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It is our policy that contributions are not only original but also advanced in the respective disciplines. Contributions that receive positive assessment from our team of assessors are published in the Journal.

Prof. Benjamin Omolayo
Editor

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EXCHANGE RATE VOLATILITY AND FOREIGN CAPITAL INFLOW NEXUS: EVIDENCE FROM NIGERIA

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Abstract

Foreign Capital Inflow remains a significant factor in the development of any nation's economy. But what is the nature of the relationship between the volatility in the exchange rate and foreign capital inflow? This paper examines the effect of this relationship on foreign direct investment in Nigeria between the period 1981 and 2010. In order to achieve its overall goal the study has utilized co-integration and error correction modeling approach. The unit root tests show that the variables are integrated of order one while the Johansen co-integration result showed that the variables are co-integrated. The regression estimates show that exchange rate volatility has significant positive impact on foreign direct investment in the long run while in the short run it has an insignificant-negative effect on foreign direct investment in Nigeria. The study concludes that exchange rate volatility has differential impact on foreign direct investment in the long run and in the short run.

JEL Classification: F21, F31.

Keywords: Exchange rate volatility, foreign direct investment, GARCH, ECM, Nigeria.

1.0 Introduction

Foreign capital inflows remain a fundamental factor in the growth of any economy irrespective of whether or not the country is developing, underdeveloped or developed. Foreign Capital Inflows (FCI) as observed by many researchers, policy makers and individual economy is desirable because it complements the domestic resources of host country. It has also been argued that, FCI (FDI) has the potential to enhance economic growth and development of the host country.

Typically, in capital – scarce developing countries like Nigeria, such offshore capital inflows are even more desirable because they serve to stimulate the strength of investment employment, debt relief, global commodity, managerial skills, and transfer of technology and growth. Similarly, foreign Capital Inflow incorporates Foreign Direct Investment FCI, (indicating Investment in real assets) and Foreign Portfolio Investment (implying Investment in financial assets). In Nigeria the FDI was last reported as N7.7

billion as at 2010 according to World Economic Forum (2011). Foreign Capital Inflow emanated as a result of the liberalization of foreign exchange market and lifting of restrictions on investors have also encouraged the entry of foreign investors into government and corporate debt market, equities and money market instruments which have in-turn triggered technology spill over, assist human capital formation, contributes to the integration of foreign trade, helps create a more competitive business environment and enhance enterprise development as opined by (OCED report, 2002). Furthermore, it should be noticed that despite the numerous benefits that are accrued to both foreign investors and host country, there are many factors that attract FDI into a country. These include taxes, market size, political stability, the openness of the economy, interest rate parity and exchange rate behavior (Walsh and Yu, 2010). Although the latter factor is seen as one of the major factors that influence the inflow of FDI into an economy, it has generated contentions among policy makers and economists in the past two decades regarding the extent to which exchange rate variability is associated with FDI both for Multi-national Corporation (MNC) and the recipient economy.

As a matter of fact, one out of the many factors that influence FDI activity is the exchange rate behavior. First and foremost, exchange rate may be defined as the domestic currency price of a foreign currency matter both in terms of their levels and their volatility. This implies that exchange rates can influence both the total amount of foreign direct investment (FDI) that takes place and the overall allocation of this investment spending across a range of countries. On the other hand, exchange rate volatility refers to the erratic fluctuation in exchange rate, which could occur during periods of domestic currency appreciation or depreciation. Exchange rate changes may lead to a major decline in future output if they are unpredictable and erratic (Mordi, 2006; and Razazadehkarsalari, Haghiri and Behrodzi, 2011).

Following from the foregoing, when a country's currency depreciates, it implies that its value declines relative to the value of another currency. It should be noted that this exchange rate movement can exhibit two potential implications for FDI. Firstly, it could reduce the country's wages and production costs relative to those of its foreign counterparts. And secondly, it could equal the country experiencing real currency depreciation to enhance its locational advantage or attractiveness as a location for receiving productive capacity investment. As a result of this "relative wage" channel, the exchange rate depreciation improves the overall rate of return to foreigners contemplating an overseas investment project in the host country. No wonder, in the literatures, one of the most casual factors that has been accounted for which attracts FDI is the effects of exchange rate volatility due to the fact that most countries adopts the floating exchange rates. This is more importantly because exchange rate volatility increases the tendency of uncertainty surrounding overseas investment and raises, the variance of expected costs and profits faced by the MNC. This give rise in uncertainty which has been thought to suppress FDI inflows as MNC's are faced with an opportunity of not waiting before committing large financial capital flows overseas as observed by Campa, (1993) which is currently the situation of Nigeria and its countries. It has further been recognized by both theoretical and empirical studies that exchange rate volatility affects FDI activity through two major

channels. The first is firms' attitude towards risk and, secondly, through the option value of investment flexibility thereby suggesting that for a risk-averse firm higher volatility lowers the certainty equivalent value of the investing firm. In essence, FDI decreases as exchange rate volatility of most economy increases. Hence, the mix feelings regarding the effect of exchange rate volatility on a country's FDI and economic growth at large. For instance, while some scholars believe that there is a positive relationship between a country's FDI and exchange rate volatility which in turn transmits to real output growth as shown by Cushman (1998). Besides this, authors like Campa (1993), Benassy-Quere et al 2001, Kiyota and Urata 2004 and Ruiz (2005) believes that there is a negative linkage between exchange rate volatility and FDI while others believe that there is no relationship between them.

Over and above all, it has been observed that the global economy has continued to integrate thereby making the flow of FDI to become increasingly influential on economic growth and development. To this end, it would be good for policy makers and economists to be able to accurately determine the actual effect of exchange volatility on FDI inflows which has become increasingly relevant. Hence, the objective of this current study is to ascertain and forecast the actual linkage that exist between exchange rate volatility and FDI inflows in Nigeria. The study will further seek to establish if causality runs between Exchange rate volatility and FDI.

The remaining part of the paper is structured into four sections. The first section presents the theoretical issues while the second section describes the research methodology. The next section analyzes and discusses the empirical analysis. This is followed by the conclusion and policy recommendation.

2.0 Literature Review and Theoretical Framework

2.1 Literature Review

The linkage between exchange rate volatility and FDI was scanty before 1980's but has gained considerable relevance in the last three decades in the literature and empirical review when many emerging third world economies has shifted towards floating exchange rate from fixed exchange rate regime through the adoption of the Structural Adjustment Policy. Although, these literatures depicting the linkage between exchange rate volatility and aggregate investment and the theoretical predictions are ambiguous despite the fact that the corresponding empirical evidence provided is scarce as observed by Kyere Boah et al (2008). This implies that more studies have been carried out regarding the relationship between FDI and growth in both developing and developed economies which Nigeria is inclusive.

In spite of the foregoing, this literature section will cover both aspects of the subject matter with particular focus on the linkage between exchange rate volatility and FDI in Nigeria.

Starting with the exchange rate volatility and FDI literature, a prominent scholar Cushman (1985) kicked off the volatility argument by investigating the effects of exchange rate uncertainty. Cushman (1985) in his study evaluated the effects across four schemes; which are functions of where inputs were purchased, financial capital was acquired and finally where output was sold. In his study he witnessed that higher exchange rate volatility

exert an increase in FDI from the US through to Canada, Japan and Europe. In consonance with the work of Cushman, Goldberg and Kolstad (1994) supported Cushman (1985, 1988) by distinguishing between the three different risk features of firms, risk averse neutral and loving. In his own study he employed quarterly bilateral data of US – FDI entering the UK, Japan and Canada. To him exchange rate variability was found to increase levels of FDI from risk averse multinational when uncertainty is correlated with export demand shocks within the foreign market as opined by (Goldberg and Kolstad 1994).

Again Frost and Stein (1991) opine that the level of exchange rate may exert influence on FDI. To him, this is not far-fetch from the fact that the depreciation of the host countries currency against the home currency increases the relative wealth of foreigners thereby including the attractiveness of the host country for FDI as firms are able to acquire assets in the host country relatively cheaply. Thus a depreciation of the host currency should increase FDI into the host country, and conversely an appreciation of the host currency should decrease FDI.

Furthermore, Gorg and Wakelin (2001) made a more significant contribution than the foregoing studies, this is because they went further to consider both inward and outward FDI by investigating empirically both direct investment from US to 12 countries and investment from these 12 countries to the U.S. The empirical estimates yielded different results from U.S outward and inward FDI, which appear contradictory. They found a positive relationship between U.S outward investment and appreciation in the host country currency while there is a negative relationship between U.S inward investment and appreciation in the dollar.

In the same vein, Udomkerkgmogkol and Morrisey (2009) also conducted study on the nexus of exchange rates and FDI. Their results depicted that devaluation attracts while volatility in local currency depresses FDI. They employed H.P – filter approach to assess devaluation and thus postponed FDI. Conversely, more recent literature has attempted to proffer explanation to the contradictory results that have been obtained by earlier studies. This was achieved by employing heterogeneity theories which have been helpful in explaining the ambiguous result from past empirical analysis that were guilty of using national aggregated data. These among others include authors such as Barrel, Gottschal and Hall (2007) who in their work employed Tobins or theory of investment to explain the observed US – FDI outflows into Europe. U.S firms exhibited risk – averse with volatility supporting outward FDI flows. Similarly, Weilitz (2003), Bernard et al (2003) and Heanneret (2011) supported the foregoing by also employing heterogeneity of productivity to explain the aggregation issues Jeanneret (2011) achieved this by assessing the trade – off between direct investment and exporting a method of supplying the foreign market using a large panel data set of outward FDI for 27 OECD countries. The results depicts that less productive firms are more inclined to relocate production thereby increasing FDI when exchange rate volatility is low, whereas more efficient firms tends to invest abroad when the level of uncertainty is higher owing to the U-shaped relationship that was observed between FDI and uncertainty. Although, authors like Ajayi (2004), Khan and Bamou (2005) and Mivega and Ngugi (2005) investigated the effect of exchange rate volatility on

FDI however, with some slight difference because they cannot explicitly examine the relationship empirically.

Apart from the literature that established the linkage between exchange rate volatility and FDI, other literatures also buttressed on the FDI – growth nexus. In this aspect, we begin with the work of Nadiri (1993) who established that there exist a positive and significant effects from U.S sourced FDI on productivity growth of manufacturing industries in France, Germany, Japan and United Kingdom. Similarly, Borensztein, Gregorio and Lee (1998) found a positive influence of FDI flows from industrial countries to developing countries growth. Although, they also pinpointed that a minimum threshold level of human capital for the productivity enhancing impact of FDI emphasizing the role of absorptive capacity.

Furthermore, Blomstron et al (1994) observed in his study that FDI inflows had a significant positive effect on the average growth rate of per – capita income (PCI) for a sample of 78 developing and 23 underdeveloped countries even though the sample of the developing countries were divided into two basis. On the level of (FCI) it was found that the effect of FDI of lower income developing countries was found not to be statistically significant despite the fact that it depicted a positive sign.

Over and above all, a far reaching effort has been made by several authors to investigate the role of FDI in the Nigerian economy. These include; Oyaide (1979), Ayanwala and Barmire (2001), Dirda (2009) and Abu (2010) who in their work provided good evidence that there exit a positive relationship between FDI and economic growth respectively. In the same vein, studies like that of Chanery – Watenbe (1958) Oseghale and Amon Khiehan (1987), Aluko (1961), Brown (1962) and Obinna (1983) reported a positive linkages between FDI and economic growth in Nigeria while studies like that of Adelegan (2000), Chanery and Stout (1966) depicted a negative effect of FDI on economic growth.

Interestingly, Mordi (2006) pinpointed that, the operators in the private sector are concerned about volatility of exchange rate due to its effect on their investment which may be capital gains or losses thereby making exchange rate volatility to depict an asymmetric effects on macroeconomic variables. On the contrary, studies like that of Akinlo (2004) observed that there is no clear relationship between FDI and economic growth in Nigeria thereby pinpointing that there is no clear relationship between FDI and economic growth in Nigeria. Consequently, Dunning and Rugmen (1985) opines that FDI contributes to the host country's gross capital formation such that higher growth industrial productivity and competitiveness and other spin-off benefits such as, transfer of technology, managerial expertise, improvement in the quantity of human resources and increased investment.

In addition, despite some sort of agreement regarding the determinant of FDI via investment in both developing and developed countries, the literature has identified some additional risk factors which have constrained investment in developing countries apart from the already identified uncertainty factor which is the exchange rate behavior that this current paper emphasized on. These factors include; inflation according to (Dombusch and Reynoso, 1989; Serven and Solimano, 1993 and Oshikoya, 1974), large external debt as opined by (Borensztein 1990, Fangee, 1992), Ownership, Location and Internalization according to (Rivoli and Salorio, 1996), Credibility of policy changes during

macroeconomic adjustment (Rodrik 1981), level and variability of the real exchange rate. For instance, Farugee 1992, Serven 1998, Jerkins and Thomas 2002 terms of trade effect (Oshikoya 1994) and political instability (Bleaney, 1993, Gamer, 1993, Root and Ahmed, 1979, Schneider and Fry, 1985) and infrastructure and institutions (Aseidu 2002 and Ajayi 2004).

2.2 Theoretical issues

Over the past years numerous theoretical hypothesis/ assumptions have been offered to explain the nexus among exchange rate volatility, FDI and Economic growth in both developing and developed economies. Apparently for the purpose of this study four major theories would be discussed briefly. These among others include the risk aversion theory, production flexibility arguments, portfolio allocation theory and the exchange rate sheltering hypothesis. Apparently the aforementioned theories/hypothesis have examined the linkages between exchange rate volatility (EXRV) and FDI from several perspectives which has in turn yield different outcomes as briefly examined in the below sub-section.

2.2.1 The production flexibility argument.

According to Aizenman (1992, 1994) the extent of investment irreversibility's on the competitive structure of the industry and overall on the convexity of the profit function in prices. He furthermore presumes that individual producers can adjust their use of a variable input factor as a result of the realization of a stochastic input into profits, such that without this variable factor coupled with fixed input factor instead of a variable factor. Hence, the production flexibility argument opines further that, more variations is associated with more FDI ex-ante and more potential for excess capacity and production shifting ex-post after a stipulated exchange rate are observed.

2.2.2 The Risk-aversion theory

This theory opines that FDI decreases as exchange rate volatility increase. This implies that there is an inverse relationship between FDI and exchange rate volatility such that the higher the volatility in the exchange rate the lower the certainty equivalent expected from exchange rate. For instance, the hypothesis of certainty equivalent levels is utilized in the expected profit functions of firms that make investment decisions today. In order to realize profits in future periods as observed by Goldberg and Koistad (1995). Conversely, Campa (1993) confirmed and extended the foregoing by asserting that risk neutral firms can utilize his assertion by means of augmenting their future expected profit. Thereby implying that will postpone their decision to enter as the exchange rate becomes more volatile thereby reducing the expected values of investing project which in turn reduce the FDI. No wonder Sercu and Vanhulle (1992) supports the aforementioned theory in a convincing way than the production flexibility argument with respect to the effect of short term exchange rate volatility which is seen as exogenous and unanticipated economic activity.

2.2.3 The exchange rate sheltering hypothesis

According to this theory firms from countries whose currencies command a premium have advantage in investing abroad and that real exchange rate depreciation can be harmful to domestic production as to produce foreign competition. Evaluation of the sheltering hypothesis suggests that it is inconsistent with the profit-maximizing behavior of firms. However, this hypothesis fails to justify why firms of strong currency economies enjoy hedging advantages. In spite of the volume of foreign investment, persistent ignorance in making decision to consolidate the above; Frost and Stero (1991) pinpoint that an appreciation of host currency has the tendency to increase FDI inflows.

2.2.4 Portfolio allocation Theory

This theory emanates from the traditional multiplier–accelerator model which states that variations in capital stock are determined basically by income and interest rate. Although, other factor that affects investment cannot be undetermined these among others incorporates risk, government policy and expected reforms via profitability accrued to investment. According to Fedderke (2002) the theory of portfolio allocation stipulates that foreign investment flows are determined by factors such as rates of return and risk. On the hand, foreign capital flows respond positively to rates of return which is adversely affected by uncertainty.

2.3 Empirical Evidence

From the array of literatures, it was discovered that while most FDI theories exhibit some empirical backings there are no sufficient supports for any single hypothesis as observed by Linzondo (1990). Although the reason for the foregoing is not far-fetched from the fact that this current study seeks to proffer justification for the sustainability of the adopted model in showing the relationship between exchange rate variability and FDI inflows within the Nigerian context.

Apparently, different techniques have been used by different authors and researchers to establish the relationship between exchange rate, exchange rate volatility and FDI inflows. For instance, Pain (2003) investigated the effect of exchange rate volatility on FDI over the period from 1981-2001. Results from his analysis depicts that higher real exchange rate volatility has a significant positive influence on inward investment from Germany into other European countries during the early and late 1990's while greater exchange rate volatility discourages FDI over the remaining periods.

Similarly, Tokunbo and Lloyd (2009) empirically investigated the impact of exchange rate volatility on inward FDI of Nigeria, by employing co integration and error correction techniques. Evidence from their results depicts that there is a positive relationship between recipient currency depreciation and FDI inflows. It was further discovered from their study that exchange rate volatility has no deterministic effect on FDI as incorporated in the standard deviation of exchange rate. In the same vein, Udomkergmogkol and Morrissey (2009) examined the linkage between exchange rate and FDI.

On the contrary, the study of Brozozoneski (2003) employed fixed assets OLS and GMM, Arellano – Bond model to examine the effect of exchange rate risk on FDI for 32 countries. Evidently, from the GARCH (1, 1), test, it was discovered that volatility has the tendency to influence FDI negatively. His study was corroborated by other authors' findings that exchange rate volatility has the tendency to influence FDI negatively. These authors among others include Barrell et al (2003), Felipe (2003) to mention few.

Furthermore, Furceri and Borelli (2008) purport that the effect of exchange rate volatility on FDI depends on a country's degree of openness. The results of their study further buttressed that exchange rate volatility exhibit a positive or null effect on FDI for economies that are relatively closed. On the other hand, it portrays a negative effect on the economies with high level of openness. Over and above all, the study of Rashid and Fazal (2010) used panel data to investigate the capital inflows and exchange rate volatility in Pakistan by applying linear and non-linear co-integration on monthly data from 1990-2007. The result indicates that, monetary expansion and inflation emanates from the inflows of capital thereby making capital inflow to exhibit the tendency to fuel exchange rate volatility. From the instances of the above, Arbatli (2011) undertook a multidimensional study on the determinants of FDI. Although, on his own case he incorporated country specific factors pull as well as global push, factors coupled with macroeconomic and institutional variables were between 1990-2009. The result showed that floating exchange rate regime is more conducive for FDI as well as promoting that floating regime is more prone to uncertainty.

After a critical review of theoretical as well as empirical literature it was discovered that there is no clear cut consensus regarding the impact of exchange rate volatility on FDI. For instance, a survey of past studies on this subject matter depicts an inconclusive outcome. While some studies exhibited positive effect others showed a negative and indeterminate effect. For instance, the former (positive) proffers a justification that FDI is export substituting. In that an increase in exchange rate volatility between the investors and host country induced a multinational to serve the host country via local production facility rather than exports thereby insulating against currency risk. On the other hand, the justification put for the negative effect emanates from the literature of irreversibility anchored by Dixit and Pindyck (1994). Given the standpoint of the above, this current study, using time series data will investigate further to ascertain if there is any relationship between exchange rate volatility and foreign Capital Inflow in Nigeria or not?

3.0 The Model and Data Sources

3.1 The Model

The model for this current paper aroused from both the empirical and theoretical foundation as stipulated in the above section. The model is specified as:

$$FDI = \alpha_0 + \alpha_1 (RGDP)_t + \alpha_2 (INT_n)_t + \alpha_3 (VEXR)_t + \alpha_4 (TOPEN)_t + \alpha_5 (INFR)_t + \varepsilon_t \quad (1)$$

To estimate the short-run relationship among variables in equation (1), the error correction model is specified as:

$$\begin{aligned} \Delta FDI_t = & \alpha_0 + \sum_{i=1}^2 \beta_1 \Delta FDI_{t-i} + \sum_{i=1}^2 \beta_2 \Delta RGDP_{t-i} \\ & + \sum_{i=1}^2 \beta_3 \Delta INT_{t-i} + \sum_{i=1}^2 \beta_4 \Delta V + \sum_{i=1}^2 \beta_6 \Delta IFR_{t-i} \\ & + \psi ECM_{t-i} + \varepsilon_t \end{aligned}$$

The ECM_{t-1} is the error correction term. The coefficient of the ECM_{t-1} measures the speed of adjustment towards the long run equilibrium.

