Granger Causality Nexus between Exchange Rate Volatility, Economic Growth And Foreign Direct Investment in Nigeria

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ABSTRACT
This study examines the causality nexus between exchange rate volatility, economic growth and foreign direct investment in Nigeria from 1980 to 2014. It provides empirical illustration of the causal relationship that exists when measures of exchange rate volatility and economic growth are regressed on foreign direct investment using pair-wise Granger causality test. The study reveals a unidirectional causality from exchange rate volatility to foreign direct investment inflow into Nigeria and bidirectional causal relationship between economic growth and foreign direct investment in Nigeria. The study recommends policies that will improve Nigeria’s trade balance and external reserve position, to strengthen the value of the naira and stabilize the exchange rate. Furthermore, the study recommends policies that will encourage domestic investment in the private sector especially the micro, small and medium scale enterprises that can make use of indigenous technology to accelerate economic growth and attract foreign direct investment inflow into Nigeria.

Keywords: Exchange rate volatility, foreign direct investment, foreign reserve, economic growth, Granger causality

JEL Classification Codes: D92, F21, F31, F38

1. INTRODUCTION
Capital in the form of foreign direct investment is increasing in importance in the global economy due to the additional financial resources they pooled for development in the host country. The flow of foreign direct investment to developing countries has been described by (Nwankwo, 2013) as episodic in the past two decades. This trend in foreign direct investment flow whether public or private is positively related to democratization and sound economic climate existing in the recipient developing countries. This indicates that the more developing countries successfully embrace democracy and employ sound economic policies, the more foreign direct investment they can attract (Edo, 2011).
The increasing globalization of production, trade and finance and the success stories of the Asian tigers has compelled the African countries to pursue major policies, structural and institutional reforms in addition to embracing democratic government with a view not only to stem the tide of economic decline and fluctuations, but to fully integrate into the global financial system which will launch the continent on the path to sustainable development. In the post independence years, many African countries, Nigeria inclusive, regardless of ideological orientation, had embarked on massive medium to long term plans in which public enterprises in all sectors were to serve as engines of growth and instrument for achieving economic independence. But African governments were realistic and able to recognize an important role for the private sector, mostly foreign capital inflow in the form of foreign direct investment. The increase in private capital inflows offers opportunities for Nigeria to invest in infrastructure and facilitate trade finance to accelerate a self-reinforcing cycle of sustained capital flows, economic progress and reduction of poverty (Omorokunwa and Ikponmwosa, 2014).

Before the oil boom of the early 1970s, Nigeria was predominantly an agrarian country, being sustained by the agricultural sector and the real exchange rate of the naira to a dollar was 0.52798 (CBN 2005). The oil boom of the 1970s led to large earnings in foreign exchange. Naturally, oil revenue is very volatile due to the dynamism in the oil’s spot and future US $ price per barrel and to unpredictable fluctuations in OPEC assigned oil quotas, of which Nigeria has been a member since 1958 following the commercial discovery of oil in Oloibiri, in Rivers State Nigeria, in 1956 (Odili, 2014). The absence of sustainable fiscal rules and a proper finance management framework for oil-related risks, in Nigeria’s variable oil and fiscal revenues in the 1980s and 1990s have led to boom-and-burst-type of fiscal policies that have generated large and unpredictable movements in government deposits and current account balances (Odili, 2014). This led to the devaluation of the naira following the adoption of the structural adjustment programme (SAP) in 1960. The Nigeria’s foreign structure is characterized by export of crude oil whose prices are inelastic and therefore not responsive to policy instruments especially in the short run and has led to constant depreciation of domestic currency. The continual fall in the value of the naira in the recent times are caused by factors which include the fall in the global oil prices, the end of the United States Quantitative Easing programme, the global fall in the price of other export commodities and the discovery of shale oil by the US. These constituted dwindling supply of the US dollars amid high demand for them. For Africa to reduce poverty, the issue of attracting FDI should be a major economic policy (UNCTAD, 2004). Successive governments in sub-Saharan African countries being aware of this situation always try to attract FDI through tax exemptions, privatization and removal of trade restrictions. However, what they have failed to consider is whether there exists a relationship between FDI inflows and macroeconomic stability. This study will therefore add more to literature by showing the causal link between volatility of exchange rate, economic growth and FDI inflows. Even though, policy makers believe that FDI is one of the most important sources of capital inflows for a developing country like Nigeria, surprisingly the causal link between exchange rate volatility,
economic growth and foreign direct investment rarely enters debates over foreign exchange rate management and monetary policy. One reason for this omission could be the lack of conclusive evidence regarding the influence of exchange rate volatility on investment behavior of multinational firms. Various studies provide evidence that multinational firms are likely to consider the level and volatility of exchange rates before investing in overseas branches, but all these studies have yielded conflicting theoretical prediction and empirical results. It is in this light that this study is carried out to investigate if actually there is a casual relationship between stability of macroeconomic variables (specifically exchange rate volatility and economic growth) and FDI inflows. This study was guided by the following research questions: 1) does exchange rate volatility Granger cause foreign direct investment in Nigeria? 2) What is the casual relationship between economic growth and foreign direct investment in Nigeria? In line with the research questions, this study tested the following hypotheses: 

- **H0**: Exchange rate volatility does not Granger cause foreign direct investment in Nigeria.
- **H0**: There is no casual relationship between economic growth and foreign direct investment in Nigeria.

The rest of the paper is organized as follows: Section 2 provides a review of related studies while Section 3 presents methodology. Section 4 presents the empirical results and discussions are presented in section 4, while section 5 is devoted to conclusion and recommendations.

2. LITERATURE REVIEW

Exchange Rate Volatility and Foreign Direct Investment

The causal linkage between exchange rate volatility and FDI can be explained by two theoretical views. The first is the dynamics of exchange rate volatility and the second is fluctuations in the bilateral level of the exchange rate between countries. The imperfect capital market theory was presented by Froot and Stain (1991). Some researchers however had opposing view to Bloningen (1997) and Froot and Stein ideas of the effect of exchange rates behavior on FDI inflows. The options theory of Dixit (1989) was used by Campa (1993) to establish that greater exchange rate uncertainty increases the options for firms to wait for a favourable opportunity to invest in a market and thereby reducing the current FDI. The study was aimed at testing whether firms expanding to the US market that deferred their investments decisions to enter the market during the 1980’s were due to U.S real exchange rate volatility. The study made use of panel based data collected from 61 U.S. wholesale trade industries for the period 1981 to 1987. The exchange rate variables were computed based on monthly data using 1980 index as the base year. This was to ensure comparability of exchange rates. The study revealed that the standard deviation of the exchange rate had significant negative impact on the level of entry in the industry. This implies that high level of exchange rate volatility decreases the number of foreign firms entering the U.S. market.

Bloningen (1997) investigated the effect of exchange rate volatility on FDI flow to Japanese economy. The study tested the assertion that a depreciation of a country’s currency may allow increase in sale of transferable assets to foreign firms operating in global markets against domestic firms that may not have
access to the market. The study used industry-level data from Japanese merged and acquired FDI into the U.S to test the objective. The study found a strong support for increased U.S acquired FDI by Japanese firms in response to real dollar depreciations relative to the YEN. The study further revealed that this exchange rate effect on the acquired FDI where primarily for high technology industries where firms’ specific assets were substantially important.

**Recent Contributions**

Beyond Froot and Stein (1991) and Blonigen (1997) models, the real options and risk aversion approaches are more recent theoretical contributions that explores the impact of heterogeneity in FDI motive (Lin et al. 2006), exchange rate endogeneity (Russ 2007), and multilateral resistance (Egger et al. 2010). These theories provide different predictions for the response of FDI to exchange rate levels and volatility.

Russ (2010) presents a general equilibrium model that allows for exchange rate endogeneity. The analysis reveals that an MNC’s response to exchange rate volatility will differ depending on the source of the shocks. A positive shock to the host country’s money supply will depreciate the host country’s currency, while income and sales by both domestic firms and MNCs in the host country’s market will increase. On the other hand, a contractionary monetary policy in the host country generates a higher exchange rate but reduces domestic sales. In contrast, a contractionary monetary shock in the foreign economy can adversely affect the value of the host country’s currency without a counteracting effect on overseas sales.

Contessi (2006) presents a model with firm heterogeneity, and endogenous exports and FDI using a general equilibrium framework. The analytical results from the model, reveals that the pricing policy of MNCs can increase the volatility of the exchange rate.

Lin et al. (2006) investigates the way exchange rate volatility influences FDI timing and propose a model with heterogeneous firm motives. The study identifies the channels through which volatility influences FDI. They argue that the exposure of profit to exchange rate risk might vary with FDI motive, predicting that firms with market-seeking motives respond to volatility by delaying FDI, and that firms with export substituting motives respond more quickly to volatility if risk aversion is high. The idea here is that market-seeking FDI might increase its exposure of profits to exchange rate risk, whereas export-substituting FDI reduces it. The authors demonstrate the importance of considering diversity of investment motivation, by showing that real options and risk aversion models are special cases of their model. Buch and Kleinert (2006) use a partial equilibrium analysis, where firms produce domestically and abroad, to encompass the competing explanations of Blonigen and Froot and Stein. Their model predicts that an appreciation of the home country currency increases FDI due to goods markets frictions.

The same appreciation will also boost FDI via the wealth effect. Xing and Zhao (2008) complement the literature by presenting another means apart from relative wealth and costs, through which exchange rates can affect FDI. They introduce a role for reverse imports as a means via which exchange rates affect FDI. They propose a two-country model with oligopolistic markets to examine the linkages among reverse
imports, FDI and exchange rates. They predict that exchange rate changes, wage and capital cost differentials, and barriers in brand name recognition contribute positively to Japanese FDI in China and reverse imports. Through FDI, a Japanese firm seeks relatively cheap Chinese inputs following a Yen appreciation. This appreciation also increases Japanese reverse imports (due to barriers in brand name recognition in Japan) and causes a decrease of exports from domestic Chinese firms.

Adu and Ntim (2014) demonstrates theoretically that exchange rate volatility have an impact on Foreign Direct Investment using a Vector Autoregressive (VAR) model. It provides an empirical illustration of effect of endogeneity when regressing measures of exchange rate volatility on foreign direct investment. The study uses pairwise Granger causality test to establish that a stable exchange rate improves foreign direct investment inflow into the country and likewise a high FDI inflow improves stability of exchange rate in the country.

Nazima (2011) carried out an empirical study in an effort to find the impact of exchange rate volatility on foreign direct investment for the Pakistan economy. A secondary time series data set was utilized over the period 1980 to 2010. The most robust and modern technique of auto regressive distributed lag (ARDL) was applied to find the short run as well as the long run estimates of the study. After establishing the long run relationship, multivariate vector error correction method (VECM) causality test was applied to find the direction of causality between exchange rate volatility and FDI. The analysis included real gross domestic product (GDP), capital account balance, trade openness, real exchange rate and volatility of exchange rate as independent variables along with the introduction of a dummy variable for the structural adjustment programme implemented during the late 1980s as explanatory variable, while foreign direct investment as dependent variable. The findings of this study revealed that exchange rate volatility has negative impact on FDI inflow in short run while this impact is positive in the long run.

Theoretical models that focus on bilateral FDI flows assume that they are independent of FDI decisions to other countries. Clearly, this is a restrictive assumption, and more work is now emerging that builds on Bénassy-Quéré et al. (2001), by taking account of host market interdependencies. Xing and Wan (2004) examine how currency devaluation affects the relative comparative advantage of FDI recipients. This model is in the spirit of Xing and Zhao (2008) in its role for reverse imports, but focuses on relative exchange rates and the effects these have on relative costs. They show that if a FDI recipient’s exchange rate appreciates more than that of a rival, its relative FDI will be diverted to the rival. As part of emerging literature on multilateral resistance, Egger et al. (2010) present a three-country model of exports and FDI. They track two channels for effects of the exchange rate. First, a positive bilateral effect following a host currency appreciation that raises MNE profits from affiliates (revenue effect). Second, an induced increase in relative production costs follows the same bilateral appreciation (competition effect). This has a negative effect on bilateral activity of MNEs, because costs are higher relative to other economies that serve the host country with exports. The third country exchange rate effects are the reverse of the bilateral effects: a negative
revenue effect, and a positive competition effect. Which of the competition or revenue effects dominates is determined by skilled labour endowments, transport and foreign investment costs. Where skilled labour is abundant and transport costs high, the model predicts that the third country exchange rate effect will be positive. In Bénassy-Quéré et al. (2001) the exchange rate effects of third countries come through correlations that affect location choice of risk averse firms, which invest in countries whose exchange rates are negatively correlated to other exchange rates as a way of diversifying FDI. However, the response of firm’s FDI activity to exchange rates in Egger et al. (2010) is determined by factor endowment, transport and FDI costs.

Omorokunwa and Ikponmwosa (2014) investigates the dynamic relationship between exchange rate volatility and foreign private investment in Nigeria from 1980 to 2011. The study employed the Error Correction Model (ECM) after a battery of preliminary investigations which include the Augmented Dickey Fuller (ADF) test for stationarity and the Engle and Granger two-step co-integration procedure. The study revealed that exchange rate volatility has a very weak effect on the inflow of Foreign Direct Investment (FDI) to Nigeria, both in the long run and in the short run and that exchange rate volatility has a weak effect on foreign portfolio investment in the short run but a strong positive effect in the long run.

Khan, Sattar and Rehman (2012) analyzed the effectiveness of exchange rate on macroeconomic variables of Pakistan. The precise objective of the study was to examine the causality between exchange rate, trade, inflation, FDI and GDP through a series of models. On the annual time series data for the years 1980-2009 unit root test for stationarity, Johansen’s cointegration test for long-run equilibrium relationship between the variables for each model and Granger causality test to check the causality between the variables were applied. The results indicate that there is no long-run equilibrium relationship between exchange rate and inflation, but there exists long-run equilibrium relationship between exchange rate and trade. There is also long-run equilibrium relationship between exchange rate and FDI and causality runs in both directions, i.e. exchange rate to FDI and FDI to exchange rate. Finally, there is long-run equilibrium relationship between exchange rate and GDP but causality does not run in either direction.

In summary, predictions from the body of theoretical work are ambiguous, across and within models. Given the nature of FDI, it seems reasonable that no single model can encompass FDI behaviour. The predicted relationship between exchange rates and FDI varies depending on factors such as configuration of revenues and costs, FDI types, or source of exchange rate shock (Phillips and Ahmadi-Esfahani, 2008). The implication of ambiguity at the theoretical level is that it remains the task of empirical work to determine the nature of the relationship on a case by case basis. Unsurprisingly, ambiguity at the theoretical level is reflected in the empirical work. Explanations for the mixed empirical findings may lie in the heterogeneity of the work, reflecting the ambiguous theoretical predictions, and also may be due to data problems and model specification issues.
Transmission Mechanisms between Foreign Direct Investment and Economic Growth

Through the stimulation of macroeconomic activities, FDI is believed to accelerate economic growth and development, by increasing total out and efficiency in resource utilization in the host country through transfer of technological knowledge and organizational structures directly to MNC subsidiaries in the host country (Blomström et al., 2000). In addition, FDI could provide technological and other spillover services to locally owned business, assisting human capital formation, contributing to international trade integration, helping to create a more competitive business environment, enhancing enterprise development and general improvement in environmental and social conditions of the host country (Phillips and Ahmadi-Esfahani, 2008).

These transmission mechanisms could ultimately lead to higher economic growth, which is the most potent tool for poverty reduction in developing countries; that notwithstanding, it is often believed that growth is not a sufficient condition for poverty alleviation, since, there is evidence that higher incomes in developing countries benefit the poor segments of the population proportionately (Phillips and Ahmadi-Esfahani, 2008).

According to neoclassical theory, FDI influences income growth by increasing the amount of capital per person, but does not influence long-run economic growth due to diminishing returns to capital; in addition, recent endogenous growth theorists (e.g., Romer, 1986; 1990 and Lucas, 1988), argue that FDI spurs long-run growth through such variables as research and development (R&D) and human capital development. They suggest that, through technology transfer to both subsidiaries and subsidiary firms in the host country, MNCs can accelerate the development of new intermediate product lines, raise product quality, facilitate international collaboration on R&D, as well as, introduce new forms of capacity building in human capital. Many studies (e.g., Balasubramanyam et al., 1996) opined that FDI contributes to total factor productivity and income growth in host economies, over and above what domestic investment would trigger, and most specifically, policies that promote indigenous technological capability, such as education, technical training, and R&D, often increase the aggregate rate of technology transfer from FDI, while, export promotion trade regimes are also important prerequisites for positive FDI impact (Phillips and Ahmadi-Esfahani, 2008).

