The Role of Central Bank of Nigeria in Exchange Rate Stabilization

Abstract

The study X-raysthe role of Central Bank of Nigeria (CBN) in exchange rate stability in Nigeria,using quarterly time series data. The study adopts GARCH family models to decipher the potency of CBN's monetary policyin exchange rate stability in Nigeria. Anchor interest rate,officialexchange rate,and money supplywere incorporated into the variance equation to determine their exact impact on the volatility variable (conditional variance). Empirical results show that Anchor interest rate, official exchange rate, and money supplyare keyin exchange rate stability in Nigeria. The study also finds that despite CBN's official intervention, exchange rate instability in Nigeria persists overtime. It concludes that Central Bank of Nigeria has a major role to play in managing exchange rate volatility in Nigeria especially when it uses the aforementioned monetary policy tools.

Keywords: Monetary Policy, Exchange Rate Fluctuation, Central Bank of Nigeria, GARCH model, Foreign Exchange Market

JEL Classification: E5, E52, F31, F41

1. Introduction

Exchange rate instability has persisted in Nigeria for decadesdespite Central Bank of Nigeria's (CBN) official intervention in the foreign exchange market. The stability of the exchange rate is vital due to the important role it plays in international trade and finance.Exchange rate fluctuations refer to the movements in the exchange rates over overtime or the departure from

standard or equilibrium exchange rate.Monetary policy refers to the tools the CBN uses to control the economy. Monetary policy tools are: Monetary Policy Rate, Open Market Operation, Cash Ratio, Liquidity Ratio, Cash Reserve Requirement, and CBN intervention in the foreign exchange market. One of the key objectives of monetary policy is to achieve price stability and keep inflation low (Akanji,2006). According to Mordi (2006),having the right exchange rate is crucial to maintaining relative stability both internally and externally.

The establishment of the Bretton Woods Institutions-International Monetary Fund (IMF), and The International Bank for Reconstruction and Development (IBRD), also known as the World Bank, helped many countries to better manage their economies after the second world war. Specially, the Bretton Woods system was formed to reform the financial system and enhance international economic co-operation that collapsed as a result of the world war. The advancement of the international financial marketsculminatedinto increase in trade volume among countries. Many countries were forced to abandon the Bretton Woods system of fixed exchange rate in the early 1970s, due to their inability sustain a huge reserve of foreign currencies. After the liberalization of exchange rate and the acceptance of flexible exchange rate system, exchange rate became much more unstable than anyone could imagine.

Moreso, with the acceptance of trade liberalization among the developed countries of the world, pegging of currencies became challenging for many countries. Globalization and trade liberalization also make nationssusceptible to second-round effect of economic policies made inmanynations, particularly the developed ones. Take for instance, the 2018 global financial crisis which was caused by collapse of sub-prime mortgage institutions haddevastating effects not only in the United States of America, but also spilled over to the rest of the world, and the mostaffected countries were the Less Developed Countries (LDCs). The Debt crises in the Eurozone and the threat of Britain’s Brexit also had impact on the world financial market, particularly, the major trading partners of the nations in the Eurozone.The recent trade war between China and United States of America did not only affect the trade volumeand exchange rate between them, but has spill-over effect on other countries, especially their major trading partners.World Bank report(2019), estimated the world economy growth rate at 2.6%. The IMF cautioned that continuous trade wars could reduce the world’s gross domestic product (GDP) by $455billion.

In Nigerian context, the cardinal characteristics of the recent economic recession experienced in the country was a rise in exchange rate fluctuation. This experience provoked a lot of debates on the efficacy of monetary policy in stabilizing exchange rate in Nigeria.According to National Bureau of Statistics (NBS), Nigerian economy witnessedfive(5) consecutive quarters ofnegative gross domestic product growth, from first quarter of 2016 to first quarter of 2017. One of the major causes of the recent economic recession in Nigeria was depreciation in the value of naira caused by fall in foreign exchange earnings due to fall in the international price of crude oil. Given that the Nigerian economy is a mono- product economy with excessive reliance on oil revenue as the major source of foreign exchange earnings and funds for public expenditure.Exchange rate policy in Nigeria has gone through many changes but spanning between two major regimes.These are fixed and flexible exchange rate systems. The fixed exchange rate system was adopted between 1960 and 1986(best known as the pre-SAP (Structural Adjustment Programme) era),while the flexible exchange rate system remains in use from 1986(also known as the post-SAP era) upuntil today, after undergoing through severalchanges (Sanni, 2006).In a bid tocut excessive reliance on the U.S dollar, the CBN entered into a Bilateral Currency Swap Agreement (BCSA) with the People's Bank of China (PBC) in 2018,which involves about 15billion Chinese's Yuan exchanging for 720billion Nigerian Naira with three years tenor (CBN Quarterly Bulletin of June 2018).CBN began its intervention in foreign exchange marketon July 20,2018 with sale of about 69.86 million CNY (equivalent of USD10.16million) in its first auctionat the range of 49 naira to 51 naira (Punch Newspaper of August 18, 2018). This move will definitely affect exchange rate fluctuation in Nigeriagiven that China is Nigeria's highest trading partner.

Exchange rate fluctuation is harmful to domestic economy, through external trade performance, and also causes inflation, through its power of pass-through. Again, exchange rate fluctuation causes uncertainty in trade andhave consequences on business decisions. Economists believe that high inflation adversely impacts real income, which in turnreduces purchasing power and welfare of households. The existing literature tries to link monetary policy to exchange rate fluctuation, especially the effectiveness of monetary policy in stabilizing exchange rate fluctuation. Most of the studies find that monetary policy has an impact on exchange rate fluctuation (see Yagmur, 2016; Gupta and Jooste, 2014; Ostry at.al, 2012; Masha, 2011; Ndubuisi at.al, 2017; Michael, 2010; Aregha, 2010; Zafar and Sabo, 2013; Umar, 2013; and Egwaikhide et.al, 2014). While others find that exchange rate fluctuation is persistent overtime

(see Syarifuddin et.al, 2014; Musyoki at.al, 2012; Benigno at.al, 2012; Adeoye and Atanda, 2010; Adeoye and Shaibu, 2014; Onanuga and Onanuga, 2015; Bala and Asemota, 2013; Umoru and Effiong, 2015; Ojo and Alege, 2014; Libman, 2017; Berument et.al, 2012; and Juvenal, 2010). However, to the best of my knowledge there is no study in Nigeria that has related monetary policy to exchange rate fluctuation using a volatility model such as GARCH (General Autoregressive Conditional Heteroscedasticity). This is because most financial time series exhibit heteroscedasticity phenomenon, econometrics models that have been designed to encounter this problem in time series are: ARCH (Autoregressive Conditional Heteroscedasticity) model constructed by Engle (1982), and GARCHmodel built by Bollerslev (1986). There is evidence that these models provide good fit for many exchange rate and financial series in the literature. Again, a GARCH model with small number of terms appears to outperform an ARCH model with many terms (Bollerslev,1986). There exists a gap in literature, particularly in finding the potency of monetary policy in exchange rate stability rate in Nigeria, considering the heteroscedasticity characteristics of financial and exchange rate data. This gap in literature is the motivation for this study. Given the above, this study wants to answer the following research questions: (1) What is the relationship between anchor interest rate, official exchange rate, money supply, and exchange rate instability in Nigeria? (2) What is the potency of anchor interest rate, official exchange rate, and money supply in exchange rate stability in Nigeria? (3) Does exchange rate instability persist in Nigeria despite CBN's monetary policy intervention, using anchorinterest rate, official exchange rate, and money supply?

2. Literature Review

2.1 Theoretical Literature Review

There are two theories that are essential to this topic. One is the theories of Aggregate Demand in an Open Economy, the other is theories of Exchange Rate Determination.

2.1.1 Theories of Aggregate Demand in an Open Economy

By virtue of the topic under investigation, which has exchange rate element in it, it is imperative to look at a theory that extends beyond the local economy. This also means that international trade and finance have assumed an important role in our discussion. To this end, Mundell-Fleming model, and Dornbusch Expectation Theory provide the theoretical bases for this study.

Mundell (1963) and Fleming (1962) argue that the bahaviour of any economy depends on the exchange rate system it is practicing- fixed or floating. The potency of fiscal and monetary

policies depends on the exchange rate regime adopted by the country.They posit that under perfect capital mobility and floating exchange rate, a country can conduct an effective monetary policy in the short-run. In a floating exchange rate regime, only monetary policy can affect income, the usual expansionary impact of fiscal policy is offset by a rise in the value of the currency. In a fixed exchange rate regime, only fiscal policy can affect income. The power of monetary policy is lost because money supply is dedicated to maintaining the exchange rate at the pre-determined level. Mundel-Fleming concludes that fiscal policy is more potent under a fixed exchange rate regime, while monetary policy is more effective under a floating exchange rate system (Mankiw, 2005, p. 326-327).

Another theory that re-enforces and validates the Mundell-Fleming Model is the Dornbusch expectation mechanism. Dornbusch (1976) emphasizes "the role of expectations in exchange rate determination and, therefore the monetary policy under floating exchange rate. Dornbusch opines that when the exchange rate is below its equilibrium level there will be a natural force in playthat would carry it upward towards equilibrium level" (Dornbusch,1976). The conclusion of Dornbusch validates the Mundell-Fleming proposition that "under perfect capital mobility and floating exchange rate, a country can conduct an effective monetary policy in the short-run".

2.1.2 Theories of Exchange Rate Determination

These theories comprise: The Purchasing power parity theory, the open interest parity theory, the news model of exchange rate, and the speculative dynamic model.

The Purchasing Power Parity (PPP) theory was postulated by Gustav Cassel in 1918. The Purchasing Power Parity (PPP) theory "states that the exchange rate between the currencies of two countries is proportional to their relative inflation. In order words, the exchange rate between currencies of two countries are in equilibrium when their purchasing power is the same in each of the two countries" (Gbanador,2007 pp. 139).The PPP theory concludes that there is always a tendency for short-run equilibrium exchange rate to adjust to the PPP (i.e., the same purchasing power).

The Open Interest Parity theory lays emphasis on the high mobility of short-term capital, which produces open interest parity. Similar to PPP, the open interest parity assumes equal expected returns on assets in two countries, adjusted for expected appreciation or depreciation. Under this hypothesis, investors expect the PPP to hold in the short-run. That is, they expect a depreciation

of the domestic currencies that just equals the difference between foreign and domestic rates of price inflation. In order words, the theory maintains that short-term real interest rate is equal in the two countries.This Open interest Parity theory emphasis short-run fluctuation of foreign exchange rates in a floating exchange rate regime.

The 'News' model of exchange rate is based on rational expectation theory, in which economic agents are well informed about market conditions and take all information into account in decision making. The 'News' model of exchange rate results from the fact that the current exchange rate reflects all relevant and available information. Given this condition, the only thing that can cause a change in the current exchange rate is unforeseen circumstances, called 'news'. Since 'news' is unpredictable and exchange rate changes depend on 'news' to that extent, exchange rates are themselves unpredictable. Like the open interest parity theory, the 'news' model also leads to high volatility and variability of exchange rate.

The speculative dynamic model assumes two classes of actors, the "Chartist" and the "fundamentalist". According to the theory, exchange rate depends on the interaction between the bahaviour of these actors. The "Chartists" are those who analyses the past bahaviour of the exchange rate and project past trend into the future, while the "Fundamentalists" uses the equilibrium rate to forecast future movements in exchange rate. That is, whether it will decline or increase in the future if it is above or below the current equilibrium rate. Due to various assumptions about the degree of influence of each of the market speculators, high volatility of exchange rate is most certain to occur.

2.2Empirical Evidence

The afore-discussed exchange rate determination theories have one important conclusion in common. The major conclusion of the various theories is that exchange rate is highly volatile and variable.The Mundell-Fleming model summarizes the role of monetary policy in an open economy setup with floating or fixed exchange rate regime. It concluded that under perfect capital mobility and floating exchange rate, a country can conduct an effective monetary policy in the short-run.Hence, the focus of monetary policy makers is on the LM* curve, which consists of monetary policy variables such as, Money supply, interest rate, foreign exchange intervention, and nominal exchange rate. Money supply, interest rate, and foreign exchange intervention are exogenous variables, while nominal exchange rate is an endogenous variable. CBN forex intervention has been included as an exogenous variable in this study to account for "Managed

Floating" exchange rate regime practiced in Nigeria. To be able to practice "Managed Floating" exchange rate system, the CBN needs to have a reserve of foreign currencies to intervene in the foreign exchange market from time to time.

The existing empirical studies tried to examine the effectiveness of monetary policy response to exchange rate stability (see Yagmur, 2016; Gupta and Jooste, 2014; Ostry at.al, 2012; Masha, 2011; Ndubuisi at.al, 2017; Michael, 2010; Aregha, 2010; Zafar and Sabo, 2013; Umar, 2013; and Egwaikhide et.al, 2014). The major conclusion of these studies is that monetary policy has impact on exchange rate fluctuations. Again, there were also studies conducted to examine the persistence of exchange rate fluctuation and central bank's monetary policy response to stabilize the exchange rate (see Syarifuddin et.al, 2014; Musyoki at.al, 2012; Benigno at.al, 2012; Adeoye and Atanda, 2010; Adeoye and Shaibu, 2014; Onanuga and Onanuga, 2015; Bala and Asemota, 2013; Umoru and Effiong, 2015; Ojo and Alege, 2014; Libman, 2017; Berument et.al, 2012; and Juvenal, 2010). These studies concluded that exchange rate fluctuation is persistent over time. However, to the best of my knowledge there is no study in Nigeria that has related monetary policy to exchange rate fluctuation using a volatility model such as GARCH (General Autoregressive Conditional Heteroscedasticity). Most financial time series exhibit heteroscedasticity phenomenon, econometrics models that have been designed to encounter this problem in time series are: ARCH (Autoregressive Conditional Heteroscedasticity) model developed by Engle (1982) and GARCHmodel developed by Bollerslev (1986). These models have been proven to provide good fit for many financial and exchange rate series in the literature. Again, a GARCH model with small number of terms appears to outperform an ARCH model with many terms (Bollerslev,1986). There exists a gap in literature in Nigeria, particularly in finding the efficacy of monetary policy in stabilizing exchange rate fluctuation in Nigeria, considering the heteroscedasticity characteristics of financial and exchange rate data. This gap in literature is the motivation for this study

3. Method of Study and Data

3.1 Nature and Sources of Data

Quarterly time series data have been used in this study. The sample data period covered is 1986Q1- 2017Q4. All the data setwere sourced from various issues of CBN statistical Bulletin.

Nominal exchange rate has been proxied by nominal effective exchange rate.MPR has been used to proxy Policy Interest Rate. This is the interest rate that guides CBNMonetary Policy Committee (MPC) decision on interest rate for the economy. Money supply has been proxied by M2.Foreign exchange intervention has been proxied by foreign reserve position.

3.2 Method of Study

This section presents the method employed to carry out the study. The choice of variables in this study was informed by the Mundell-Fleming model of small open economy. However, this study adopts the method of study employed by Syarifuddin et al (2014) since similar research topic is being studied. Like Syarifuddin et al (2014), the ARCH (Autoregressive Conditional Heteroscedasticity) family models has been employed to investigate CBN monetary policy response to exchange rate fluctuations in Nigeria. Specifically, the GARCH (General Autoregressive Conditional Heteroscedasticity) model has been employed in this study.

3.2.1 Model Specification

According toSyarifuddin*et al* (2014) “two proposed processes to measure volatility are presented in ARCH model developed by Engle (1982) and GARCH model developed by Bollerslev (1986). These models have been proven to provide a good fit for many exchange rate series in the literature. Allowing volatility shocks to persist over time by imposing autoregressive structure on the conditional variance. This persistence over time is consistent with periods of relative volatility and tranquility in returns and it is employed to explain the non-normalities in exchange rate series”(Syarifuddin et al, 2014). Furthermore, unlike real sector data, heteroscedasticity exists in many financial series such as exchange rate, inflation rate, money supply, stock prices, etc., which do not have constant mean and variance. ARCH and GARCH models are econometrics models designed to encounter this problem in time-series. This study attempts to examine CBN monetary policy response to exchange rate fluctuations in Nigeria using the GARCH (1, 1) model.Bollerslev (1986) showed with instances thata GARCH model with small

number of parameters appears to perform as well or even better than an ARCH model with many parameters, cited in (Greene, 2003: 241).

As discussed earlier, the variablesemployed in this study emanated from the LM* curve of the Mundell-Flaming model of small open economy. These variables are: nominal exchange rate, policy interest rate, money supply, CBN foreign exchange intervention. However, policy interest rate, money supply and CBN forex intervention are exogenous variables, while nominal exchange rate is an endogenous variable.

This study employed the GARCH (1, 1) model and it is specified as follows:

The functional form of the model is specified as follows:

$$NER_t = f(PIR_t, MS_t^s, FXI_t) \quad (1)$$

Where;

NER_t = Nominal exchange rate in the current quarter, PIR_t = Policy interest rate in the current quarter, MS_t^s = Money supply in the current quarter, FXI_t = CBN FX intervention in the current Quarter

The econometric form of the model is specified as follows:

$$NER_t = \beta_0 + \beta_1 PIR_t + \beta_2 MS_t^s + \beta_3 FXI_t + \upsilon_t \quad (2)$$

β_1, β_2, and β_3 represent partial slope coefficients or parameters of the mean equation, while β_0 represent the intercept term or constant term., υ_t represents disturbance term of the mean equation.

Assume that conditional on the information available at time $(t-1)$, the disturbance term is distributed as follows:

$$\upsilon_t | \upsilon_{t-1} \sim N(0, \sigma_t^2)$$

$$Var = (\upsilon_t) = \sigma_t^2$$

From equation 2 we can obtain an ARCH model, which allows conditional variance to change overtime as a function of past errors:

$$\upsilon_t^2 = \alpha_0 + \alpha_1 PIR_t + \alpha_2 MS_t^s + \alpha_3 FXI_t + \rho_1 \upsilon_{t-1}^2 + \rho_2 \upsilon_{t-2}^2 + \rho_\rho \upsilon_{t-p}^2 \quad (3)$$

GARCH (1,1) model for this study is specified as follows:

$$\sigma_t^2 = \gamma_0 + \gamma_1 PIR_t + \gamma_2 MS_t^s + \gamma_3 FXI_t + \rho \upsilon_{t-1}^2 + \tau \sigma_{t-1}^2 + \mu_i \quad (4)$$

Where $\gamma_0, \rho, \tau > 0$ and $\rho + \tau < 1$

$\gamma_1, \gamma_2, \gamma_3$ represent the partial slope coefficients or parameters of the GARCH (1, 1) volatility model. While γ_0 represents the intercept term or constant. μ_i stands for the error term. σ_t^2

represents Conditional Variance at the current quarter. υ_{t-1}^2 represents previous quarter squared residual from the mean equation (3) (known as the ARCH term). σ_{t-1}^2 represents previous quarter conditional variance from the volatility model (4) (known as the GARCH term).From equation (4), the ARCH parameter, ρ is the lag of the squared residual from the mean equation. It tells if volatility reacts to market movements i.e. if volatility from previous quarters affect volatility in current quarter. The GARCH parameter, τ is forecast variance from previous quarter. "The sum of the ARCH and GARCH terms informs us if volatility shocks are persistent. If $\rho + \tau < 1$, shocks would die out slowly, but if $\rho + \tau > 1$, shocks would die out quickly" (Bollerslev and Woodridge, 1990) as cited in Onanuga and Onanuga (2015: pp.165).

4. Empirical Results and Discussion

Two models have been used in this study to explain monetary policy response to exchange rate fluctuations in Nigeria. Table 1 shows the result of the mean equation of the original model; hence it is just a "means to an end". It shows the linear relationship between the Nominal Exchange Rate (NER) and monetary policy variables, such as Policy Interest Rate (PIR), Money Supply (MS), and CBN Foreign Exchange Intervention (FXI).The results of Augmented Dickey-Fuller (ADF) and Phillips-Perron(PP) stationarity tests (see table 2 in appendices) revealed that all variables included in the model are I (1) series, that is, they are non-stationary at level form but became stationary after first difference. This finding validates the observationmade by Gujarati and Sangeetha (2007): "A characteristics of most financial time series is that in their level form they are random walks; that is, they are nonstationary. On the other hand, in the first difference form, they are generally stationary" (Gujarati and Sangeetha, 2007). These variables are: Nominal Exchange Rate (NER), Policy Interest Rate (PIR), Money Supply (MS) and CBN Foreign Exchange Intervention (FXI). The result of Engle-Granger co-integration test (see table 3 in appendices) also showed that the dependent variable (NER) and the independent variables (PIR, MS, and FXI) are cointegrated.Furthermore, ARCH Heteroskedasticity test (see table 4 in the appendices) is statistically significant, rejection null hypothesis of "no heteroscedasticity". In other words, it shows evidence of "ARCH effect", which is the justification for us to run a GARCH model. Breusch-Godfrey Serial Correlation LM test (see table 5 in the appendices) is statistically significant, rejecting the null hypothesis of "no serial correlation". This finding also supports the estimation of a GRACH model.The result of Correlogram Q-Statistics (see table 6

in the appendices), shows evidence of autocorrelation among the residuals as graph of Autocorrelation (AC) and Partial Autocorrelation(PAC) have zero probability values. Again, Correlogram of Squared residuals (see table 7 in the appendices) have zero probability values, showing sign of "ARCH effect".

Given the foregoing, we estimate the GARCH (1, 1) model, otherwise called the volatility model (see table 8 in appendices). A distinguishing feature of this model is that the error variance may be correlated over time because of the phenomenon of volatility clustering. However, Bollerslev-Wooldridge (1992) covariance method was applied to the volatility model to achieve a robust result. The results are divided into two parts. The first part shows the result of the mean equation while the second part shows the result of the variance equation. It is worthy to mention that the model regressors (PIR, MS and FXI) are explicitly accounted for in the variance equation, which is supposedly the volatility equation. This is to enable us see how CBN monetary policy response has helped to stabilize the exchange rate overtime.From the GARCH (1, 1) model results, where the research objectives are focused, the coefficients of all the three monetary policy variables in the conditional variance equation are highly statistically significant. Interpreting individually, Policy Interest Rate (PIR), a proxy for interest rate, conforms to apriori expectation, because the coefficient of Policy Interest Rate (PIR) is positive. From the coefficient, the average interest rate, when other variables are held constant, is about 12.72.This means that a unit increase in Interest rate, ceteris paribus, leads on average to about ₦12.72 increase or appreciation in the value of domestic currency. The model result also shows that interest rate is statistically significant and effective in stabilizing exchange rate fluctuations in Nigeria. Money supply conforms to a priori expectation because it has a negative coefficient. Its coefficient is about -7.70 meaning that a unit increase in money supply, other factors remaining constant, reduces exchange rate on the average by about ₦7.70, that is, foreign currencies become more expensive. This is due to the indirect relationship between money supply and interest rate. The model result also shows that Money supply is statistically significant and effective in stabilizing exchange rate fluctuations in Nigeria. CBN FX intervention proxied by external reserve position conforms to apriori expectation, because it has a negative coefficient. Its coefficient is about -3.04, meaning that a unit increase in CBN FX intervention, other factors held constant, leads on average to about ₦3.04 reduction in exchange rate in Nigeria. That is, foreign currencies become cheaper. Hence, CBN FX intervention has a very huge impact on exchange rate fluctuation in Nigeria.

Hence, the model result shows that it is statistically significant, meaning that it is effective in stabilizing exchange rate fluctuations in Nigeria.

Also, typical of GARCH (1, 1) model is that the sum of coefficients of the lagged squared error and lagged conditional variance is close to unity. Hence, the sum of the coefficients of lagged squared error and lagged conditional variance in the variance equation in table 2 above is about 0.75. This implies that there is presence of an exchange rate volatility shocks and also indicates that exchange rate fluctuations are persistent in Nigeria overtime, however the fluctuation in exchange rate was found to be statisticallyinsignificant. This is consistent with the findings of Syarifuddin etal (2014), and Adeoye and Atanda (2010).Unlike their findings, the volatility in this studywas found to be statistically insignificant.

5. Summary and Conclusion

This study attempted to investigate the effect of monetary policy response in stabilizing exchange rate fluctuations in Nigeria, using GARCH (1, 1) model. The Theoretical framework was based on Mundell-Fleming model of small open economy,Dornbusch expectation mechanism, and theories of exchange rate determination. Hence, the variables employed emanated from the LM* curve of the Mundell-Flaming model of small open economy. The variables are Nominal Exchange Rate, Policy Interest Rate, Money supply, and CBN Forex Intervention. However, Policy Interest rate, Money supply, CBN Forex Intervention are exogenous variables, while Nominal Exchange rate is endogenous variable. Quarterlytime series data were used to estimate the model and the sample period covered were 1986Q1 to 2017Q4. That is, the SAP and the post- SAP era. These are the periods when Nigeria started practicing flexible and float-managed exchange rate regimes, till date). Empirical results show that Anchor interest rate, official exchange rate, and money supplyare keyin exchange rate stability in Nigeria. The study also finds that despite CBN's official intervention, exchange rate instability in Nigeria persists overtime. It concludes that Central Bank of Nigeria has a major role to play in managing exchange rate volatility in Nigeria especially when it uses the aforementioned monetary policy tools.

Again, exchange rate fluctuations are persistent over time, meaning that theremay be need for CBN to continuously intervene in the foreign exchange market in order to stabilize the exchange rate in Nigeria. This assumes that CBN may not allow the exchange rate to flow freely.

In order to ensure efficient and effective management of the exchange rate in Nigeria, CBN may have to deal with the issue of multiple exchange rate currently in practice in Nigeria. This will help to resolve the problem of round-tripping of dollar and other foreign currencies, which eventually comes back to hurt the economy in the form of inflation.

The findings of this study suggest that to stabilize the naira exchange rate, CBN may haveto streamline and unify different exchange rates in Nigeria to a single exchange rate against the US dollar and other major foreign currencies in order to manage exchange rate fluctuations effectively.

The study may suggest thatthe most effective way to manage the exchange rate is to support local industries to produce for export. CBN may ensure that larger percentage of loans given by Deposit Money Banks (DMBs) are directed to local manufacturing companies that produce for export, especially those that produce import substituted goods.

The results of the study suggest that high interest rate in Nigeria may attract foreign investors to take advantage of high returns on their investment, however, experiences have shown that most of the foreign investments are portfolio investment. They pull out their funds at the slightest signal of crises. The CBN may rather target Foreign Direct Investors, who can create employment for the teeming youths. The results further suggest thatto continue to intervene in the forex market the CBN may need to continually grow its external reserve position. While this is a temporary solution, it would rather be better for the government to push for diversification of the Nigerian Economy away from oil and gas. The results also suggest that refined petroleum products top the list of items that account for the fluctuation of the exchange rate, rather than import refined petroleum products, the government should intensify effort to refined enough petroleum products domestically that will meet domestic demand and if possible export the excess to other African countries.

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APPENDICES

Appendices I: Pre-estimation and Models Test Results

TABLE 1 Mean Equation and Pre-estimation Test Results

Variable	Coefficient	Standard Error	t-Statistic	Prob.
C	30.88982	15.72147	1.964818	0.0517
PIR	-0.633279	0.953753	-0.663987	0.5079
MS	0.760897	0.087991	8.647470*	0.0000
FXI	0.000149	9.21E-05	1.612793	0.1093
R-Squared	0.493243			
Adjusted R-Squared	0.480983			
F-Statistic	40.23106			0.0000
Durbin-Watson Stat.	0.143710			

Pre-Estimation Checks:	test statistic	critical value
Jarque-Bera (Normality test)	18.52913*	5.99147
ARCH Heteroscedasticity test	88.51875*	3.84146
Engle-Granger Co-integration test	-2.032702*	-1.943364
Breusch-Godfrey Serial Correlation	111.7033*	3.84146

Source: Author's calculation using Eviews10
Significant at 5% level is denoted by *

TABLE 2

UnitRoot Test

Augmented Dickey-Fuller and Philips-Perron Unit Root Test							
Variables	ADFTest Statistic	ADF Critical Values	Decision	PP Test Statistic	PP Critical Values	Level of Significance	Decision
NER	-9.713367	-2.884477	Reject Ho	-9.686445	-2.884477	5%	Reject Ho
PIR	-10.56194	-2.884477	Reject Ho	-12.4635	-2.884477	5%	Reject Ho
MS	-11.83808	-2.884477	Reject Ho	-11.83186	-2.884477	5%	Reject Ho
FXI	-13.12371	-2.884856	Reject Ho	-32.51096	-2.884477	5%	Reject Ho

Source: Author's Calculation using Eviews 10

TABLE 3 Engle-Granger Co-integration Test

ADF Test statistic	ADF critical value	Level of significance	Decision

-2.032702-1.943364	5%	Reject Ho	

Source: Author's calculation using Eviews 10

TABLE 4 Heteroskedasticity Test: ARCH.

F-Statistic	287.5386	Prob. F (1,125)	0.0000
Obs*R-squared	88.51875	Prob. Chi-squared (1)	0.0000

Source: Author's calculation using Eviews 10

TABLE 5 Breusch-Godfrey Serial Correlation LM

F-Statistic	418.1158	Prob. F (2,122)	0.0000
Obs*R-squared	111.7033	Prob. Chi-square (2)	0.0000

Source: Author's calculation using Eviews 10

TABLE 6 Correlogram Q-Statistics
Sample: 1986Q1 2017Q4
Included observations: 128

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|*******	.|*******	1	0.912	0.912	109.10	0.000
.|******|	.|. |	2	0.834	0.008	200.93	0.000
.|***** |	.|. |	3	0.760	-0.012	277.82	0.000
.|***** |	.|. |	4	0.685	-0.044	340.85	0.000
.|***** |	.|. |	5	0.630	0.069	394.47	0.000
.|**** |	*|. |	6	0.565	-0.075	438.08	0.000
.|**** |	.|. |	7	0.518	0.062	474.98	0.000
.|*** |	*|. |	8	0.456	-0.114	503.87	0.000
.|*** |	.|. |	9	0.402	0.016	526.52	0.000
.|** |	.|. |	10	0.349	-0.047	543.74	0.000
.|** |	.|. |	11	0.301	0.017	556.62	0.000
.|** |	.|. |	12	0.262	-0.008	566.44	0.000
.|** |	.|. |	13	0.216	-0.041	573.19	0.000
.|* |	*|. |	14	0.169	-0.066	577.35	0.000
.|* |	.|. |	15	0.122	-0.021	579.54	0.000
.|* |	.|. |	16	0.079	-0.021	580.46	0.000
.|. |	.|. |	17	0.045	0.019	580.77	0.000
.|. |	*|. |	18	0.003	-0.084	580.77	0.000

.|. |	.|. |	19	-0.031	0.002	580.91	0.000
.|. |	.|. |	20	-0.065	-0.037	581.57	0.000
*|. |	*|. |	21	-0.108	-0.079	583.39	0.000
*|. |	.|. |	22	-0.144	-0.017	586.64	0.000
*|. |	.|. |	23	-0.178	-0.015	591.64	0.000
*|. |	.|. |	24	-0.199	0.013	597.99	0.000
**|. |	*|. |	25	-0.241	-0.154	607.34	0.000
**|. |	.|. |	26	-0.275	-0.009	619.69	0.000
**|. |	*|. |	27	-0.314	-0.094	635.98	0.000
***|. |	.|. |	28	-0.350	-0.002	656.34	0.000
**|. |	.|* |	29	-0.338	0.200	675.53	0.000
**|. |	.|. |	30	-0.334	-0.025	694.41	0.000
**|. |	.|. |	31	-0.322	-0.011	712.23	0.000
**|. |	.|. |	32	-0.306	0.041	728.41	0.000
**|. |	*|. |	33	-0.314	-0.147	745.63	0.000
**|. |	.|. |	34	-0.319	-0.024	763.63	0.000
**|. |	.|* |	35	-0.303	0.149	780.04	0.000
**|. |	.|. |	36	-0.273	0.041	793.48	0.000

Source: Author's calculation using Eviews 10

TABLE 7 Correlogram of Residuals Squared

Sample: 1986Q1 2017Q4
Included observations: 128

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|******|	.|******|	1	0.827	0.827	89.511	0.000
.|******|	.|** |	2	0.783	0.316	170.54	0.000
.|***** |	.|* |	3	0.725	0.075	240.58	0.000
.|***** |	.|* |	4	0.728	0.206	311.62	0.000
.|***** |	*|. |	5	0.656	-0.094	369.91	0.000
.|**** |	*|. |	6	0.598	-0.097	418.70	0.000
.|**** |	.|. |	7	0.561	0.032	461.98	0.000
.|**** |	.|. |	8	0.516	-0.060	498.87	0.000
.|*** |	.|. |	9	0.465	-0.043	529.16	0.000
.|*** |	.|. |	10	0.435	0.060	555.85	0.000
.|*** |	.|. |	11	0.393	-0.041	577.80	0.000
.|** |	*|. |	12	0.336	-0.093	594.01	0.000
.|** |	.|. |	13	0.297	0.010	606.78	0.000
.|** |	*|. |	14	0.234	-0.132	614.78	0.000
.|* |	.|. |	15	0.195	-0.033	620.36	0.000
.|* |	.|. |	16	0.130	-0.057	622.89	0.000
.|* |	*|. |	17	0.081	-0.083	623.87	0.000
.|. |	.|. |	18	0.032	-0.010	624.03	0.000
.|. |	.|. |	19	0.000	0.025	624.03	0.000
*|. |	**|. |	20	-0.087	-0.214	625.20	0.000
*|. |	.|* |	21	-0.099	0.110	626.73	0.000

*|. |	*|. |	22	-0.158	-0.075	630.63	0.000
*|. |	.|. |	23	-0.173	-0.024	635.35	0.000
**|. |	.|. |	24	-0.224	0.031	643.38	0.000
**|. |	.|. |	25	-0.234	0.007	652.22	0.000
**|. |	*|. |	26	-0.275	-0.091	664.53	0.000
**|. |	.|. |	27	-0.316	-0.047	681.01	0.000
**|. |	.|* |	28	-0.312	0.090	697.23	0.000
**|. |	.|. |	29	-0.323	-0.030	714.81	0.000
**|. |	.|. |	30	-0.340	0.010	734.46	0.000
***|. |	*|. |	31	-0.376	-0.067	758.74	0.000
***|. |	.|. |	32	-0.382	-0.061	784.04	0.000
***|. |	.|. |	33	-0.383	0.051	809.67	0.000
***|. |	.|. |	34	-0.372	0.021	834.14	0.000
***|. |	.|. |	35	-0.363	0.061	857.67	0.000
***|. |	*|. |	36	-0.372	-0.067	882.64	0.000

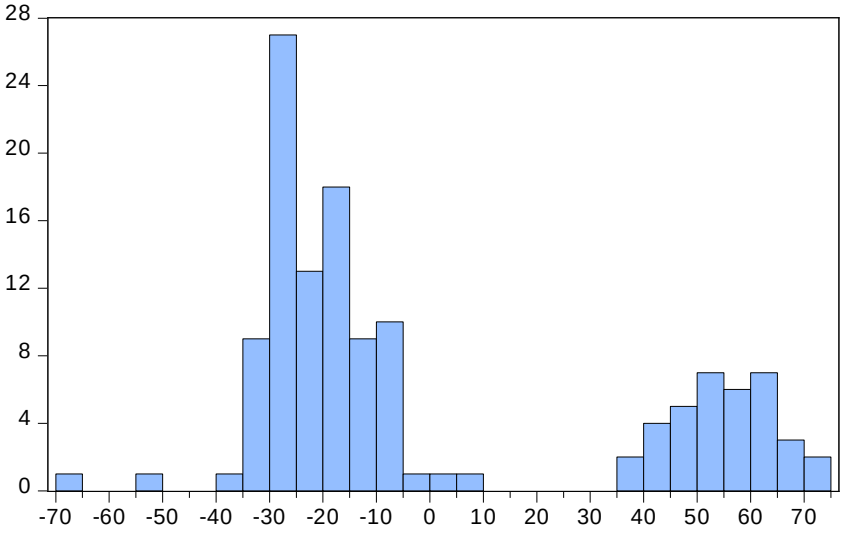
Source: Author's Calculation using Eviews10

TABLE 8: Volatility Model Results

Variable	**Coefficient**	**Standard Error**	**z-Statistic**	**Prob.**
C	0.850749	0.769976	1.104903	0.2692
D(PIR)	0.142742	0.082964	1.720526	0.0853
D(MS)	-0.294043	0.058961	-4.987105*	0.0000
D(FXI)	-2.05E-06	4.16E-06	-0.493623	0.6216
Variance Equation				
C	85.49326	98.92004	0.864266	0.3874
α: ARCH (-1)	0.149999	0.126169	1.188880	0.2345
β: GARCH (-1)	0.600000	0.357567	1.678005	0.0933
D(PIR)	12.72430	5.668880	2.244589*	0.0248
D(MS)	-7.70E-06	2.816077	-2.73E-06*	1.0000
D(FXI)	-3.04E-09	0.000903	-3.36E-06*	1.0000
$\alpha + \beta$	0.749999			

Source: Author's calculation using Eviews10.
Significant at 5% level is denoted by *

TABLE 9 Jarque-Bera Normality Test



Source: Author's calculation using Eviews 10

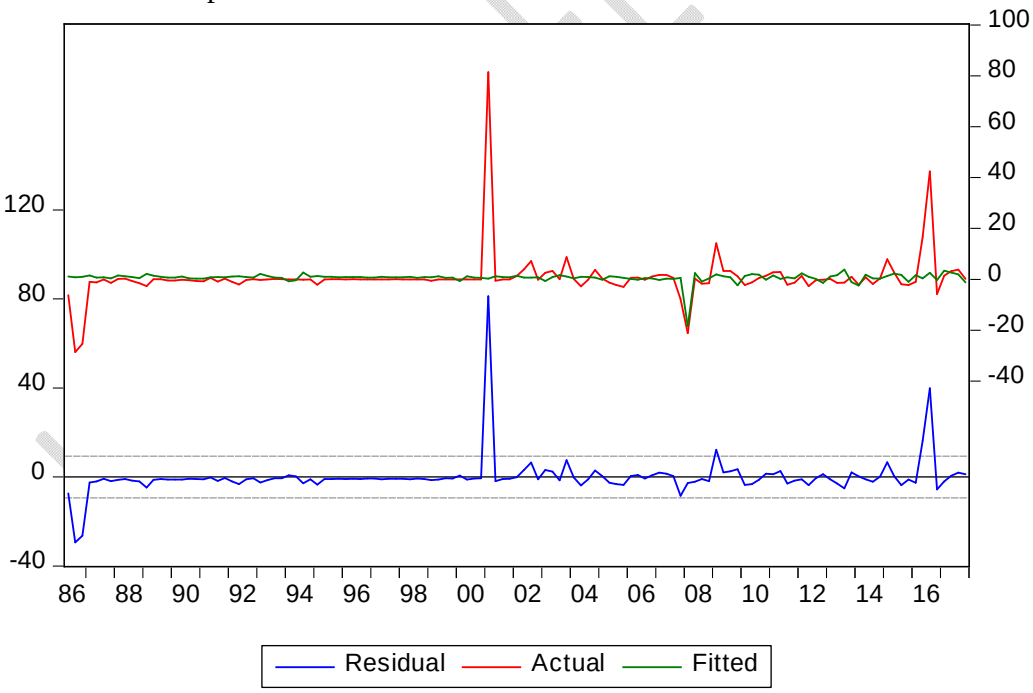
TABLE 10 Correlation Matrix Table.

