# Exchange Rate Volatility in Nigeria: Evidence from a Parametric Measure

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## ABSTRACT

*The study uses a parametric measure to discover the trend and possible causes of exchange rate volatility in Nigeria over the period 1986: 1-- 2009: 4. The study revealed that exchange rate has been volatile in Nigeria given the fact that the standard deviation of exchange rate has been unusually high and unusually low during the period under investigation. The parametric measure of exchange rate further confirmed a high degree of volatility which portrays higher risk to a risk-averse economic agent. The study therefore recommends that the government should always take a cognizance look at the frequent movement in the exchange rate with a view to regulating it because higher risks attached to high degree of volatility may scare off both domestic and foreign investors.*

**Keywords:** *Exchange Rate, Nigeria, E-GARCH*

## 1. INTRODUCTION

Prior to the introduction of Structural Adjustment Program (SAP) in 1986, Naira enjoyed appreciable value against US dollar, a factor that creates opportunity for rapid economic growth and stability. With introduction of new economic program, the country began to suffer unstable exchange rate that caused a high degree of uncertainty in the Nigeria business environment. Domestic investors face enormous risk as no one, no matter how intelligent could predict the likelihood of the foreign exchange market performance. The situation must equally have an effect on importation level of the country. Nigeria as a developing country striving to develop its industrial base needs to harness its foreign exchange market to enable domestic investors import relevant machineries, equipments and raw materials for the industrial consumption (Abba, 2008).

### 1.1 Statement of Problem

Exchange rate volatility according to the literature has to do with the unusual movements of the exchange rate. Several authors have therefore written on the extent to which the volatility in exchange rate has affected some basic macroeconomics phenomena which normally determine the directions of the working of the economy. The standard theoretical justification of the investigation of the volatility in exchange rate is that exchange rate volatility represents uncertainty and risk which will impose costs on risk-averse economic agents (Isitua, 2006). However, in a reaction to this, literatures have given diverse results. The diversity of results may not be unconnected with the fact that different methods of measuring exchange rate volatility have been adopted by different researchers over time.

There are no general ways of measuring volatility according to existing theories. This is because there is no consensus on the model of firm behaviour facing risk arising from fluctuations in exchange rates; Different statistical measures of exchange rate volatility have been proposed in the literature.

However, two measures have widely been used in the literature on this subject. These are the simple standard deviation method and a volatility measure generated from a generalised autoregressive conditional heteroscedasticity (GARCH) process. The standard deviation method has been criticised for wrongly assuming that the empirical distribution of the exchange rate is normal and for ignoring the distinction between predictable and unpredictable elements in the exchange rates process (Musonda, 2000; Hook and Boon, 2000). The GARCH method has two distinct problems. Firstly, the non-negativity conditions of the variance may be violated by the estimated model. Secondly, the models cannot account for leverage effects, although they can account for volatility clustering and leptokurtosis in the series. Different economists use different models to

measure exchange rate volatility (Orkhan, 2010). Orkhan (2010) however gives the list of various means of measuring volatility in the exchange rate and their users including the results (see Orkhan, 2010)

The paper therefore aims at using a different approach to the measure of volatility in exchange rate, which is parametric in nature and then analyse the trend which the exchange rate volatility has followed and discuss the possible causes of such trend in the Nigerian exchange rate system.

## 1.2 Significance of The Study

This study is conducted to discover the trend and pattern that exchange rate volatility follows in Nigeria. Given the fact that exchange rates across world's major currency have ceased to assume a fixed rate, it is necessary to conduct a research on the extent to which exchange rate has been volatile in Nigeria so that the country's policy makers at all capacities can be resuscitated of the danger attached to volatility in exchange rate and suggest possible way-out

The rest of the paper is organised as follows; chapter two covers the review of current related literature, chapter three addresses the methodology adopted in the study while chapter four presents the analysis, chapter five concludes the study