Where: FDI=foreign direct investment;
 RGDP= Economic Growth
 INT=short term interest rate;
 VEXR= exchange rate volatility
 TOPEN=trade openness;
 IFR=infrastructures

Measurement of Volatility

Exchange rate volatility is calculated using the Generalized Auto-Regressive Conditional Heteroscedasticity GARCH (1,1) methodology specified as:

AR (q) is defined as:

$$y_t = \hat{\nu}_0 + \sum_{i=1}^q \hat{\nu}_i y_{t-i} + v_t$$

$$v_t \sim N(0, \sigma_t^2)$$

Equation (3) above is the conditional mean and described how y_t evolves over time.

The conditional variance equation of equation (3) is given below.

(b) AR(q)-GARCH (1,1) is defined as:

$$\sigma_t^2 = \hat{\nu}_0 + \hat{\nu}_1 v_{t-1}^2 + \phi \sigma_{t-1}^2 \xi_t$$

where y_t is exchange rate; v_t is the residuals that are used to test for the presence of GARCH effects in y_t ; q is the lag length chosen on the basis of AIC and/or BSC; σ_t^2 is the conditional effects in y_t derived from GARCH (1, 1), ξ_t is the standardized residuals, and $\hat{\nu}_0, \hat{\nu}_1$ and ϕ are constant such that $\hat{\nu}_0 > 0, \hat{\nu}_1 \geq 0, \phi \geq 0$ and $0 < \phi < 1$ for the process to be stable. Therefore, the non-negativity constraint is imposed on σ_t^2 . Otherwise, given a negative coefficient, a sufficiently large realized value of the lagged squared error term v_{t-1}^2 would result in a negative σ_t^2 . If the value of v_{t-1}^2 is large, the conditional variance of v_t will be large as well and vice-versa (Chipili, 2012).

3.2 Data Sources

The data sources for the dependent and explanatory variables was gotten from a secondary source vis-à-vis the statistical bulletin of the Central Bank of Nigeria, Statement of annual reports, World Development Indicators (WDI) published by the World Bank. The data used were annual, this is based on the constraint of getting quarterly data.

3.3 Economic Methods and Estimation Techniques

All the variables used are in their logged form with exception to exchange rate volatility, trade openness and domestic interest rate. This is because it would make interpretation more robust and meaningful. Furthermore, volatility is measured by ARCH/GARCH technique according to Engle (1982) and Bollersler (1986). Moreso, as a result of the use of different time series data some econometric techniques were utilized. More importantly, they are employed to basically achieve the objectives of this current study. These among others include the GARCH modeling techniques used to determine volatility of exchange rate. The study also employed unit root test, co-integration and vector Error correction-mechanism.

4.0 Empirical Analysis

4.1 Unit Root Test

This study commenced its empirical analysis by testing the properties of the variables via the Augmented Dickey-Fuller (ADF) and the Philip-Perron unit root tests. Both test showed that all the variables were integrated of order one; that is, the variables became stationary after first difference. The stationarity test estimates are presented in table 1.

Table 1: Unit Root Test

Augumented Dickey-Fuller (ADF) Test				Philip-Perron (PP) Test		
Variables	Level	1 st Diff	Status	Level	1 st /2 nd Diff	Status
lfdi	-0.1824	-10.9151*	I(1)	-0.9902	-11.6954*	I(1)
lrgdp	0.9030	-3.2296*	I(1)	1.8865	-3.0920*	I(1)
Int	-2.5605	-5.5466*	I(1)	-2.4872	-7.4290*	I(1)
Vol_ext	0.6537	-3.6556*	I(1)	0.6537	-3.6556*	I(1)
Open	3.5937	-6.6676*	I(1)	4.4430	-6.6442*	I(1)
Lifr	1.4138	-3.9504*	I(1)	2.6449	-3.7713*	I(1)

Note: *=1% and **=5% significance level.

4.2 Co-integration Estimation

Sequel to the unit root estimation above, the co-integration estimate was carried out using the Johansen (1991) co-integration technique. This is a powerful co-integration test, particularly when a multivariate model is used. Also, it is robust to various departures from normality in that it allows any of the six variables in the model to be used as the dependent variable while maintaining the same co-integration result (Nwachukwu and Odigie, 2009). The result of the co-integration estimate is presented in table 2 below.

