Impact of Exchange Rate on Selected Macroeconomic Variables in Nigeria, 1986-2017.

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Abstract

This paper examines the impact of exchange rate on selected macroeconomic variables in Nigeria. The paper covers the period of 1986 to 2017 taking into consideration the trade liberalization policy (SAP era) and Export Promotion Policy (post SAP era) (1999 to date). The aim is to analyze the extent to which exchange rate affects selected macroeconomic variables. The data for this study were analyzed using analytical tools. The analytical tools involved the use of Vector Error Correction Model, Augmented Dickey-Fuller (ADF) test, stability test, Lag Order Selection Criteria, and the Johansen Co-integration Test. The result revealed that the coefficients of GDP, inflation rate, money supply and trade openness conformed to a priori expectation while interest rate did not. This implies that as GDP rises, the exchange rate will appreciate. This is because as the country produces more goods, it means there would be an increase in exports, which boosts the exchange rate of a country. Similarly, an improvement in exports will also increase the level of openness of the economy, which affects the exchange rate positively. Conversely, as inflation rises, the value of money erodes, which leads to a depreciation of the exchange rate, because the exchange rate is computed using relative commodity prices of different countries. The study found that GDP, trade openness and inflation rate significantly affect exchange rates, while interest rate and money supply do not significantly affect the exchange rate in Nigeria. The study, therefore, concludes that while some macroeconomic variables are instrumental to exchange rate appreciation, others are detrimental to it and leads to exchange rate depreciation. On the basis of these findings, the paper recommends that the government of Nigeria should focus on expanding productive activities so as to improve the exports of the nation which can lead to a reduction of exchange rate depreciation, It also recommends that the monetary authorities should avoid rapid variations in the growth of money so as to avoid frequent increases in the rate of inflation which is detrimental to exchange rate appreciation.

Keywords: Exchange rate, Interest rate, Inflation, Money supply, Gross domestic product, Nigeria.

Introduction

The exchange rate is an important macroeconomic variable used as a parameter for determining international competitiveness and it serves as an indicator of competitiveness for any country's currency. In view of that, the lower the value of this indicator in any country the higher the competitiveness of such currency of that country. Exchange rate system includes set of rules, arrangement and institutions under which nations effect payments among themselves.

The exchange rate is said to be an important element in the economic growth and development of a developing nation. Exchange rate policies influence the economic activities and to a large extent, dictate the direction of macroeconomic variables in the country. The mechanism of exchange rate determination is different systems of managing the exchange rate of a nation's currency in terms of other currencies and this should be properly done in a way that will bring about efficient allocation of scarce resources so as to achieve growth and development.

In Nigeria and indeed many developing countries, the price of foreign exchange plays a critical role in the ability of the economy to attain optimal levels in production activities. In the wake of policy change, occasioned by the introduction of structural adjustment programs (SAP) in July, 1986, led to the emergence of the flexible exchange rate as oppose to fix the exchange rate as a regime that was in place before the policy change. During the fixed exchange rate regime, the supply of foreign exchange was highly subsidized through the overvaluation of domestic currency. The essence of the policy was to maintain a relatively cheaper cost of importation of industrial raw-material and equipment, so as to sustain the policy of import substitution industrialization strategy (Obadan, 2015).

To further consolidate the period of the oil boom of the 1970s, the government continued to sustain overvaluation of domestic currency, so as to douse the inflationary pressure arose from the monetization of the oil windfall gains through the Udoji committee known as "Udoji Awards" of 1975. But in the wake of persistent balance of payment deficit caused by the downward trend in the oil price in the international market led to the jettison of the fixed exchange rate, and emergence of flexible exchange rate through second-tier-exchange rate market (SFEM). This policy led to the downward trend in exchange rate and the impact of overvaluation of the exchange rate came with the massive importation of foreign goods because they are cheaper and while exports are relatively expensive and uncompetitive in the international market and led to the importation of large volumes of consumer goods and thereby worsen the country's balance of payment deficit (Gbosi, 2015). In view of the above anomaly, it is important to investigate the impact of exchange rate on macroeconomics variables for the period of 1986-2017; a sample size of 31 years, a period long enough for time series analysis. However, several studies on the impact of exchange rate on macroeconomic variables have been conducted, but most of these studies