## 2. LITERATURE
## 2.1 Conceptual framework
### 2.1.1 The Concept of Exchange Rate
Exchange rate is simply the price of foreign currency which clears the foreign exchange market (Mcdonald, 1990). Therefore, exchange rate of currency is the link between domestic and foreign prices of goods and services. Also, exchange rate can either appreciate or depreciate. Appreciation in the exchange rate occurs if less unit of domestic currency exchanges for a unit of foreign currency while depreciation in exchange rate occurs if more unit of domestic currency exchanges for a unit of foreign currency. However, exchange rate can be measured in two ways;

    (i)       the nominal exchange rate
    (ii)     the real exchange rate

The nominal exchange rate is the number of unit of domestic currency that must be given up to get a unit of foreign currency. In other word, nominal exchange rate is the price of domestic in term of foreign currency. It is denoted as E.

The real exchange rate is the relative price of foreign goods in term of domestic goods. In other word, it is the exchange rate adjusted for price. It is denoted as;

$e=Ep^*/p$

Where E= nominal exchange rate

p*=foreign price

p=domestic price

### 2.1.2    Volatility in the Exchange Rate
Exchange rate volatility is defined as the risk associated with the unexpected movement in the exchange rate (Ozturk, 2006). In other word, it is the risk associated with currency depreciation or appreciation. In the literature, the word volatility takes a very specific meaning. "Volatility is the day to day, month to month variability of exchange rate, a variability that may have no trend to it" (Marston et al, 1988). In other word, volatility is a high frequency concept referring to movements in the exchange rate over relatively short period of time. But it is not the only component of variability. There is also another component of exchange rate variability which is called misalignment. Misalignment refers to long-lasting movements of exchange rate from its long run equilibrium. Misalignment refers to capacity for an exchange rate to depart from its fundamentals over a long period of time. Distinction between volatility and misalignment is important because there is evidence that the movement in the exchange rate reflected in the volatility measures is unanticipated. So, trading firms must cope with uncertainty about exchange rates. That means international trade is affected by this kind of variability. In contrast to exchange rate volatility, misalignments mostly anticipated and they undermine economic performance in several dimensions. They may generate adjustment cost, recession, deindustrialization, inflation and protectionism.

Since 1973, collapsing fixed parity system, Bretton-Woods and moving to flexible exchange rates, the nature of exchange rate variability has changed considerably. There is strong evidence that volatility is much greater under flexible exchange rates regimes. Before the collapse of the Bretton-Woods system, exchange rates were

fixed at an official rate and adjustment took the form of infrequent discreet jumps in the level of exchange rate. After 1973, exchange rates were allowed to adjust more or less continuously in response to market forces. There was widespread surprise in the early years floating at the size of the short-time fluctuations in the exchange rates, they were expected to diminish as markets learned to cope with rapid changing in market conditions. But volatility has not diminished (Kenen and Rodrik, 1986)

Various statistical measures of volatility have been used in the literature. Some of these measures are standard deviation, deviation from trend, the difference between previous forward and current spot rates, Gini mean difference coefficient, and scale measure of variability. However, these all measures have their own shortcomings. Instead of using above measures of volatility, Autoregressive Conditional Heteroskedasticity (ARCH) type of models has often been used in the literature lately (Kayis and Ozturk, 2005).

### 2.1.3    *Evolution of the Foreign Exchange Markets in Nigeria*
The evolution of the foreign exchange market in Nigeria could be traced to the establishment of the Central Bank of Nigeria (CBN) in 1958 and subsequent enactment of the Exchange Control Act of 1962. Prior to this period, foreign exchange earned by the private sector used to be held in balances abroad by commercial banks, which acted as agents for local exporters. Similarly, during the period agricultural exports contributed the bulk of foreign exchange receipts. The fact that the Nigerian pound was tied to the British pound sterling at par, with easy convertibility, delayed the development of an active foreign exchange market. With introduction of Naira as an official currency of Nigeria, the exchange process commenced.

However, the increased exports of crude oil, in the early 1970s, following the sharp rise in its prices enhanced official foreign exchange receipts. The foreign exchange market experienced a boom during this period and the management of foreign exchange resources became necessary to ensure that shortages did not arise. However, it was until 1982 that comprehensive exchange controls were applied as a result of foreign exchange crisis that set in that year. The increasing demand for foreign exchange at a time when the supply was shrinking encouraged the development of a flourishing parallel market for foreign exchange.

Before 1986, importers and exporters of non-oil commodities in Nigeria were required to get appropriate licenses from the federal ministry of Commerce before they could participate in the foreign exchange market. Generally, import procedures followed the international standard of opening of letters of credit (L/Cs) and subsequent confirmation by correspondent banks abroad. The use of form 'M' was introduced in 1979 when the comprehensive import supervision scheme (CISS) was put in place to guard against sharp import practices. The authorization of foreign exchange disbursement was a shared responsibility between the federal ministry of finance and the CBN. The federal ministry of finance had responsibility for public sector applications, while the CBN allocated foreign exchange in respect of private sector applications.

The exchange control system was unable to evolve an appropriate mechanism for foreign exchange allocation in consonance with the goal of internal balance. This led to the introduction of the second-tier foreign exchange market (SFEM) in September, 1986. Under SFEM, the determination of the Naira exchange rate and allocation of foreign exchange were based on market forces. To enlarge the scope of the foreign exchange market, bureau de change was introduced in 1989 for dealing in privately sourced foreign exchange. Additionally, the federal ministry of finance had its allocative powers transferred to the CBN.

As a result of volatility in rates, further reforms were introduced in the foreign exchange market in 1994. These included the formal pegging of the Naira exchange rate, the centralization of foreign exchange in the CBN, the restriction of bureau de change to buy foreign exchange as agents of the CBN, the reaffirmation of the illegality of the parallel market and the discontinuation of open accounts and bills for collection as means of payments sectors.

The foreign exchange market was liberalized in 1995 with the introduction of an autonomous foreign exchange market (AFEM) for the sale of foreign exchange to end-users by the CBN through selected authorized dealers at market determined exchange rate. In addition, bureau de change was once more accorded the status of authorized buyers and sellers of foreign exchange. The foreign exchange market was further liberalized in October 1999 with the introduction of an inter-bank foreign exchange market (IFEM). (CBN Statistical Bulletin 2005, CBN Statistical Bulletin 2008)

### 2.2. Empirical Literature
Exchange rate volatility as discussed so far in this paper has to do with the unusual movements of the exchange rate. Exchange rate volatility became significant following the breakdown of the Bretton Wood Agreement in

1973 after which exchange rate became flexible among world currencies. Literature put it that exchange rate became more volatile in Nigeria after the introduction of widely known currency control measures called the Structural Adjustment Programme (SAP) in 1986. As a quick reminder, the interest of this paper lies in appraising several measures of volatility in exchange rate adopted by various recent authors in the literature and coming up with a distinct measure which may serve as a model of volatility measures.

In one of the noticeable empirical studies conducted can be traced to Vergil (2002). He investigated the impact of real exchange rate volatility on the export flows of Turkey to the United States and its three major trading partners in the European Union for the period between 1990 and 2000. The standard deviation of the percentage change in the real exchange rate is employed to measure the exchange rate volatility.

With a view to establishing a more elaborate measure of volatility in the exchange rate Pickard (2003) uses stochastic co-efficient econometric modelling to forecast real exchange rate volatility and examine how expected and unexpected volatility affect bilateral trade flows of certain steel products between Canada, Mexico and the United States in an empirical study using monthly data for the period 1996 – 2002. Also, in an attempt to adopt a parametric measure of exchange rate volatility in Nigeria, Isitua and Neville (2006) investigated the effect of exchange rate volatility on trade flows in Nigeria. Their study employed the generalized auto-regressive conditional heteroskedasticity (GARCH) technique to measure exchange rate volatility.

In conclusion, a critical look at the findings of these various authors reveals that the degree of exchange rate volatility differs from one study to the other. This, of course, might be the reason why the findings of these studies on the effect of exchange rate volatility on a particular macroeconomic phenomenon, such as trade are not uniform.

## 3. METHODOLOGY

Given the fact that several researchers have ignored the degree of volatility in exchange rate among world currencies, the paper adopts a more rigorous parametric measures of exchange rate volatility in Nigeria using the Exponential Generalised Autoregressive Conditional Heteroskedasticity (E-GARCH) modelling technique which addresses the defects identified with both the pure GARCH model and the simple standard deviation measure.

### 3.1 Technique of Analysis

Since exchange rate behaviour represent the only important variable of concern as depicted by the study so far, we start by testing for the its stationarity property. This is necessary given the recent innovation in econometric modelling which has indicated that many macroeconomics time series are not stationary in their levels and that many time series are most adequately represented by their first difference. In testing for stationary of the variables, we employed the Augmented Dickey-Fuller and Phillip-Peron Unit Root test.

In the ADF test, the hypothesis f=0 or p=1 of non-stationarity or unit root is tested against the alternative which states that a series is stationary if -1<p<1. The Philips-Peron test (PP) on the other hand uses non-parametric statistical methods to account for the serial correlation in the error term, without necessarily adding lagged difference terms as in the ADF case (see Sheu,2008).

According to Charemza and Deadman (1997),

ADF is given as

$$x_t = a_0 + a_1 x_{t-1} + \sum \alpha \, x_{t-1} + U_t$$

## 4. DATA ANALYSIS AND DISCUSSION

### 4.1  The Trend of Exchange Rate Volatility in Nigeria

Volatility in exchange rate is the unexpected movement either upward or downward of the exchange rate over a period of time. Therefore, as a result of its nature, it represents a risk associated with upward and downward movement of the exchange rate. Volatility in exchange rate has assumed various forms in Nigeria according to various studies in the literature. Also, studies have revealed different patterns taken by exchange rate volatility especially during the period under investigation in Nigeria. Some authors reported positive trend while some gave the contrary. All results have emerged from different measures of volatility. Thus, to find the trend of exchange rate volatility in Nigeria and with a view to discovering a more reliable trend of exchange rate volatility, both parametric and non-parametric measures of exchange rate volatility are undertaken in this study

### 4.1.1 Non-Parametric Measure of Exchange Rate Volatility

The non-parametric measure of exchange rate volatility gives the estimation of the mean and the standard deviation of exchange rate. This is shown in the table below

**Table 4.1. Means and Standard Deviation of Exchange Rate in Nigeria (1986-2009)**

| Sample | No of Observation | Mean | Standard Deviation |
|---|---|---|---|
| 1986-1991 | 6 | 5.99 | 2.69 |
| 1992-1997 | 6 | 21.15 | 1.72 |
| 1998-2003 | 6 | 96.49 | 35.4 |
| 2004-2009 | 6 | 131.2 | 9.24 |

The analysis carried out in the above shows that the standard deviation of the exchange rate has been unusually high and unusually low. This depicts a high degree of volatility in the exchange rate during the period under investigation.
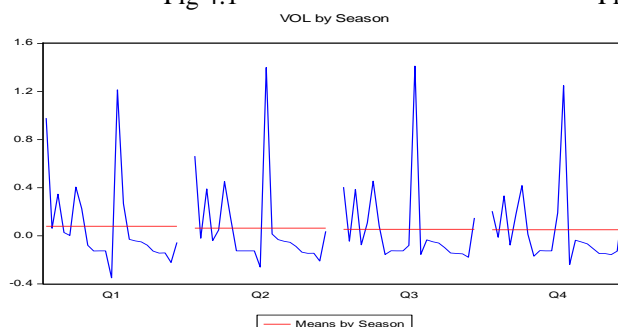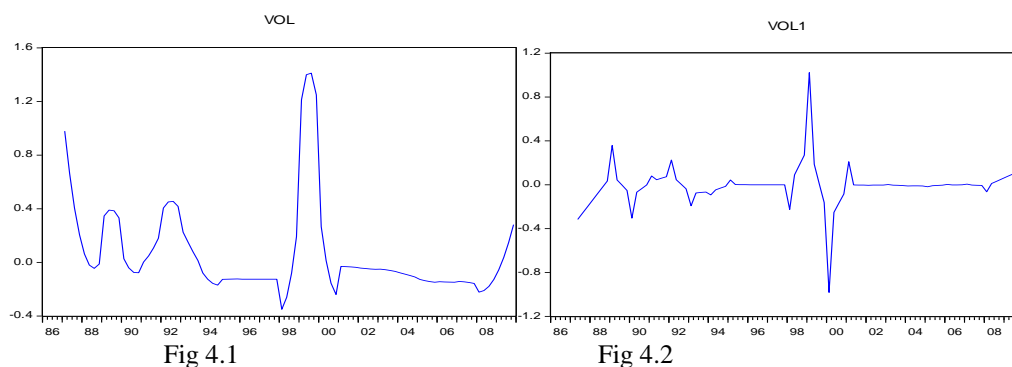
### 4.1.2. Parametric Measures of the Exchange Rate

The parametric measure of exchange rate volatility on the other hand estimates volatility in exchange rate using the Exponential Generalised Autoregressive Conditional Heteroskedasticity (E-GARCH) model in this study. This is distinct from some past studies that employed the pure GARCH model to estimate exchange rate volatility. Literatures have given a number of advantages of the E-GARCH model over other methods of measuring volatility. For instance, first, E-GARCH automatically tests for ARCH effects in the series. Second, the model expresses explicitly the log of the conditional variance which implies that the leverage effect is exponential rather than quadratic, and that forecasts of the conditional variance are guaranteed to be non-negative. The presence of leverage effect can be tested by the hypothesis that $\sigma < 0$. The impact is asymmetric if $\sigma \neq 0$

The EGARCH model was proposed by Nelson (1991). The specification for the conditional variance is:

$$\log(\sigma_t^2) = c + \beta \log(\sigma_{t-1}^2) + \alpha \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}}$$

Where $\sigma_t^2$ the conditional variance of the real exchange rate is, $\varepsilon_{t-1}$ are the residuals and $c$, $\beta$, $\alpha$ and $\gamma$ are parameter estimates. $\varepsilon_{t-1}$ represents the ARCH term, which is a measure of information about volatility in the previous period while $\sigma_{t-1}^2$ is the GARCH term representing last period's forecast variance. Figure 4.1 below shows the plots of exchange rate volatility trend measured with the above explained E-GARCH model



Fig 4.1                    Fig 4.2



Soure: Author's computation
Fig. 4.3

Figs 4.1-4.3 show the various plots of the trend of exchange rate movement from 1986 to 2009. A cursory look at these plots indicates that this variable displays clustering trend during the period under investigation. This is to further confirm the trend of exchange rate volatility in Nigeria. This trend clearly shows a high degree of variability of exchange rate, which equally denotes high degree of volatility. In the period between 1996 and 1998, the volatility is constant. This occurred following the adoption of pegged exchange rate policy during the period by the then military head of state, Gen. Sani Abacha. In a nutshell, it can be deduced that shift from controlled regime to market oriented regime of exchange rate paves way for high volatility of the foreign exchange rate in Nigeria.

## 5. CONCLUDING REMARK

Volatility in exchange rate began to interest researchers because of the nature of the exchange rate movement since the advent of the floating exchange rate movement following the breakdown of the Bretton Wood Agreement in 1973. Series of studies have been conducted in other to discover the effects of such volatility on major macroeconomics variables but this study diverted a little away by exploring more on the meaning, menace, danger, causes and the extent of exchange rate volatility in Nigeria. After series of analysis, the study found that; the standard deviation of the exchange rate is unusually high and unusually low suggesting that there is a substantial volatility in the exchange rate over the period under study. Also, during the course of the analysis, it was found that exchange rate displays a clustering trend during the period under investigation. This shows high degree of volatility in the exchange rate in Nigeria. Most studies in the literature have identified exchange rate volatility as a risk which will impose high cost on a risk-averse economic agent and the intensity of such risk depends greatly on the degree of the volatility. Higher degree of volatility will therefore bring about higher risk to the economic agent involved. A note of warning is therefore signalled to the government of Nigeria to always take cognizance look at the exchange rate movement with a view to regulating it. Since exchange rate volatility is high in Nigeria, both local and foreign investors may be scared of investing in the economy. This therefore portrays adverse effect on the GDP growth.

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