Olusanya (2013) takes a look at the impact of foreign direct investment inflow and economic growth in a pre and post deregulated Nigerian economy, a Granger causality test was use as the estimation technique from 1970 - 2010. The analysis de-aggregates the economy into three period; 1970 to 1986, 1986 to 2010 and 1970 to 2010, to test the causality between foreign direct investment inflow (FDI) and economic growth (GDP). The result of the causality test shows that there is causality relationship in the pre-deregulation era that is (1970-1986) from economic growth (GDP) to foreign direct investment inflow (FDI) which means GDP causes FDI, but there is no causality relationship in the post-deregulation era that is (1986-2010) between economic growth (GDP) and foreign direct investment inflow (FDI) which means GDP causes FDI. However, between 1970 to 2010 it shows that is causality relationship between economic growth (GDP) and
foreign direct investment inflow (FDI) that is economic growth drive foreign direct investment inflow into the country and vice versa.

Eravwoke and Eshanake (2012) assessed the direction of causality between foreign direct investment and economic growth in Nigeria. An exploratory research design that involves a combination of ordinary Least Squares (OLS), Augmented Dickey Fuller (ADF) unit root test, and the Granger causality test to test whether foreign direct investment granger cause economic growth in Nigeria. The results revealed that Economic growth (GDP) does not granger cause foreign direct investment (FDI) in Nigeria.

3. MODEL SPECIFICATION

The econometric model employed in this investigation was based on the past theoretical and empirical research work of Adu and Ntim (2014) and Eravwoke and Eshanake (2012). According to Ogundipe and Aworinde (2011) when conducting an econometric study, the direction of the causal flow among variables is determined with reference to the information obtained from the theoretical underpinning. The regression analysis is hinged on the assumption that the model is a good fit and the nature of casualty relationship is determined in the model. This study therefore employed Granger causality to test the causal relationship between exchange rate volatility, economic growth and foreign direct investment (FDI) in Nigeria.

We assumed that the effect of exchange rate volatility on FDI operates through its effect on trade hence a proxy variable for the openness of trade needs to be incorporated in the equation. Thus we have included the ratio of balance of trade to GDP as a proxy for openness of the economy. The functional form in which the model based is stated thus:

\[
\text{FDI} = f(\text{EXRV}, \text{GDP}, \text{DOP}, \text{EXTR}, \text{INFLR})
\]

Equation 1 can be stated explicitly as:

\[
\text{FDI} = \alpha_0 + \alpha_1 \text{EXRV} + \alpha_2 \text{GDP} + \alpha_3 \text{DOP} + \alpha_4 \text{EXTR} + \alpha_5 \text{INFLR} + U
\]

Where, EXRV is exchange rate volatility, GDP is gross domestic product, FDI is foreign direct investment, DOP is degree of openness, EXTR is external reserve, INFLR is inflation rate, \( \alpha \) is constant and \( U \) is error term.

The exchange rate volatility measure is constructed in a similar way to those used in literature. The volatility variable EXRV is constructed for a given year as the sample “standard deviation” of the change in the logarithm of the nominal average monthly exchange rate. According to economic theory, it is expected that an increase in the level of foreign direct investment will increase the level of economic activities, and an increase in the rate of exchange will hinder the growth of economic activities. Openness of the economy is included because it is a significant determinant of foreign direct investment. All the variables are in log form. This study sourced data relating to volume of foreign direct investment (FDI) inflow, gross domestic product (GDP), exchange rate, balance of trade, inflation rate, and external reserve from the Central Bank of Nigeria’s Statistical Bulletin and National Bureau of Statistics for the study period 1981 – 2014.
Model Estimation Technique: Granger Causality Test

The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another (Granger, 1969). The Granger (1969) approach to the question of whether $x$ causes $y$ is to see how much of the current $y$ can be explained by past values of $x$ and then to see whether adding lagged values of $x$ can improve the explanation $y$. $y$ is said to be Granger caused by $x$ if $x$ helps in the prediction of $y$, or equivalently if the coefficients on the lagged $x$'s are statistically significant.

Generally, causality between two economic variables has been tested using Granger and Sims causality test (Granger, 1969). Within a bivariate context, the Granger-type test states that “if a variable $x$ causes variable $y$, the mean square error (MSE) of a forecast of $y$ based on the past values of both variables is lower than that of a forecast that uses only past values of $y$’.

This Granger test is implemented by running the following regression:

$$
\Delta y_t = \alpha + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \epsilon_t \quad \text{Eqn. (3)}
$$

and testing the joint hypothesis $H_0: y_1 = y_2 = \ldots y_p = 0$ against $H_1: y_1 \neq y_2 \neq \ldots y_p \neq 0$. Granger causality from the $y$ variable to the coincident variable $x$ is established if the null hypothesis of the asymptotic Chi-Square ($\chi^2$) test is rejected. A significant test statistic indicates that the $x$ variable has predictive value for forecasting movements in $y$ over and above the information contained in the latter’s past values.

4. DATA PRESENTATION AND ANALYSIS

Unit Root Test.

Before testing for co-integration and causality, the stationarity properties of the variables under investigation were checked by using Augmented Dickey-Fuller (ADF) unit root test. To ascertain the order of integration of time series data, unit root test was applied at level as well as first difference. The tests were performed using E-views 8.0 statistical package which automatically selects the number of lagged dependent variables in order to correct for the presence of serial correlation (Asteriou and Hall, 2007). The result is presented in

Table 4.1: The Results of Augmented Dickey-Fuller (ADF) Test.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level</th>
<th>First Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Constant without Trend</td>
<td>Constant with Trend</td>
</tr>
<tr>
<td>FDI</td>
<td>-1.766997</td>
<td>-2.01999</td>
</tr>
<tr>
<td>EXRV</td>
<td>-0.946143</td>
<td>-2.109675</td>
</tr>
<tr>
<td>GDP</td>
<td>-0.769159</td>
<td>-1.132594</td>
</tr>
<tr>
<td>DOP</td>
<td>-2.175206</td>
<td>-2.148288</td>
</tr>
<tr>
<td>EXTR</td>
<td>-1.285171</td>
<td>-2.197721</td>
</tr>
<tr>
<td>INFLR</td>
<td>-2.077769</td>
<td>-1.789239</td>
</tr>
</tbody>
</table>

Source: Author’s Computations, 2015

Note: Asterisks *, denote statistically significant at 5%.
The result of Augmented Dickey-Fuller (ADF) unit root test presented in Table 4.1 shows that the time series data were not stationary at levels. However, the tests showed a consistent results by rejecting the null (HO: a unit root) hypothesis of a unit root at first difference, against the one-sided alternative whenever the ADF statistic is less than the critical value at a statistically significant level of 5%. Hence, we conclude that the series is stationary at first difference.

**Co-integration Test**

This involves testing for the existence or otherwise of long-run equilibrium between the series in the model. This study employed the maximum likelihood test procedure suggested by Johansen and Juselius (1988, 1990). To determine the number of co-integrating vectors, Johansen (1988) and Johansen and Juselius (1990) suggested two statistical tests. The first test is the trace test (λ trace). It tests the null hypothesis that the number of distinct co-integrating vector is less than or equal to q against a general unrestricted alternatives q=r, this test is shown in the equation below:

\[ \lambda_{\text{trace}}(r) = -T \sum_{t=r+1}^{T} \ln(1 - \lambda t) \]  

Where: T is the number of usable observations, and \( \lambda_1 \) are the estimated eigenvalue from the matrix. The second statistical test is the maximum eigenvalue test (λ max) that is calculated according to the following formula:

\[ \lambda_{\text{max}}(r, r + 1) = -T \ln(1 - \lambda r + 1) \]

The test concerns a test of the null hypothesis that there is r co-integrating vector against the alternative of r+1 co-integrating vectors. The test results are presented in Tables 4.2 and 4.3, respectively.

**Table 4.2: Johansen co-integration test results (trace)**

<table>
<thead>
<tr>
<th>Hypothesized no. of (E(s))</th>
<th>Eigen value</th>
<th>Trace statistic</th>
<th>0.05 critical value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None*</td>
<td>0.9956</td>
<td>342.64</td>
<td>109.98</td>
<td>0.0000</td>
</tr>
<tr>
<td>At most 1*</td>
<td>0.9560</td>
<td>207.23</td>
<td>82.49</td>
<td>0.0000</td>
</tr>
<tr>
<td>At most 2*</td>
<td>0.8767</td>
<td>129.13</td>
<td>59.46</td>
<td>0.0000</td>
</tr>
<tr>
<td>At most 3*</td>
<td>0.8281</td>
<td>76.81</td>
<td>39.89</td>
<td>0.0000</td>
</tr>
<tr>
<td>At most 4</td>
<td>0.5372</td>
<td>28.79</td>
<td>29.80</td>
<td>0.0520</td>
</tr>
<tr>
<td>At most 5</td>
<td>0.3859</td>
<td>13.53</td>
<td>15.49</td>
<td>0.0969</td>
</tr>
<tr>
<td>At most 6</td>
<td>0.0521</td>
<td>1.34</td>
<td>3.84</td>
<td>0.2476</td>
</tr>
</tbody>
</table>

