Factors Explaining Exchange Rate Volatility in Nigeria: Theory and Empirical Evidence

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Abstract

The study empirically investigated the factors explaining the volatility of the bilateral exchange rate of the naira to the U.S. dollar, using data for 1970-2013 period. The EGARCH (1,1) modeling technique was used. The empirical evidence indicated that volatility of the naira exchange rate was characterised by clustering, strong leverage effect and moderate degree of persistence. It was found that increased net capital flows, greater integration of the Nigerian economy into the global market, deepening of the nation's financial system, favourable crude oil prices, increase in the level of external reserves as well as economic growth were germane to dampening conditional volatility of the country's exchange rate. It was also found that external debt and monetary expansion had the potential to exacerbate volatility in the exchange rate. Policies recommended to mitigate volatility of the exchange rate included greater integration of the economy into the global market, which implies diversification of the country's export base, less reliance on external borrowing, building up and maintaining a robust external reserves position, financial system development and use of contractionary monetary policy to control broad money growth.

Keywords: Exchange Rate, Volatility, Theory, Empirical Evidence
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I. Introduction

A large volume of the literature on international trade and finance focuses on the effect of exchange rate volatility on economic growth. Several studies indicated that exchange rate volatility can negatively affect key macroeconomic indicators, including investment, productivity, consumption, trade and capital flows. However, a few empirical studies have focused on the determinants of volatility of exchange rate. Exchange rate volatility refers to wide fluctuations of the exchange rate around its equilibrium value. The swings generate uncertainty in the economy, and increase business and investment risks, with far-reaching negative spill-over effects in the case of developing and emerging market economies.

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The floating/flexible exchange rate regime is more susceptible to volatility, compared with a fixed exchange rate. Friedman (1953), however, observed that instability in exchange rate is a symptom of instability in the underlying economic structure. He argued that a flexible exchange rate system does not necessary have to be unstable, but where it is unstable, it is primarily because there is underlying instability in the economic conditions. Friedman's view was corroborated by Mckinnon and Schnabel (2004) and Stancik (2006), who noted that exchange rate stability is a fundamental property of stable economic development. The implication is that unstable economic development or output volatility is a major cause of exchange rate volatility (Morana, 2009).

The change from fixed exchange rate system to the flexible exchange rate system occurred in the industrial economies in 1971, following the collapse of the gold standard (Stockman, 1983; Mussa, 1986; Calderon and Kubota, 2009). Other countries, including some of the developing countries followed at various times later on. For example, in Nigeria, the switch from the fixed exchange rate regime to the flexible regime was in 1986, as part of the implementation of the Structural Adjustment Programme (SAP) policies; in Gambia, 1986; in Israel, 1990s; and in Venezuela, 2002. The general switch brought larger volatility for both real and nominal exchange rates (Al Samara, 2009), and the effects on economic growth and development of the nations have been pervasive. The effects have been mixed, though predominantly negative, especially in the developing economies (Davis and Lim, 2001; Devereux and Lane, 2001; Schnabel, 2007; Ezike and Amah, 2011).

Exchange rate is a key macroeconomic price which has significant implications for an economy. Excessive exchange rate volatility causes uncertainty in the economy, impacting negatively on economic growth through its effects on investment and investor confidence, productivity, consumption as well as international flows of trade and capital (Broda and Romalis, 2003; Ezike and Amah, 2011). Most developing and emerging economies with the free float/flexible exchange rate system would have to grapple with the problem of exchange rate volatility, leading to "a fear of floating". (Calvo and Reinhart, 2002; Deveneux and Lane, 2001).

From a microeconomic perspective, exchange rate volatility is associated with higher transaction costs, as the cost of hedging foreign exchange risk increase with volatility (Adubi, 1999; Schnabel, 2007). At the macro level, it causes inflation, due to the high cost of hedging foreign exchange against the risk it generates.

Exchange rate volatility also adversely affects international trade and capital flows (Stancik, 2006).

The deregulation of the Nigerian foreign exchange market in 1986, as part of the structural adjustment policies, marked the transition from fixed to the flexible exchange rate regime. Since that time the naira- exchange rate to the dollar has fluctuated remarkably. The effect of exchange rate volatility can be pervasive and devastating for an open, mono-product and highly import-dependent developing economy like Nigeria, with poorly developed financial markets (Aghion et. al., 2006). The country's export trade (especially non-oil export trade) has suffered much setback as a result of the instability in the exchange rate of the local currency (Aliu, 2003 and Nwidobie, 2007). Similarly, the nation's stock market has been adversely affected by volatility (Subair and Salihu, 2010). The nation, being highly import-dependent has experienced rising inflation rate, partly attributed to exchange rate volatility due to the high cost of hedging foreign exchange risk. Exchange rate volatility also affects both domestic and foreign investment adversely because it leads to uncertainty, affecting investors' confidence as well as engendering huge business and investment risk. It is, therefore, imperative for policy makers to implement policies that can stabilise exchange rate.

In view of the potential severe adverse implications that an excessively volatile exchange rate poses for economic growth and development, and the need to maintain stable economic growth, this paper sets out to investigate empirically the factors that may be germane to explaining the volatility in the naira-dollar exchange rates. Accordingly, the main objective of the paper is to investigate the factors that explain volatility of the bilateral exchange rate of the naira to the US dollar, with a view to recommending appropriate policies that can mitigate its volatility. To this end, we structure the rest of the paper, following this introductory section into four Sections. Section 2 surveys the related theoretical and empirical literature. The theoretical framework underlying the model to be specified and the methodology of the study are discussed in Section 3. Section 4 contains the discussion of the empirical results, while Section 5 contains the summary, policy recommendations and the conclusion.

II. Review of Literature

II.1 Factors Explaining Exchange Rate Volatility

Although, there is no consensus on the causative factors of exchange rate volatility, numerous factors have been identified in the literature. Some of the

factors are, oftentimes, country-specific. The commonly cited factors include trade openness, capital flows, economic growth rate, level of financial development, level of external reserves, external indebtedness, and existing exchange rate regime, among others. The way and manner as well as the extent to which each of the factors influences exchange rate movements, varies and depends on the prevailing economic conditions in each country (Stancik, 2006). It is widely agreed in the literature, however, that fluctuations in the exchange rate of countries in transition (i.e. emerging market economies) are more likely to be influenced by these factors (Stancik, 2006; Al Samara, 2009). In this section, we review the literature on the determinants of exchange rate volatility, and discuss the mechanism through which the various factors cause volatility.