Table 2: Summary of the co-integration Estimation

Trace Test			Maximum Eigen value Test				
Null	Alternative	Statistics	95% critical values	Null	Alternative	Statistics	95% critical values
=0	$r \geq 1$	133.745	95.754	r=0	r=1	53.279	40.076
≤ 1	$r \geq 2$	80.467	69.818	$r \leq 1$	r=2	36.739	33.877
≤ 2	$r \geq 3$	43.727	47.856	$r \leq 2$	r=3	18.997	27.584
≤ 3	$r \geq 4$	24.731	29.797	$r \leq 3$	r=4	13.663	21.1325cfr

Source: Author’s Computation, 2013

From table 2, it was observed that the null hypothesis of no co-integration, for $r=0$ and $r \leq 1$ were rejected by both the trace and the maximum eigen-value statistic. The statistical values of these tests were greater than their critical values. However, the null hypothesis of no co-integration that is $r \leq 2$ could not be rejected by the trace and maximum eigen-value statistics because their statistical values were less than their critical values. The implication of the so-integration estimate is that there are three co-integrating equations at five per cent in the model. The long-run relationships (co-integrating equation) can be expressed as follows:

4.3 Long Run Estimate

$$\text{LFDI}_t = 2.731\text{OPNX}_t - 8.591\text{LRGDP}_t + 0.311\text{INT}_t \\ = 0.003\text{VOL_EXT}_t - 1.3651\text{FR}_t + \varepsilon_t$$

$$\text{T: } [9.754]^* \quad [-10.492]^* \quad [8.639]^* \quad [3.75]^* \quad [-6.563]^*$$

$$\text{SE: } (0.280) \quad (0.819) \quad (0.036) \quad (0.0008) \quad (0.208)$$

Note: *, ** and *** implies 1%, 5% and 10% significance level respectively.

All the variables were observed to have a significant influence on foreign direct investment. With exception to economic growth (LRGDP) and infrastructures (LINFRA) which had negative effects on foreign direct investment, all other variables in the model had positive effect on foreign direct investment. With respect to the variable of interest, exchange rate volatility (VOL_EXT) had positive and significant influence on foreign direct investment which was in line to the findings by Dhakal, Nag, Pradhan and Upadhyaya (2010) but in contrast to the findings by (Udoh & Egwaikhide, 2008; Chakrabarti, 2001). The positive effect of trade openness (OPNX) and short term interest (INT) indicate that the more open an economy is and the higher the level of domestic interest rate, the higher would be the inflow of foreign direct investment into the Nigerian economy. The negative effect of economic growth (LRGDP) and infrastructures (LINFRA) indicate that the more of these variables the lower the level FDI inflows into the Nigerian economy.

4.4 Dynamic Error Correction Model

In addition to the long run estimate discussed above, the short run relationship among the variables was also examined. Before, the short run estimate, the stationarity property of the residual from the long run estimate was examined and the result is presented on table 3 below. Both the Augmented Dickey Fuller test (ADF) and the Philip-Perron test revealed that the residual is integrated of order one at five per cent significant level.

Variable	ADF Test	P-P Test	Order of Integration
Resid	-7.0455*	-9.7349*	I(0)

Note: *implies 1% significance level.

Following the residual stationarity test, we over parameterized the first differenced form of the variables in equation (2) and used Schwarz Information Criteria to guide parsimonious reduction of the model. This helps to identify the main dynamic pattern in the model and to ensure that the dynamics of the model have not been constrained by inappropriate lag length specification (Amassoma et al, 2011; 2013).

With respect to the parsimonious regression estimate capturing the short run analysis, it is observed from table 4 that there are significant improvement in the parsimonious model of the over parameterized model (see appendix). The Adjusted R-square, F-stat, and the D.W improved significantly. The results further showed that the coefficient of the error-term for the ECM model is both statistically significant at one per cent and negative. The coefficient estimate of the error correction term of -1.12 implied that the model corrects its short run equilibrium by about 112 per cent speed of adjustment in order to return to the long run equilibrium. Also, the negative sign of the error correction term indicates a move back towards equilibrium.

Apart from the above, the appropriateness of the model was further verified by carrying our various diagnostic tests on the residual of the ECM model; namely the histogram and normality test, the serial correlation LM test and the heteroskedasticity

Breusch-Pagan-Godfrey and ARCH Tests. The Jarque-Bera statistic from the histogram and normality test was insignificant (see appendix), implying that the residual from the error correction model is normally distributed. Moreso, both the serial correlation and the heteroskedasticity Breusch-Pagan-Godfrey and ARCH tests confirmed that there is no serial correlation in the residuals of the ECM regression (see appendix). This is because the F-statistics of both tests were insignificant. This shows that there are no lagged forecast variances in the conditional variance equation. In other words, the errors are conditionally normally distributed, and can be used for inference (Nwachukwu and Odigie, 2009). Overall, the model could be considered to be reasonably specified based on its statistical significance and fitness.

In addition to the above and with respect to the coefficient of individual variables, it was observed that the co-efficient of the first lagged value of foreign direct investment was positive (0.362) and significant while the coefficients of the first (-0.773) and second lagged (-0.407) values of trade openness was negative and significant. The coefficient value of current economic growth was positive (3.710) and positive while the coefficients of the first (-0.043) and second lagged (-0.088) values of short term interest rate were also significant but negative. The coefficients of current value of exchange rate volatility was observed to be negative and insignificant while the coefficient of value of the first lag of infrastructure was positive (1.556) and significant at one per cent level.

With respect to the key variable of interest, it was revealed that exchange rate volatility has a positive and significant effect on foreign direct investment in the long run while in the short run it revealed a negative but insignificant effect on foreign direct investment in the short run. The implication of these findings is that exchange rate volatility increases the inflows of foreign direct investment into the Nigerian economy but the magnitude of such effect is so infinitesimal. The positive relationship between exchange rate volatility and foreign direct investment may result from the fact that given the historical depreciation of exchange rate in the Nigeria, it may be the case that Multinational Companies (MNCs) perceive volatility more towards depreciation and under such situation it may be profitable for these companies to move production to the Nigerian economy (Dhakal et al., 2010). However, in the short run have a negative but significant effect on foreign direct investment in Nigeria.

Table 4: Parsimonious Short Run Regression Estimate

<i>Variables</i>	Coefficient	Std. Error	t-Statistics	Probability
C	-0.2295	0.1209	-1.8988	0.0747
ECM(-1)	-1.1213	0.1733	-6.4694	0.0000
Δ LFDI(-2)	0.3620	0.1089	3.3249	0.0040
Δ LOPNX(-1)	-0.7727	0.2162	-3.5742	0.0023
Δ LOPNX(-2)	-0.4069	0.1557	-2.6142	0.0181
Δ LRGDP	3.7095	1.3229	2.8040	0.0122
Δ INT(-1)	-0.0429	0.0189	-2.2711	0.0364
Δ INT(-2)	-0.0875	0.0244	-3.5852	0.0364
Δ VOL_EXT	-1.71E-05	1.06E-05	-1.6154	0.1246
Δ LIFR(-1)	1.5563	0.4099	3.7964	0.0014
Adjusted R2	0.8704	S.D dependent		0.6088
S.E of Regression	0.2710	Var:F-Statistic		12.689
D.W Stat	2.4104	Prob. (F-Statistic)		0.0000

Source: Author's Computation, 2013

5. Summary and Conclusion

The relationship between exchange rate volatility and foreign direct investment in Nigeria within the period 1981 to 2010 has formed the main concern of this paper. The stationarity result revealed that all the variables are integrated of order one while the Johansen co-integration estimate showed that the variables in the model were co-integrated. Sequel to the co-integration estimate, the long run estimate showed that exchange rate volatility had a significant and positive influence on foreign direct investment, while short run estimate revealed that exchange rate volatility had a negative effect on foreign direct investment but this effect was observed to be significant in the short run.

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Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.776641	Prob. F(2, 15)	0.4776
		Prob. Chi-	
Obs*R-squared	2.533553	Square(2)	0.2817

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.794556	Prob. F(9, 17)	0.6260
		Prob. Chi-	
Obs*R-squared	7.994582	Square(9)	0.5347
Scaled explained SS		prob. Chi-	
	3.788723	Square(9)	0.9248

Heteroskedasticity Test: ARCH

F-statistic	0.815590	Prob. F(1, 24)	0.3754
		Prob. Chi-	
Obs*R-squared	0.854517	Square(1)	0.3553