Source: Researchers’ Computations 2015

Trace test indicates 4 co-integration eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level, ** Mackinnon-Haug-Michelis (1999)’s P-values.
Table 4.3: Johansen co-integration test result (maximum eigenvalue)

<table>
<thead>
<tr>
<th>Hypothesized no. of (E(s))</th>
<th>Eigen value</th>
<th>Max-eigen Statistic</th>
<th>0.05 critical value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None*</td>
<td>0.9956</td>
<td>135.41</td>
<td>46.23</td>
<td>0.0000</td>
</tr>
<tr>
<td>At most 1*</td>
<td>0.9560</td>
<td>78.10</td>
<td>40.08</td>
<td>0.0000</td>
</tr>
<tr>
<td>At most 2*</td>
<td>0.8767</td>
<td>52.32</td>
<td>33.88</td>
<td>0.0001</td>
</tr>
<tr>
<td>At most 3*</td>
<td>0.8281</td>
<td>27.03</td>
<td>27.58</td>
<td>0.0602</td>
</tr>
<tr>
<td>At most 4</td>
<td>0.5371</td>
<td>19.26</td>
<td>21.13</td>
<td>0.0896</td>
</tr>
<tr>
<td>At most 5</td>
<td>0.3859</td>
<td>12.19</td>
<td>14.27</td>
<td>0.1037</td>
</tr>
<tr>
<td>At most 6</td>
<td>0.0521</td>
<td>1.34</td>
<td>3.84</td>
<td>0.2476</td>
</tr>
</tbody>
</table>

Source: Researcher’s Computations 2015

Max-eigenvalue test indicates 3 co-integrating equation(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level. ** Mackinnon-Hang-Michelis (1999)’ P-values.

The co-integration test results showed that there are co-integrating vectors in the model, with the trace test giving four (4) co-integrating equations and the maximum eigen value test giving three (3) co-integrating equations at 5% level of significance. This implies a long run relationship between the variables.

Table 4.4: Granger causality test Lag selection

Endogenous variables: LNGDP LNFDI LNEXCH LNGNS LNINFR LنينTR LنبOP

<table>
<thead>
<tr>
<th>Lag</th>
<th>LogL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-138.7915</td>
<td>NA</td>
<td>0.000274</td>
<td>11.66332</td>
<td>12.00461</td>
<td>11.75798</td>
</tr>
<tr>
<td>1</td>
<td>11.94717</td>
<td>205.0047</td>
<td>9.42e-08</td>
<td>3.524226</td>
<td>6.254508</td>
<td>4.281490</td>
</tr>
<tr>
<td>2</td>
<td>153.4045</td>
<td>113.1659*</td>
<td>1.81e-10*</td>
<td>-3.872363*</td>
<td>1.246916*</td>
<td>-2.452492*</td>
</tr>
</tbody>
</table>

* indicates lag order selected by the criterion

Table 4.5: VAR Lag Order Selection Criteria


<table>
<thead>
<tr>
<th>Lag</th>
<th>LogL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-65.77447</td>
<td>NA</td>
<td>1.32e-06</td>
<td>6.328215</td>
<td>6.673800</td>
<td>6.415128</td>
</tr>
<tr>
<td>1</td>
<td>-0.277986</td>
<td>85.43020</td>
<td>3.89e-07</td>
<td>4.893738</td>
<td>7.658419</td>
<td>5.589048</td>
</tr>
<tr>
<td>2</td>
<td>118.9081</td>
<td>82.91206*</td>
<td>4.16e-09*</td>
<td>-1.209399*</td>
<td>3.974378*</td>
<td>0.094306*</td>
</tr>
</tbody>
</table>

* indicates lag order selected by the criterion
Granger Causality Test

The series under considerable were non-stationary at levels and were not co-integrated; Granger causality had therefore been employed in ‘first difference’ on the dependent variable (FDI) and the independent variables (EXRV, GDP, DOP, EXTR, INFLR). The results are presented in Table 4.6 below:

**Table 4.6: Pairwise Granger Causality Tests**

<table>
<thead>
<tr>
<th>Null Hypothesis:</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(LNFDI) does not Granger Cause D(LNEXRV)</td>
<td>31</td>
<td>0.79400</td>
<td>0.4672</td>
</tr>
<tr>
<td>D(LNEXRV) does not Granger Cause D(LNFDI)</td>
<td></td>
<td>3.92934</td>
<td>0.0067</td>
</tr>
<tr>
<td>D(LNFDI) does not Granger Cause D(LNGDP)</td>
<td>31</td>
<td>6.37917</td>
<td>0.0058</td>
</tr>
<tr>
<td>D(LNGDP) does not Granger Cause D(LNFDI)</td>
<td></td>
<td>5.24506</td>
<td>0.0160</td>
</tr>
<tr>
<td>D(LNFDI) does not Granger Cause D(LNDOP)</td>
<td>31</td>
<td>0.25413</td>
<td>0.7776</td>
</tr>
<tr>
<td>D(LNDOP) does not Granger Cause D(LNFDI)</td>
<td></td>
<td>4.58385</td>
<td>0.0128</td>
</tr>
<tr>
<td>D(LNFDI) does not Granger Cause D(LNEXTR)</td>
<td>31</td>
<td>3.97036</td>
<td>0.0346</td>
</tr>
<tr>
<td>D(LNEXTR) does not Granger Cause D(LNFDI)</td>
<td></td>
<td>4.09373</td>
<td>0.0230</td>
</tr>
<tr>
<td>D(LNFDI) does not Granger Cause D(LNINFLR)</td>
<td>31</td>
<td>0.20145</td>
<td>0.8189</td>
</tr>
<tr>
<td>D(LNINFLR) does not Granger Cause D(LNFDI)</td>
<td></td>
<td>6.46866</td>
<td>0.0076</td>
</tr>
</tbody>
</table>

Source: Researcher’s computation 2015

From the result of the Granger causality test in Table 4.6, it was revealed that a unidirectional causality run from EXRV, DOP and INFLR to FDI. This result is in line with Khan et al. (2012) in the case of Pakistan and Adu and Ntim (2014) in Ghana. On the other hand, there was bidirectional causal flow between FDI and GDP, and between FDI and EXTR. This confirms the result findings of Olusanya (2013) in the case of Nigeria. However, Eravwoke and Eshanake (2012) found no causality between GDP and FDI in Nigeria. This implies that changes in the past values of EXRV, DOP and INFLR can be used to explain changes in the present value of FDI in Nigeria. This explains the reason for the low level of foreign direct investment in Nigeria. Exchange rate shocks, high level of inflation and low level of openness of the economy therefore has negative impact on foreign direct investment inflow into Nigeria. The bidirectional causal link between FDI and GDP and between FDI and EXTR is in line with the ‘a priori’ expectations. Theoretically, growth in GDP and increase in external reserve will attract foreign inflow of capital in the form of foreign direct investment and vice versa.

**CONCLUSION**

This study examined the causal linkage between exchange rate volatility, gross domestic product and foreign direct investment in Nigeria using time series data from 1980 to 2014. The time series data were tested for stationarity by means of the Augmented Dickey Fuller unit root test. Having found that the series was stationary at first difference, the study conducted co-integration test to determine the existence of long run
relationship of the variables in the model. This was followed by Granger causality tests to determine the direction of causal flow between the variables.

The Granger causality test revealed that a unidirectional causality run from EXRV, DOP and INFLR to FDI. While, bidirectional causal flow between FDI and GDP, and between FDI and EXTR were found. This calls for the need for urgent policy measures to stabilize the exchange rate and reduce external shocks on the naira. The findings equally suggest the need to increase the degree of trade openness of the Nigerian economy for greater growth performance. Undoubtedly, development policies that are aimed at ensuring greater private (domestic and foreign) participation in the economy will lead to increases in the level of trade openness. Policies that will improve output level in Nigeria reduce political risks, lower corporate income tax rates and ensure full integration of the Nigerian economy into the world economy will likely increase the inflow of foreign direct investment (FDI) into Nigeria and enhance economic growth.

REFERENCES