II.1.1 Capital Flows

International capital flows comprise the flows of both long-term and short-term capital. Long-term capital such as foreign direct investment is often regarded as sustainable capital, while short-term capital comprising mainly of foreign portfolio investment (FPI) is regarded as temporary capital, (Rashid and Hussain, 2010). Inflow of capital causes appreciation of the domestic currency (Cordon, 1994; Oaikhenan and Aigheyisi, 2011), while outflow of capital leads to currency depreciation. Thus, the flow of capital in and out of an economy causes fluctuations in the exchange rate of the domestic currency in relation to the currencies of its trading partners. However, the degree of the fluctuations in the exchange rate arising from capital flows depends on the composition of the capital as well as the depth of the financial markets. Where there is a preponderance of short-term (temporary) capital which is generally believed to be highly volatile in nature, this may generate volatility in the exchange rate than when there is more of long-term (sustainable) capital (Jean-Louis, 2009 cited in Al Samara 2009). Kapur (2007) attributed excessive exchange rate volatility to what he called "destabilising capital flows". Sudden slowdown in private capital inflow into emerging market economies, and a corresponding slow reversal from large current account deficits into smaller deficits or small surpluses) can also generate volatility in the real exchange rate (Calderon and Kubota, 2009).

Capital flows generate less volatility in the exchange rate of countries with well-developed financial markets than in countries with poorly developed financial markets. Thus, it is widely agreed that international capital flows generate more volatility in exchange rate of the currencies of developing or transitional economies than in industrialised economies. This could be linked to the fact that the financial markets of most developing/emerging market economies are still poorly developed (Schnabel, 2007; Chit and Judge, 2008; Saborowski, 2009).

II.1.2 Trade Openness

Trade openness also plays a role in explaining volatility in exchange rate. The extent to which it influences exchange rate volatility depends on the degree of integration of the economy into the global market (Calderon and Kubota, 2009). The implication is that the more open an economy is, the less volatile is the exchange rate of its currency (Stancik, 2006). However, trade openness only mitigates volatility in the exchange rate where there is greater flexibility in the adjustment of aggregate prices (Obstfeld and Rogoff, 1995, 1996; Hau, 2000, 2002), and when the flexibility has been linked to greater openness of the economy (Obstfeld and Rogoff, 1996). These structural linkages between the degree of flexibility of aggregate prices and exchange rate volatility accentuate exchange rate volatility in less open economies. The situation is even more worrisome as policy actions to stabilise the exchange rate may risk greater volatility in inflation, output and interest rate. Thus, in the small open economy as espoused by Calvo and Reinhart (2002) and the sticky price model developed by Gali and Monacelli (2005), a necessary trade-off exists in the attainment of stability in exchange rate and ensuring stable inflation and output gap. Such economy can, therefore, be thought of as a balloon: squeezing volatility out of one part merely transfers the volatility elsewhere (Flood and Rose, 1999; West, 2003).

II.1.3 External Reserves

There are two main types of benefits that are derivable from a high level of external reserves holdings in the literature. The first is the reduction in the likelihood of currency crisis or a sudden stop, which is the sudden unwillingness by international lenders to renew their credit lines in times of market uncertainty. The second benefit is that higher reserves adequacy tends to be associated with lower external borrowing costs (Hviding, Nowak and Ricci, 2004). In addition, these authors also identified a third benefit of holding reserves in emerging market economies, namely it can help reduce real exchange rate volatility. This is because the monetary authority can make use of the stock of external reserves to stabilise the exchange rate of the domestic currency, thus preventing volatility in that market. The theory proposes the existence of an inverse relationship between the level of external reserves and the volatility of the real exchange rate (Cady and Gonzalez-Garcia, 2007). This relationship, according to Hviding et. al., (2004), seems to be non-linear to the extent that the benefits of holding reserves for lowering volatility diminish with higher reserves holdings. Thus, advanced economies with huge external reserves, highly liquid currencies and stable financial markets are unlikely to derive any significant value from reserves

holdings as a precautionary fund (Office of International Affairs, 2007). When the level of foreign reserves exceeds the level required for precautionary purpose, the benefit of holding reserves with a view to curtailing volatility in the exchange rate begins to diminish (Park and Estrada, 2009).

The external reserve level has important implications for macroeconomic stability and a country's ability to cope with external crises. This is particularly true for emerging market economies that are often plagued by external shocks, in the face of their limited access to international capital markets. Therefore, external reserves serve as an important insurance in these countries in the event of external shocks (Dhasmana, 2011).

II.1.4 Fiscal Deficit

Apriori reasoning considers the relationship between fiscal deficit and exchange rate volatility to be positive. This implies that huge fiscal deficits could cause wide swings in the exchange rate (Avila, 2011). This is corroborated by the existing empirical evidence which indicated that nominal effective exchange rate volatility was higher in countries with higher inflation and higher fiscal deficits (Canales-Kriljenko and Habermeier, 2009). Rising government deficits in relation to GDP, it has been argued, do not only engender high interest rate and volatility in exchange rate, it also caused adverse movements in other key macroeconomic aggregates (Ussher, 1998). Iyoha and Oriakhi (2002), in their study of the Nigerian economy, found that fluctuations in the naira-dollar exchange rates in the 1978 - 1985 period were caused by nominal shocks from fiscal deficits. Ogunleye (2008) also explained the sharp fluctuations in the real exchange rate by the excessive expenditure resulting from the oil wind-fall during the period.

II.1.5 Economic Growth

There is a plethora of theoretical and empirical studies focusing on the effect of exchange rate volatility on investment, productivity, trade, capital flows and economic growth (DeGrauwe,1988; Adubi and Okunmadewa, 1999; Aliu, 2003; Stancik, 2006, Aghion et. al., 2006; Schnabel, 2007; Aliyu, 2009; Boar, 2010; Shehu and Youtang, 2012). It is believed, however, that a two-way causal relationship exists between economic growth and exchange rate volatility. The implication is that economic growth can also cause exchange rate volatility. The exchange rates of currencies of highly developed economies appear to be more stable than those of emerging markets and developing countries (Calderon and Kubota, 2009). This has been attributed to the fact that the industrialised countries have well developed and stable financial system, unhindered access to international capital markets, highly liquid currencies, central bank

independence, highly open economies, and these countries also tend to adopt inflation targeting as their monetary policy framework. These features are known to accelerate the growth rate of their economies, and insulate them against external shocks, which cause volatility in key macroeconomic aggregates, the exchange rate inclusive. This is suggestive of the existence of an inverse relationship between economic growth and the volatility of real exchange rate. A high and possibly rising economic growth rate will tend to reduce volatility in the exchange rate (Bastourre and Carrera, 2007). Greater productivity, which is a necessary cause and effect of economic growth has also been associated with less volatility in exchange rate (Sanusi, 2004).