either focused on the impact of exchange rate on trade or on growth or were done outside the shore of this country. In addition, the majority of the studies on exchange rate did not consider the possibility of the long run relationship between exchange rate and their macroeconomic variables. Suffice it to say that most of their time frames are too short to access the long run behavior of exchange rates and its macroeconomic variables. The choice of this period is due to the fact that Nigerian economy has practiced different types of exchange rate regimes within the given period. All these constitute the gap other studies have not been able to bridge that this paper has succeeded in filling. The main objective of this paper is to examine the impact of exchange rate on selected macroeconomic variables in Nigeria. Apart from the introduction, the rest of the paper is organized into section 2, literature review, section 3, is the materials and methods used, section 4 is the data presentation and discussion of the results, finally section 5 is conclusion and policy recommendations.

Conceptual Clarification

Exchange Rate

According to Oriavwote and Oyovwi (2012), the exchange rate is defined as the rate at which one country's currency is exchanged for the currency of another country. This implies that the exchange rate is the price of one country's currency relative to other countries' currency. Furthermore, Bakoulas, Baum and Caglayan (2012) defined exchange rate as the price at which exchange between two countries take place. They stated that the modality to determine the exchange rate is an issue that has taken the center stage of monetary and international economics. Monetary policy authority in Nigeria is faced with the problems of having a stable and realistic exchange rate, which is in consonance with other macroeconomic fundamentals. This is because exchange rate instability can have serious adverse consequences on prices, investments and international trade decisions. A realistic exchange rate is one that reflects the strength of foreign exchange inflow and outflow, the stock of reserves as well as ensuring equilibrium in the balance of payments that is consistent with the cost and price levels of trading partners (Ojo, 2012).

More so, Nouri and Samimi (2012) define exchange rate as the amount of local or home currency required to purchase one unit of a foreign currency. They opined that exchange rate is determined by the demand and supply of foreign currency, trade balance, current account balance and capital account balance. GDP per capita is often considered as an indicator of a country's growth. Changes in the exchange rate translate directly into changes in domestic collections from imports and exports. For a given level of imports or exports, a more depreciated real exchange rate would increase the base of trade taxes in domestic currency terms, which would in turn increase trade tax collections.

Oladipupo and Ogheneov (2014) perceive exchange rate as the price of one currency in terms of another. The increase or decrease of real exchange rate indicates the strength or the weaknesses of the currency in relation to foreign currency, and it is a

standard for illustrating the competitiveness of domestic industries in the world market. When there is deviation of this rate over a period of time from the benchmark or equilibrium, the exchange rate is said to be volatile. It also indicates that the misalignment of the exchange rate has occurred where there is a multiplicity of markets parallel with the official market. It is of a general belief that the appreciation of a currency expands imports and reduces exports while the depreciation of currency increases the cost of importation; thereby discouraging imports and encouraging export. Risk adverse investors invest in exports so as to worry less about the changes in the exchange rate and prevent a sudden loss of revenue (Olowe, 2015).

Masha and Adamgbe (2015) have defined exchange rate as the rate at which one currency exchanges for another. The exchange rate is said to depreciate if the amount of domestic currency requires buying a foreign currency increases, while the exchange rate appreciates if the amount of domestic currency require buying a foreign currency reduces. An appreciation in the real exchange rate may create current account problems because it leads to overvaluation. Overvaluation in turn makes imports artificially cheaper while exports relatively expensive, thus reducing the international competitiveness of a country.

Ehinomen and Oladipo (2015) define exchange rate as the price of one currency (the domestic currency) in terms of another (the foreign currency). The exchange rate plays a key role in international economic transactions because no nation can remain in autarky due to varying factors endowment. Movements in the exchange rate have ripple effects on other economic variables such as interest rate, inflation rate, unemployment, money supply and so on. These facts underscore the importance of the exchange rate to the economic well being of every country that opens its doors to international trade in goods and services.

Concept of Interest Rate

In the views of Rasaq (2016), interest can be defined as the return or yield on equity or the opportunity cost of deferring current consumption in the future. This definition clearly shows that interest is a concept which can mean different things depending from the perspective it is viewed. The interest rate can therefore be seen as a nebulous concept, a position affirmed by the availability of different types of this rate. Some of which are savings rate, discount rate, lending rate and the Treasury bill rate. