothesis 3

H_O: There is no significant effect of exchange rate volatility on FPI in Nigeria

From table 4.6 above (panel B), the probability value for C (6) is less than 0.05. Since the p-value is less than 0.05, we reject Ho and conclude that there is significant effect of exchange rate volatility on FPI in Nigeria.

Hypothesis 4

H_O: there is no significant asymmetric leverage effect in exchange rate on FPI in Nigeria.

From table 4.6 above (panel B), the probability value for C (7) is less than 0.05. Since the p-value is less than 0.05, we reject Ho and conclude that there is significant asymmetric leverage effect in exchange rate on FPI in Nigeria

Normality Test

This test is to enable us determine whether the residual follows the normal distribution as postulated by classical OLS assumption. This is tested using the Jarque-Bera test. The hypothesis is formulated as follows:

Ho: $\mu = 0$ (Residual follow normal distribution)

H_1: $\mu \neq 0$ (Residual does not follow normal distribution)

The Jarque- Bera test result is presented in Figure 2 below:

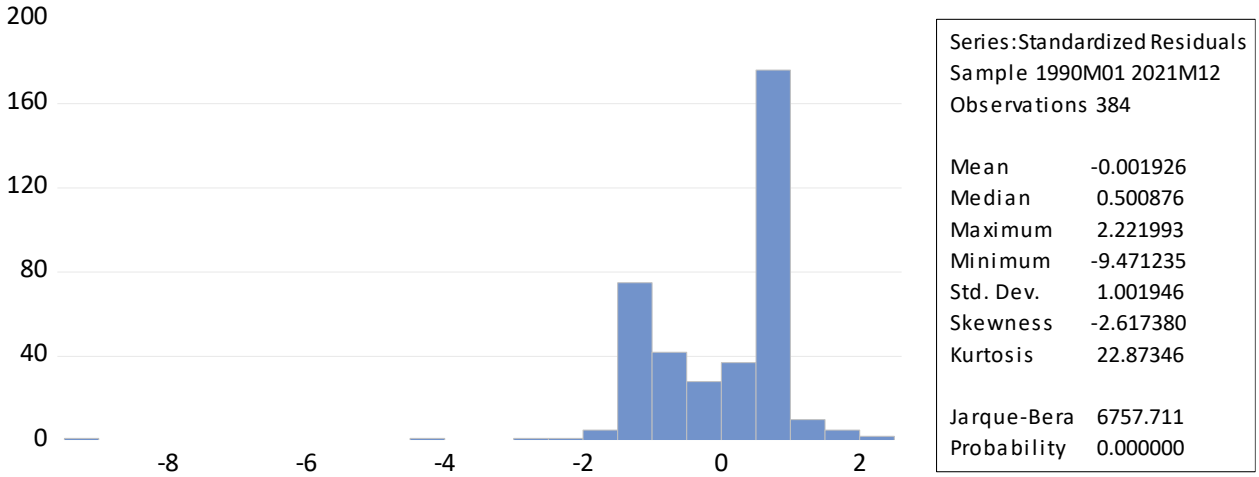

Figure 1: Jarque- Bera Test.

Evidently, the null hypothesis is rejected since the Jarque- Bera probability is 0.0000 (< 0.05). Thus, we reject Ho and conclude that the residual does not follow a normal distribution. This is expected of a volatile series.

5. Summary, Conclusion and Recommendations

5.1 Summary of Major Finding

The summary of major findings of this work is itemized as follows:

i. The EGARCH result demonstrates that shocks sent from exchange rate to FPI continues for quite a while before its impact ceases to exist.
ii. The fluctuation condition result shows that foreign exchange is exceptionally delicate to unpredictability in swapping scale market suggesting that enormous conversion standard market instability actuates high instability in foreign portfolio investment returns.
iii. The gamma coefficient which estimates the impact is similarly sure and exceptionally huge implying that the impacts of the previous period uplifting news in unfamiliar swapping scale market delivers more unpredictability than awful news.

5.2 Conclusion

The study examined the link between the exchange rate volatility and foreign portfolio investment in Nigeria using monthly data that covers the period 1990M1 to 2021M12. To achieve the objective of the study, the authors applied EGARCH model in ascertaining the dynamics between exchange rate volatility and foreign portfolio investment in Nigeria.

A review of existing literature revealed some gaps which indicate that the empirical focus has been unduly on the real component of foreign private investment, that is FDI, and FPI was neglected, which has now become a significant component of foreign capital flows. In view of the above, this present re-examination focuses on the nexus between exchange rate volatility and foreign portfolio investment using monthly series data.

5.3 Policy Recommendations

Following the observational disclosures of this work, we make the following recommendations:

i. It is important that sound foreign exchange management policies are established to curb exchange rate volatility, since it has been demonstrated in this study to have significant effect on foreign portfolio investment in the country.
ii. The Nigerian government as a matter of urgency should build institutional capacity that will engender the inflow of foreign portfolio investment.
iii. There is the need for domestic actions to be taken by government and policy makers in the country to attract foreign portfolio investment on a sustainable level. These include image building (re-building Nigeria), domestic regulatory reforms, appropriate foreign exchange rate policies and marketing of investment opportunities.

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