II.1.6 External Indebtedness

The direction of influence of external indebtedness on volatility in exchange rate remains as yet contentious. One line of argument is that external indebtedness could amplify volatility in the exchange rate, while another holds that it could mitigate it. According to Cavallo et. al., (2002), foreign indebtedness engenders volatility in the exchange rate. This is especially so in countries, where external liabilities are denominated in foreign currencies. Many emerging market economies may have little capacity to cope with a high degree of volatility in their exchange rate, compared with their creditors. This partly explains why they display *a fear of floating (*Eichengreen and Haussman, 1999; Calvo and Reinhart, 2002; Deveneux and Lane, 2002). External borrowings, especially by private commercial banks and firms, were identified as a major factor responsible for the severity of the Asia financial and currency crises during the late 1990s (Corsetti et. al., 1999; Kawai, 2002), with Indonesia, the Philippines, Thailand and South Korea the most severely affected economies. It is noteworthy that the accumulation of foreign debts had been rapid in those economies in the period that immediately preceded the outbreak of the 1997 financial crisis. The rapid accumulation of external debt, especially in the 1995/96 period resulted in an overshooting of the currencies of these Asian countries (Siregar and Pontines, 2005). Also, Devereux and Lane (2002) found that bilateral exchange rate volatility (relative to creditor countries) is strongly negatively affected by the stock of external debt. They noted that while this is true of developing economies, external debt is generally not significant in explaining bilateral exchange rate volatility in industrial countries.

II.1.7 Monetary Policy

Monetary policy is a potential stabilisation tool as well as an independent source of economic fluctuations (West, 2003; Gali and Monacelli, 2005). The goals of monetary policy include the attainment of price and exchange rate stability, full

employment, favourable balance of payments (BOP) position, maintaining low inflation rate, among others. Real exchange rate volatility has been associated with unpredictable movements in relative prices in an economy. Thus, the use of monetary policy in stabilising prices can also indirectly mitigate volatility in the real exchange rate.

The monetary authority influences the level of money supply and interest rates to achieve set targets and objectives. In economic theory, changes in money supply generate fluctuations in the exchange rate, *ceteris paribus*. While an increase in money supply depreciates the domestic currency, a decline in interest rate could trigger capital flight, resulting in a depreciation of the domestic currency (Al Samara, 2009). Changes in both foreign money supply and interest rate could also influence movements in the exchange rate of the domestic currency, if the economy is linked to the foreign economy. As a result of the linkages of money supply and interest rate to the exchange rate, shocks to money supply and interest rate could generate volatility in the exchange rate (Ogunleye, 2008; Grydaki and Fontas 2011).

In recent times, inflation-targeting has become a major monetary policy framework used by many monetary authorities. Its implementation also has some implications for exchange rate volatility. Nominal and real exchange rate volatility is typically lower in countries where this framework has been adopted, compared with countries that do not adopt inflation-targeting (Rose, 2007). Thus, monetary policy can be used to control both nominal and real exchange rate volatilities. Olalekan(2008), however, stated that exchange rate volatility responds to monetary policy with some lags. This, in his view, implies that monetary policy may be effective in dampening exchange rate volatility in the medium horizon but might not be effective in the short-run.

II.1.8 Exchange Rate Regime

The two commonly adopted exchange rate regimes are the fixed regime and the flexible regime. However, since the collapse of the Bretton Woods system in 1972, several variants of exchange rate arrangements have emerged. Some of these variants are very similar, making it almost impossible to distinguish between the fixed and the flexible exchange rate regimes, and they include the managed floating, crawling pegs, crawling bands, currency boards, dollarisation, pegged-but-adjustable-systems, among others (Frenkel, 1999; Edwards (2002) cited in Bastourre and Correra (2007). It is often hard to figure out what the exchange rate regime of a country is in practice since there are multiple conflicting regime classifications (Rose, 2011). In a fixed exchange rate regime (also referred to as

pegged exchange rate regime), the value of the domestic currency is pegged to that of another single currency or to a basket of currencies or to another measure of value such as gold. A fixed exchange rate arrangement serves to stabilise the value of a domestic currency in relation to the currency to which it is pegged. This makes trade and investment between the two countries easier and more predictable, and it is especially useful for small open economies (with relatively less developed financial markets) in which the share of external trade to GDP is significant.

In a flexible exchange rate regime, the value of a currency is allowed to fluctuate according to the market forces of demand and supply in the foreign exchange market. Managed float regime (also known as dirty-float) is an exchange rate arrangement in which the exchange rate fluctuates from day to day, with the monetary authority oftentimes intervening to influence the exchange rate by buying and/or selling the foreign currency as and when required.

The consensus is that exchange rates are generally more stable in fixed than in flexible regimes. Put differently, exchange rates tend to be more volatile in flexible regime, although the stability of the exchange rate has been linked to stable economic development (Mckinnon and Schnabl, 2004; Stancik, 2006). To Friedman (1953), the instability of the exchange rate can be linked to instability in the underlying economic structure. To him, a flexible exchange rate needs not be an unstable exchange rate, but where it is unstable, it is primarily because there is instability in the underlying economic conditions. This suggests that though exchange rate volatility is more of an issue in flexible exchange rate regime, the stability or otherwise of the exchange rate is also influenced by the stability (or otherwise) of the underlying economic conditions. Thus, according to Flood and Rose (1999), it is simply hard to believe that the post-1973 (floating) era has been so much more volatile from a macroeconomic perspective than the pre-1973 (fixed) period.

II.2 Exchange Rate Policies and Regimes in Nigeria

The main objectives of exchange rate policy in Nigeria are to preserve the value of the domestic currency (the naira), maintain a favourable external reserves position and ensure external balance without compromising the need for internal balance and the overall goal of macroeconomic stability (CBN, 2011). In Nigeria, in the early 1960s there was little concern for exchange rate policy as it had almost no significance in macroeconomic management. Between 1960 and 1967, the Nigerian currency was adjusted in relation to the British pound with a

one-to-one relationship between them. A fixed parity was also maintained with the American dollar between 1967 and 1974.

The fixed parity arrangement was abandoned between 1974 and late 1976, when an independent exchange rate management policy commenced. This pegged the naira to either the U.S. dollar or the British pound sterling, whichever currency was stronger in the foreign exchange market. The main objective of exchange rate policy in this period was to operate an independently managed exchange rate system that would influence real variables in the economy and to lower the rate of inflation. Consequently, a policy of progressive appreciation of the naira was pursued over the period, aided by the oil boom that occurred at the same time (Adubi, 1999). The oil boom in the 1970s made it mandatory to manage foreign exchange resources to avoid a shortage in the event of a slump in oil prices. However, shortages in the late 1970s and early 1980s compelled the government to introduce some *ad hoc* measures to control excessive demand for foreign exchange. It was not until 1982 that comprehensive exchange control measures were put in place. The increasing demand for foreign exchange at a time when supply was shrinking encouraged the development of a flourishing parallel market for foreign exchange. In general, the exchange control system was unable to evolve an appropriate mechanism for foreign exchange allocation that achieves internal balance. The system was discarded on September 26, 1986, with a new mechanism put in place under the Structural Adjustment Programme (SAP) that was introduced in 1986.

Under the SAP, a transitory dual exchange rate system was adopted. This, however, metamorphosed into the foreign exchange market (FEM) in 1987. Bureau-de-Change was introduced in 1989 with a view to enlarging the size of the FEM. In 1994, there was a policy reversal which was necessitated by the unrelenting pressure on the naira in the foreign exchange market. Further reforms such as the formal pegging of the naira exchange rate, the centralisation of foreign exchange in the CBN, the restriction of Bureau-de-Change to buy foreign exchange as agents of the CBN, were introduced into the foreign exchange market in 1994 to mitigate volatility in exchange rates. There was another policy reversal in 1995 to that of guided-deregulation. This resulted in the Autonomous Foreign Exchange Market (AFEM), the failure of which led to the introduction of a daily, two-way quote Inter-bank Foreign Exchange Market (IFEM) on October 25, 1999.

The Dutch Auction System (DAS) was introduced on July 22, 2002 to replace the IFEM as a result of the increased demand pressure in the foreign exchange

market, leading to depletion of the country's external reserves. The DAS was conceived as a two-way auction system in which both the CBN and authorised dealers would participate in the foreign exchange market to buy and sell foreign exchange (Omojemite and Akpokodje, 2010). The CBN is expected to determine the amount of foreign exchange it is willing to sell at the price buyers are willing to buy. Since its introduction, the DAS has been largely successful in achieving the objectives of the monetary authorities. Generally, it assisted in narrowing the arbitrage premium from double digit to a single digit. Secondly, the DAS has enhanced the relative stability of the Naira, vis-à-vis the US Dollar, which is the intervention currency (Sanusi, 2004).

II.3 Related Empirical Works

There are existing empirical studies on the factors that cause exchange rate volatility in various countries. Some of the known empirical studies include Grydaki and Fontas (2011), Rashid and Hussain (2010), Calderon and Kubota (2009), Stancik (2006), Hviding et. al., (2004), Broda and Romalis (2003), Hau (2002) among others.

Grydaki and Fontas (2011) investigated the short-run and long-run determinants of nominal exchange rate volatility in certain Latin American countries using the data for the 1979-2009 period. They estimated a multivariate GARCH model and included the covariances of certain determinants which had been ignored in similar works. They found that financial openness, alternative exchange rate regimes as well as nominal volatility in both money supply and inflation explained exchange rate volatility. Output variations were found to be important as well, but only in countries with floating exchange rate regime. The effect of financial openness on volatility of nominal exchange rate was significant in all countries studied. Flexible exchange rate regime was also found to increase exchange rate volatility.

In a study of key factors contributing to the volatility of the exchange rate of the euro in the new EU member countries, Stancik (2006) used the threshold autoregressive conditional heteroskedastic (TARCH) model. He found that openness had a negative effect on exchange rate volatility. *News* factor also had significant effect on exchange rate volatility. The extent of the effect of both factors (openness and news), however, varied substantially across countries.

Hau (2002) studied the openness of an economy (proxied by the ratio of import to GDP) and its impact on real exchange rate movements (measured as the standard deviation of the percentages of the effective real exchange rate over

intervals of 36 months). He found that trade integration and real exchange rate volatility were negatively correlated. The estimated small open economy model, capturing both the tradable and non-tradable sectors, indicated that more open economies have a more flexible aggregate price level. This flexibility reduced the effects of unanticipated money supply shocks, which in turn can lower real exchange rate volatility.

In a study of the effects of capital inflow on domestic price levels, monetary expansion and exchange rate volatility in Pakistan, Rashid and Hussain (2010), applied linear and non-linear co-integration and Granger causality test within a bivariate and multivariate frameworks. They found existence of a significant inflationary impact of capital inflow, especially during the seven-year period before their analysis. Their empirical evidence suggested the need to manage capital inflow in such a way that such flows should neither create an inflationary pressure in the economy nor fuel exchange rate volatility.

Broda and Romalis (2003) developed an empirical model to identify the relationship between trade and exchange rate volatility. Using disaggregated trade data for a large number of countries during the 1970-1997 period, they found strong evidence supporting the proposition that trade dampens exchange rate volatility. In addition, they found that once the reverse-causality problem was addressed, the large effects of exchange rate volatility on trade found in some previous literature were greatly reduced.

In another study, Calderon and Kubota (2009) used instrumental variables technique to examine the impact of trade and financial openness on real exchange rate volatility in a sample of industrial and developing countries during the 1975-2005 period. They found that high real exchange rate volatility was a result of high productivity shocks and sharp oscillations in monetary and fiscal policy shocks. Furthermore, they found that the real exchange rates of countries that were more integrated appear to be more stable. They also found that greater financial openness engendered greater fluctuations in the real exchange rate.

In their study, Hviding et. al., (2004) investigated the impact of foreign exchange reserves in reducing currency volatility in emerging market countries. They employed a panel data on 28 countries for the 1986-2006 period. They introduced a battery of control variables in the regression to account for other factors affecting exchange rate volatility. The results obtained in the study

provided support for the proposition that robust reserves holdings reduces volatility in exchange rate.

Empirical work by Avila (2011) has shown that for the Argentine economy, fiscal deficit was an important variable explaining volatility in exchange rate. An increase in the mean deficit by one point of GDP increased mean volatility by 73 points or 18.0 per cent. Their conclusion was that there was a seemingly positive correlation between fiscal deficit and the volatility of key macroeconomic prices such as the real exchange rate and the real interest rate.

In a study of the New Zealand economy, West (2003) estimated that a 25.0 per cent fall in the standard deviation of real exchange rate (i.e. unconditional real exchange rate volatility) can be accomplished at the price of an increase in the standard deviation of output of about 10-15 per cent, of inflation volatility of 0-15 per cent and of interest rate volatility of about 15-40 per cent. This implies that in an attempt to mitigate exchange rate volatility, the economy would risk increased volatility in output, inflation and interest rate.

Olowe (2009) investigated the volatility of naira/dollar exchange rates in Nigeria using GARCH(1,1), GJR–GARCH(1,1), EGARCH(1,1), APARCH(1,1), IGARCH(1,1) and JS-GARACH(1,1) models. Using monthly data from January 1970 to December 2007, volatility persistence and asymmetric properties of foreign exchange market on volatility were investigated. The study presented results separately for the period before deregulation, that is, the period of the fixed exchange rate regime (January 1970 – August 1986) and for the managed float regime period, (September 1986-December 2007). The results from all estimated models showed that volatility was persistent, and were similar for both the fixed exchange rate and the managed-float exchange rate regimes.

Employing two techniques, namely the Vector Error Correction Model (VECM) and the ARCH Modeling techniques, Al Samara (2009) investigated the factors that determine and affect the volatility of the equilibrium real exchange rate. Using data on the Syrian economy for the 1980-2008 period, the estimated results indicated that the real exchange rate exhibited volatility around its equilibrium level with a relatively slow speed of adjustment. The estimated ARCH model indicated that real shock to volatility would persist, but that they would die out slowly.

In a panel data versus a country-specific analysis of the daily volatility of the exchange rates of the U.S. dollar and fourty-three (43) other currencies, using

data for the 1990-2001 period, Golan and Beni (2007) found a positive correlation between exchange rate volatility, real interest rates and the intensity of central bank intervention. To them, the positive correlations obtained most probably reflect cross-country differences, which, in their view, may be explained by the fact that countries with relatively high exchange rate volatility maintain higher real interest rates and employ more central bank intervention. An examination of a country-specific case using Israel as case study, however, revealed that real interest rates and central bank intervention were negatively correlated with exchange rate volatility.

Chipili (2009) examined the sources of volatility in the real and nominal Zambia Kwacha exchange rates with respect to the currencies of that country's major trading partners. The study used data from January 1964 to December 2006 and a GARCH modeling technique. The result indicated that the switch from the fixed to the flexible exchange rate regimes had significant positive effect on the conditional volatility of real exchange rate. In addition, while both monetary and real factors accounted for the observed volatility in exchange rates, the former had a relatively larger effect than the latter, thus, underscoring the important role of monetary policy in exchange rate management.

III. Theoretical Framework, Model Specification and Methodology

III.1 Theoretical Framework and Model Specification

One theory that explains exchange rate volatility is that of Optimum Currency Areas (OCAs) postulated by Mundell (1961). To Horvath (2005), the optimum currency areas proposition largely explains the dynamics of bilateral exchange rate variability and pressures. It identifies variables such as intensity of trade interdependence, dissimilarity of export commodity structure, openness, asymmetric shock to output and economic size (Ling, 2001; Horvath, 2005) as germane to a country's decision to join a monetary union. One of the objectives of forming a monetary or currency union is to reduce volatility in key macroeconomic indicators, including the exchange rate. The optimum currency areas (OCAs) theory suggests that a number of variables can help to explain patterns of exchange rate variability and intervention across countries on the grounds that the same factors that inform the decision of whether to form a currency union also influence exchange rate volatility across countries (Bayaomi and Eichengreen, 1998; Masson and Yusop, 2006).

According to the OCA proposition, the higher the intensity of trade links among countries, and the more similar are shocks to their output, the more stable (or less

volatile) will the exchange rate of the national currencies be (Horvath, 2005). The volume of trade among countries and asymmetric shocks (which occur when unexpected disturbances affect one country's output differently from another's) as well as differences in countries' (economic) size are germane to explaining volatility in exchange rates. It has been argued that bringing these variables under control through the formation of a currency union has the potential to reduce exchange rate volatility (Scrimgeor, 2011).

In this study, we included as many variables as possible identified in the broad literature as determining exchange rate in our model since our major objective is to empirically investigate and identify the factors that explain the volatility of the bilateral exchange rate of the naira to the U.S. dollar. We noted that since earnings from oil export contribute well over 90.0 per cent to Nigeria's foreign exchange earnings and that it is also a significant determinant of the size of the country's foreign exchange reserves, a link could possibly exist between oil price movements and the exchange rate. Thus, volatility in oil prices is expected to explain volatility in the country's exchange rate. For this reason, we included an oil price volatility variable, among others, in our modeling of exchange rate volatility. We specify our model in its functional form as:

XRTV=*f* (NCF, OPN, XRSV, FDEF, GDP, EXDT, MS, FDEV, OILPV) (1a)

Where:
XRTV = Exchange Rate Volatility
NCF = Net Capital Flows (-)
OPN = Degree of Trade Openness (-)
XREV = External Reserves (-)
FDEF = Fiscal Deficit (+)
GDP = Gross Domestic Product (-)
EXDT = External indebtedness (+)
MS = Money Supply (M_2) (+)
FDEV = Financial Development (M_2/GDP) (-)
OPR = Oil Price (-)

The *a priori* expectations with respect to sign of the variables are indicated against the definition of each variable.

III.2 Empirical Methodology

We employed the method of Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) modeling developed by Nelson (1991) to investigate the factors explaining exchange rate volatility in Nigeria. The choice

of the EGARCH, an extension of the GARCH model developed by Bollerslev (1986), is based on the fact that it fits the data better than the GARCH model. Moreover, unlike the GARCH model, the EGARCH model specifies conditional variance as an exponential function, thereby removing the need for (non-negativity) restrictions on the parameters to ensure positive conditional variance. Thus, the problem of non-negativity of the variance is solved within the EGARCH model. It also has an additional variable whose coefficient captures the leverage effect which is the asymmetric effect of past shock on conditional variance.

EGARCH modeling involves the joint estimation of a mean and (conditional) variance equations. The multivariate EGARCH (1,1) model adopted for this study (based on its simplicity and robustness) is defined as follows:

Mean equation:

$$EXRT = C + \varphi EXRT(-1) + \in_t \quad (1b)$$

Where: EXRT = Exchange rate
C = Constant intercept
$EXRT_{(-1)}$ = One-period lag values of exchange rate
$\in_t$ = error term

The mean equation is a first order autoregressive process.

The conditional variance equation, following Olowe (2009) is:

$$log(\delta_t)^2 = w + \alpha \left| \frac{\in_{t-1}}{\delta_{t-1}} - \sqrt{\frac{2}{\pi}} \right| + \gamma \left| \frac{\in_{t-1}}{\delta_{t-1}} \right| + \beta log(\delta_{t-1}^2) \quad (2)$$

Where ω, α, β and γ are the volatility parameters.

The leverage effect, which is the asymmetric effect of past shock is captured by γ which is usually negative. The implication of the negative sign of γ is that all things being equal, positive shocks generate less volatility than negative shock (Longmore and Robinson, 2004 cited in Olowe, 2009). β is a determinant of the degree of persistence of volatility. a is used to determine the presence or otherwise of volatility clustering. If a is significant, it implies the presence of volatility clustering. Conditional volatility for these models tends to rise (fall) when the absolute value of the standardised residuals is larger (smaller). Statistically, insignificant a is, however, inconclusive (Olowe, 2009).

Incorporating the explanatory variables into the framework of the conditional variance equation yields the following:

$$log(\delta_t)^2 = w + \alpha\left|\frac{\epsilon_{t-1}}{\delta_{t-1}} - \sqrt{\frac{2}{\pi}}\right| + \gamma\left|\frac{\epsilon_{t-1}}{\delta_{t-1}}\right| + \beta log(\delta_{t-1}^2) + \sum_{i=1}^{n} \varphi_i X_t \quad (3)$$

Where φ_i is the parameter of each of the explanatory variables included in the model. Estimating this equation will enable us investigate the way and manner each of the variables explains conditional volatility in the exchange rate. Our study, however, differs substantially from Olowe (2009) on account of the explanatory variables in our specification and the period covered.

III.3 The Data

The data used in this study consist of annual time series for the period 1970 to 2013. The data were obtained from several secondary sources, including the Central Bank of Nigeria (CBN) Statistical Bulletin and CBN Annual Reports and Statement of Accounts, Organisation of Petroleum Exporting Countries (OPEC) publications and publications of the National Bureau of Statistics. Data for OILPV is calculated as unconditional variance of oil price, that is, the standard deviation of the logs of quarterly oil price data.

IV. Presentation, Discussions and Implications of Results

IV.1 Presentation and Discussion of Results

We begin the analysis by generating the data series of conditional variance of exchange rate by an exponential GARCH (EGARCH(1,1)) process (Equation 2). The exchange rate volatility variable (EXRTV) is then regressed on the exogenous variables, using the method of ordinary least squares (OLS). The OLS estimated result corrected for first-order positive autocorrelation is presented in Table 1.

The robustness check revealed that the model has a fairly satisfactory goodness of fit as indicated by the R-squared and Adjusted R-squared. Specifically, the R-squared indicated that 76.7 per cent of the systematic variation in the dependent variable was explained by the regressors. The F-statistic was highly significant even at the 1.0 per cent level and it indicated that the explanatory variables were jointly significant in the determination of the naira exchange rate volatility. The Durbin-Watson statistic clearly indicated absence of first order autocorrelation in the model.

An examination of the estimated parameters revealed that the signs of the NCF, TOPN, FDEV, MS and XREV variables conformed to *a priori* expectations while those of the RGDP, XDEBT, FD and OPR variables did not conform. It also showed

that only the coefficients of the NCF, FDEV, FD, MS variables were statistically significant, though the MS variable was only significant at the 10.0 per cent level. This implied that the naira exchange rate volatility was influenced by net capital flows, financial sector development, fiscal deficit and the stock of money in the economy. Specifically, exchange rate volatility is mitigated or dampened by increase in net capital flows and financial sector development. Increase in money stock, on the other hand, engenders increase in exchange rate volatility. The influence of the other variables on naira exchange rate volatility were not statistically significant.

Table 1. OLS Estimation Result (Corrected for First Order positive Autocorrelation using AR(1)

EXRTV=158.2722 - NCF0.000139 - LTOPN16.15277 - LFDEV112.2511 + LRGDP8.866318 - LXDEBT9.094690 - FD0.000137
(0.468953) (-2.311309) (-0.350369) (-2.271016) (0.300041) (-0.742065) (-3.031522)

+ LMS31.74482 + LOPR6.845702 - LXREV1085321 + AR(1) 0.425443
(1.860803) (0.219602) (-0826449) (2.334383)

R-squared	0.767194	Akaike info criterion	10.99116
Adjusted R-squared	0.692095	Schwarz criterion	11.44626
F-statistic	10.21580	Hannan-Quinn criter.	11.15797
Prob(F-statistic)	0.000000	Durbin-Watson stat	1.941138

Source: Authors' Estimations using Eviews 8

The results presented in Table 1 were supplemented by the outcome of estimation of an exponential GARCH (1,1) model incorporating the exogenous variables, with the conditional variance of exchange rate (measure of exchange rate volatility) as the dependent variable. The result obtained were largely similar to those obtained using the OLS method and are presented in Table 2.

Our focus in the analysis was on the variance equation which modeled the conditional variance of exchange rate (measure of exchange rate volatility) and incorporated the selected regressors. We noted that the volatility parameter, γ [C(5)] capturing the leverage effect was negatively signed (as expected) and highly statistically significant, even at the 1.0 per cent level. This is indicative of a strong leverage effect and implies that positive shocks to the exchange rate generate less volatility in it than negative shocks. The parameter measuring the degree of persistence of volatility, β [C(6)] is 0.57 and is also highly significant at the 1.0 per cent level. This suggests that the volatility of the naira exchange rate is moderately persistent. The parameter that determines the presence or otherwise

of volatility clustering, a is [C(4)] and it is highly significant even at the 1.0 per cent level. This suggests that the naira exchange rate is characterised by volatility clustering.

Table 2. Exponential GARCH (1,1) Model with Variance Regressors

EXRT= -0.099086 + EXRT(-1)1.020802
(-1.004992) (80.20526)

Variance Equation:

C(3) 4.050067 + C(4)0.590951 - C(5)1.008480 + C(6)0.568318 - C(7) -4.92E-06 – C(8)0.867367 +
(3.246960) (3.076679) (-6.553218) (14.79439) (-1.814126) (-5.758703)

C(9)0.298509 - C(10)0.323641 + C(11)0.686650 - C(12)4.56E-06 + C(13)0.073219 –
C(14)0.919932 –
(0.652747) (-5.870489) (11.03092) (-2.340156) (0.795501) (-5.060665)

C(15)0.357207
(-14.76122)

R-squared	0.960807	Akaike info criterion	4.700092
Adjusted R-squared	0.959851	Schwarz criterion	5.314464
F-statistic	10.21580	Hannan-Quinn criter.	4.926653
Durbin-Watson stat	1.835806		

Source: Authors' Estimations using Eviews 8

An examination of the coefficients of the regressors revealed that the signs of most of the regressors conformed to *a priori* expectations, except those of the FDEV and FD. Furthermore, the empirical results indicated that all but the FDEV and MS variables exerted significant impact on exchange rate volatility. The empirical evidence indicated too that net capital flows, trade openness, favourable oil prices, external reserves and economic growth all served to dampen exchange rate volatility, while external debt exacerbated it. We were, however, cautious in our interpretation of the observed negative sign of the fiscal deficit variable, which was counter-intuitive and suggested that increase in fiscal deficit dampened exchange rate volatility.

Table 3. Heteroskedasticity Test: ARCH

F-statistic	0.044695	Prob. F(1,40)	0.8336
Obs*R-squared	0.046877	Prob. Chi-Square(1)	0.8286

Source: Authors' Estimations using Eviews 8

The result of the ARCH test indicated absence of remaining ARCH effect, while the residual correlation test clearly indicated absence of autocorrelation as all the probabilities were evidently larger than 0.05. With coefficient of skewness approximately zero, the normality test indicated near-normality.

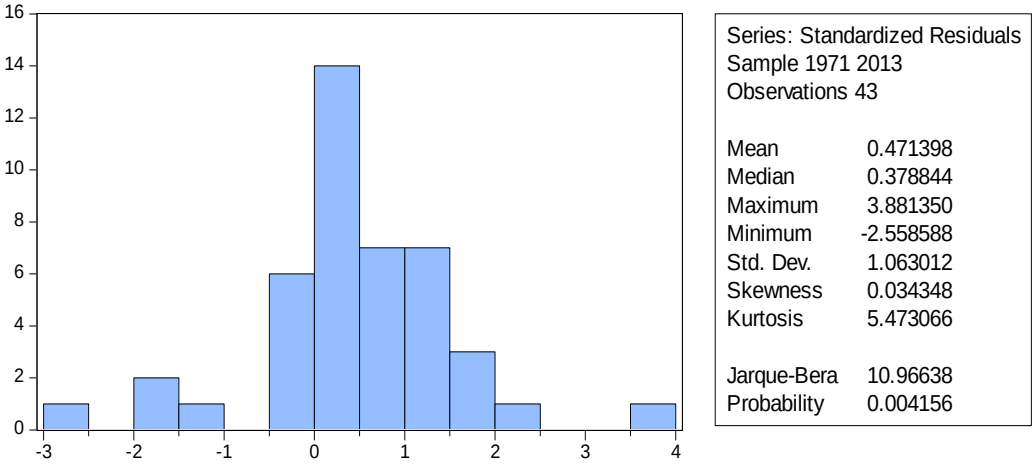
Table 4. Autocorrelation Test

Sample: 1970 2013
Included observations: 43

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
. | . |	. | . |	1	0.033	0.033	0.0512	0.821
.*| . |	.*| . |	2	-0.066	-0.067	0.2545	0.881
.*| . |	.*| . |	3	-0.104	-0.100	0.7772	0.855
.*| . |	.*| . |	4	-0.151	-0.151	1.9092	0.752
.*| . |	.*| . |	5	-0.099	-0.110	2.4059	0.791
. |*. |	. | . |	6	0.081	0.054	2.7510	0.839
. |*** |	. |** |	7	0.362	0.333	9.8019	0.200
. | . |	. | . |	8	-0.015	-0.053	9.8146	0.278
.*| . |	.*| . |	9	-0.085	-0.076	10.227	0.332
. |*. |	. |*. |	10	0.089	0.177	10.690	0.382
.*| . |	. | . |	11	-0.132	-0.047	11.745	0.383
. | . |	. |*. |	12	0.039	0.103	11.841	0.459
. | . |	.*| . |	13	-0.023	-0.100	11.875	0.538
.*| . |	**| . |	14	-0.069	-0.220	12.193	0.591
. | . |	. | . |	15	-0.060	-0.007	12.442	0.645
. | . |	. | . |	16	-0.055	-0.045	12.657	0.698
. | . |	. | . |	17	0.058	-0.064	12.912	0.742
. |*. |	. |*. |	18	0.111	0.160	13.868	0.738
. | . |	.*| . |	19	0.005	-0.099	13.870	0.791
. | . |	. | . |	20	-0.022	0.008	13.910	0.835

Source: Authors' Estimations using Eviews 8

Figure 1: Normality Test



IV.2 Policy Implications of Results

The empirical evidence obtained in the paper has far-reaching implications for policies that are aimed at stabilising the naira exchange rate. The negative sign and statistical significance of the capital flows (NCF) variable imply that large net capital flows can possibly dampen the volatility of the naira exchange rate to the dollar. Thus, the more of (growth enhancing) capital the country attracts, the less volatile the bilateral naira-dollar exchange rate is likely to be.

The coefficient of the trade openness variable, which measures the degree of integration of the Nigerian economy with the global economy, also has negative sign and it is highly statistically significant, implying that the more open the Nigerian economy is, the less volatile will be the exchange rate of the naira. This finding is in line with the theoretical proposition, and corroborates the findings of existing studies such as Broda and Romalis (2003) and Calderon and Kubota (2009).

The negative and significant coefficient of the RGDP variable suggested that economic growth is associated with exchange rate stability in a desirable way since it serves to dampen its volatility. This is in consonance with the observations of Sanusi (2004) and the findings by Bastourre and Carrera (2007) and Calderon and Kubota (2009).

The observed positive and significant coefficient of the external debt variable implied that increase in foreign indebtedness engenders a rise in the volatility of naira exchange rate. This is in conformity with Cavallo et. al.'s (2002) findings. This

is clearly undesirable and thus has implications for the country's notorious penchant to accumulate foreign debt.