	PIR	MS	FXI
PIR	1	-0.49327	-0.22604
MS	-0.49327	1	0.237873
FXI	-0.22604	0.237873	1

Source: Author's Calculation using Eviews10

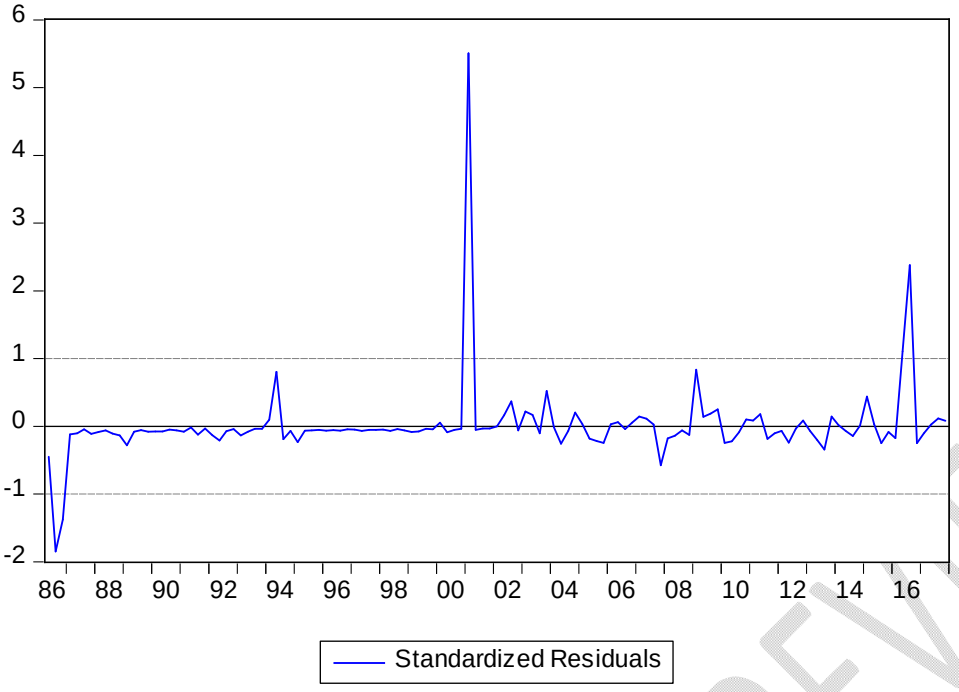
Appendices II: Graphs of Variables used in the model

FIGURE 1 Graph of Residuals: Actual versus Fitted



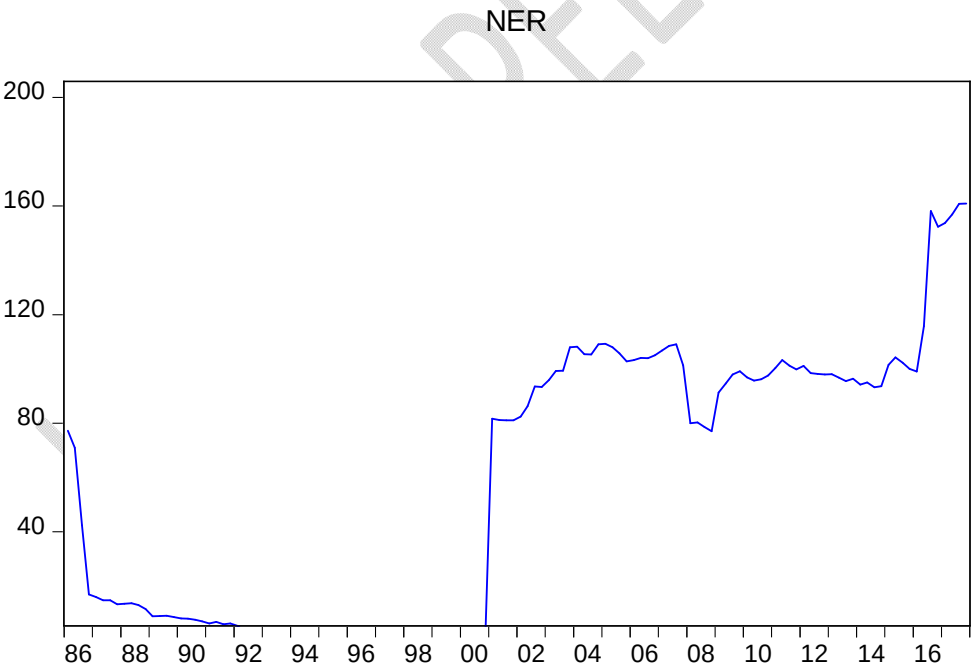
Source: Author's calculation using Eviews 10

FIGURE 2 Graph of Standardized Residuals



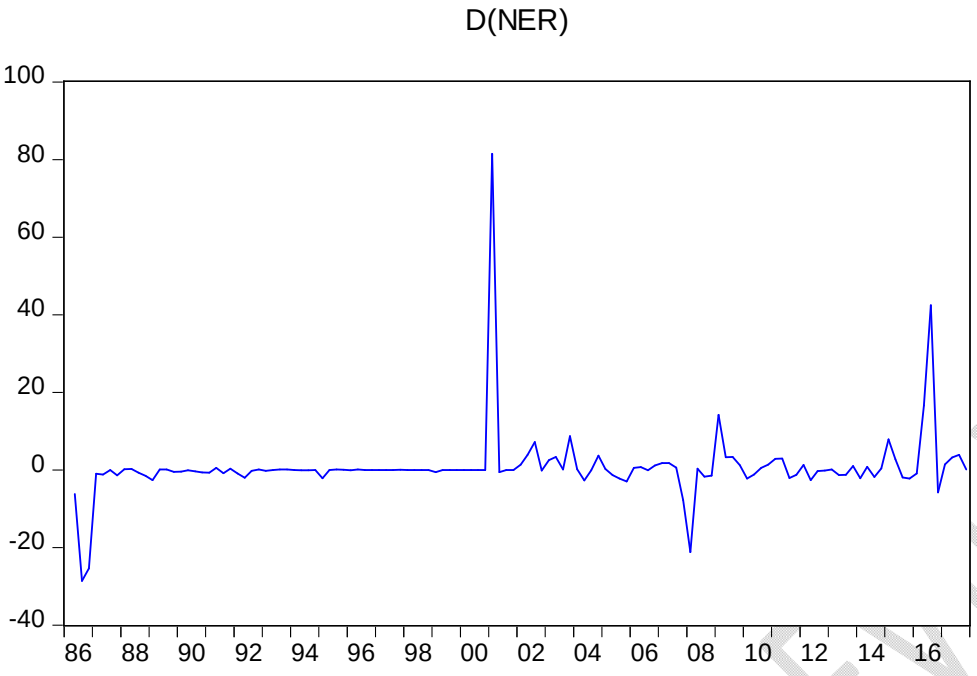
Source: Author's calculation using Eviews 10

FIGURE 3 Graph of Nominal Exchange Rate at Level form



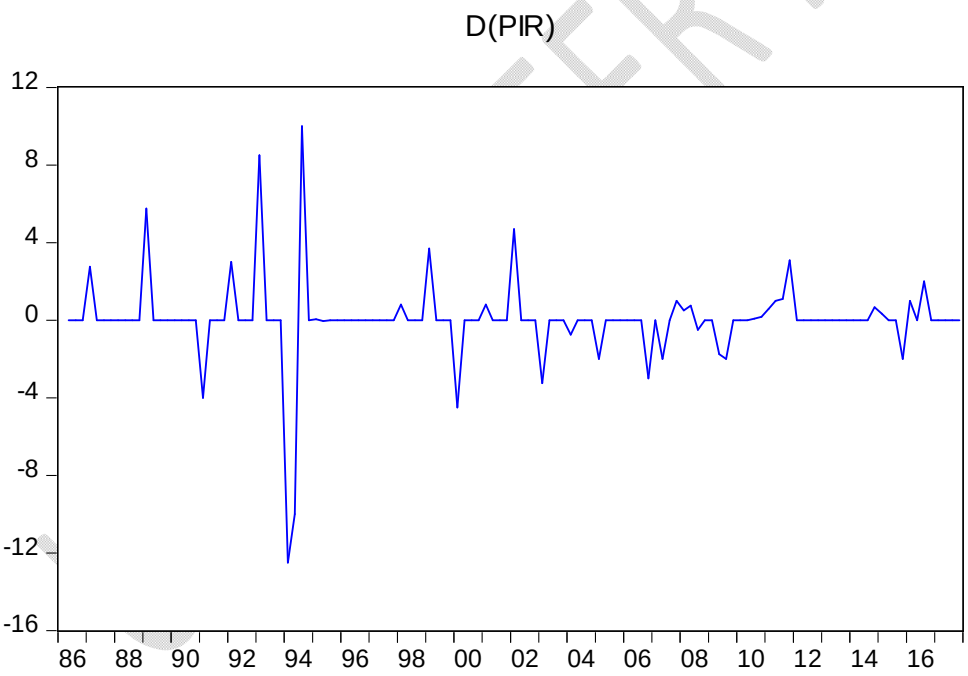
Source: Author's calculation using Eviews 10

FIGURE 4 Graph of Nominal Exchange Rate after First Difference



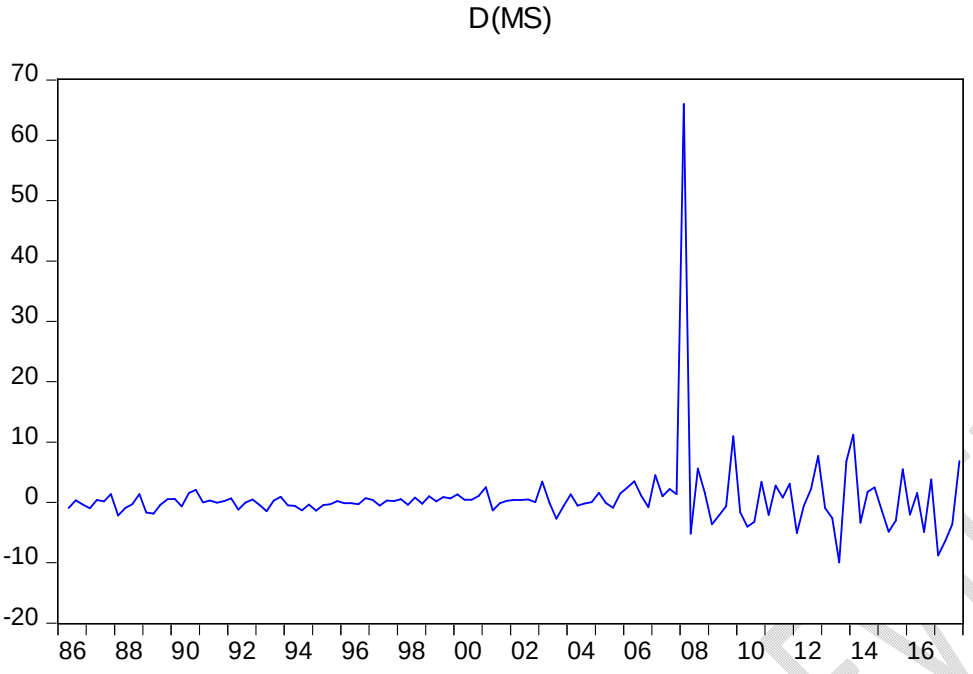
Source: Author's calculation using Eviews 10

FIGURE 5 Graph of Policy Interest rate after First Difference.



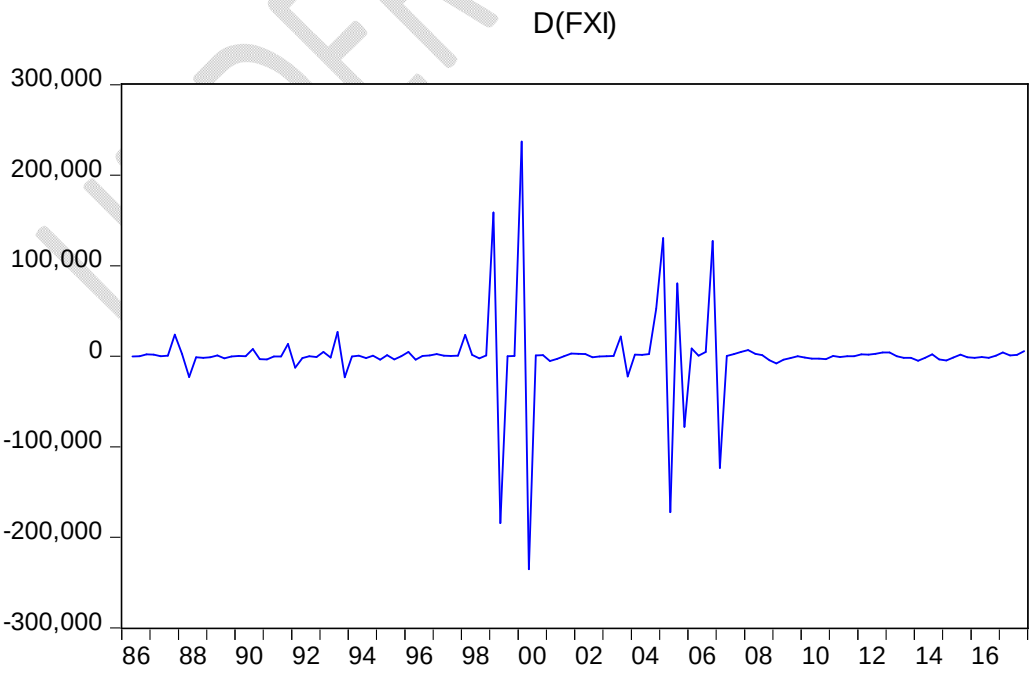
Source: Author's calculation using Eviews 10

FIGURE 6 Graph of Money Supply after First Difference



Source: Author's calculation using Eviews 10

FIGURE 7 Graph of CBN Foreign Exchange Intervention after First Difference.



Source: Author’s calculation using Eviews 10