The empirical evidence indicated that fiscal deficit (FDEF) significantly dampens exchange rate volatility contrary to expectation. The finding is not only atheoretic and indeed counter-intuitive, it contradicts the assertion by Iyoha and Oriakhi (2002) and the findings by Ogunleye (2008), Canalse-Kriljenko and Habermeier (2009) and Avila (2011). But it may be explained by the possibility that government borrowings to finance its deficits tend to constrain the availability of funds to speculators and *professional dealers* in foreign exchange, whose activities largely account for the wide swings and volatility that the exchange rate has exhibited, especially in recent times.

We observed that although the OLS estimates indicated that financial sector development engenders stability in the exchange rate by significantly dampening exchange rate volatility, the empirical finding based on the EGARCH (1,1) model indicates that its impact is not significant. The implication of the result from the OLS estimation is that sound financial system abates exchange rate volatility.

The observed positive and statistically significant coefficient of the broad money supply variable implied that monetary expansion significantly engenders volatility of the bilateral naira-dollar exchange rate. Furthermore, the observed negative and statistically significant coefficient of the external reserves variable, XREV, suggested that increase in the country's reserve holdings is associated with less volatility and thus greater stability of the exchange rate. This finding has implications for the management of the country's external reserves and specifically from the perspective of the highly undesirable penchant by policy makers to run down and thus deplete the country's reserve holdings, even for the flimsiest of reasons. Finally, the empirical evidence indicated that oil price increase served to dampen the volatility of the bilateral naira-dollar exchange rate. This is not unexpected, considering that increase in crude oil prices translate to increase in real GDP (since the country's economy is largely dependent on earnings from crude oil export), increase in foreign exchange reserves (since earnings from crude oil export account for a hugely significant share of the country's foreign exchange earnings) and considering also that positive shock (which is implied by a rise in crude oil prices) is associated with a decline in volatility, in line with the empirical finding with respect to the asymmetric leverage effect.

V. Summary, Policy Recommendations and Conclusion

V.1 Summary

We have empirically investigated the factors explaining volatility in the bilateral exchange rate of the Nigerian currency, the naira, to the U.S. dollar. The empirical evidence revealed that increase in net capital flows, the level of financial development, the level of external reserves, the degree of integration of the Nigerian economy with the global economy, increase in crude oil price as well as economic growth can help to mitigate the volatility of the Naira exchange rate. We found also that external indebtedness and monetary expansion have the potential to exacerbate volatility in exchange rate. Contrary to *a priori* expectation, our empirical evidence indicated that fiscal deficit negatively and significantly affects exchange rate volatility, indicating that fiscal deficit was strongly significant in dampening exchange rate volatility in Nigeria within the period covered by this study. These empirical findings have implications for policies that are formulated to manage the country's exchange rate.

V.2 Recommendations for Policy

1. Since the empirical evidence shows that net capital flows mitigates exchange rate volatility, measures that are capable of attracting more of development targeted or sustainable capital into the economy are imperative. In addition, policies that are designed to mitigate capital flight, which anecdotal evidence suggests, is increasing in the country should also be pursued. The measures should include creating a conducive/enabling environment for businesses to thrive and to develop the nation's financial system to make for greater efficiency and effectiveness. This should be accompanied by policies that are aimed at managing the inflow of capital as excessive inflow of capital has the potential to create inflationary pressures in the economy as well as fuel volatility in the exchange rate.

2. We recommend, in the light of the empirical findings with respect to the openness variable that policies that are aimed at further integrating the Nigerian economy with the global economy be formulated and implemented. This logically calls for policies that are aimed at addressing the export side of the trade equation, as failure to do this would accentuate Nigeria's import-dependency and further put Nigeria in the position of a *willing loser* in an increasingly globalising world.

3. Considering that external debt has the potential to exacerbate exchange rate volatility, the use of external loans by all tiers of government and the private sector should be carefully managed. This calls for a return to the position in 2006/2007 when State Governments were barred from contracting foreign loans.

4. There is need for measures that are aimed at controlling the growth of broad money supply and the overall level of liquidity in the economy. The Central Bank needs to deploy the use of monetary policy instruments in an efficient and optimal way to realise this. In this regard, any strategy that seeks to curtail the level of liquidity in the economy will be highly desirable as it will serve to instill financial discipline in the spending behaviour of agents in the economy. We are of the view that the Treasury Single Account initiative should be faithfully, sincerely and transparently implemented as it has the potential to check reckless spending in the economy by the various tiers of government, especially the State Governments many of whom have penchant for reckless spending that smacks off grossly irresponsible fiscal behaviour.
5. In view of the fact that external reserve was observed to dampen the volatility of the exchange rate, there is need to articulate and implement measures that are geared towards beefing up the country's external reserves position and maintain it at optimal and sustainable levels that are consistent with stable exchange rate. This implies saving significant portion of the country's export earnings which are, in any case, synonymous with oil export earnings, especially in periods of favourable movements in oil prices.

6. The finding that financial development helps to mitigate volatility of the exchange rate calls for commitment on the part of the government through its relevant agencies to the development of the nation's financial system. In this vein, policies that seek to improve the breadth and depth of the country's financial system and to enhance financial inclusion in the economy, through, for example, the agent banking initiative will be appropriate.

7. Finally, in view of the fact that economic growth is associated with reduction in volatility of the exchange rate, thus, enhancing exchange rate stability, measures to accelerate the growth rate of the economy should be put in place. These include formulation and implementation of investment friendly policies to boost the level of domestic and foreign

investment in the economy, thus boosting employment, reducing poverty, expanding the level of domestic output of goods and services, reducing importation and boosting export, increasing the level of foreign exchange reserves, etc.

V.3 Conclusion

Exchange rate volatility poses serious challenge to macroeconomic management. Indeed, it has the potential to undermine the efficacy of macroeconomic policies that are designed to influence the economy in a desired direction. We sought, in this paper, to empirically identify the factors that policy makers may tinker with in order to mitigate volatility in the bilateral exchange of the naira to the U.S. dollar. The findings in the study may be relevant even within the context of the exchange rate of the naira to any other currency or indeed the exchange rate of the naira to a basket of currencies. Consequently, we recommend the empirical findings in the paper to policy makers in the formulation and implementation of policies that are designed to attenuate the volatility that has characterised the exchange rate of the country's currency, especially since the adoption of the floating exchange rate regime in 1986.

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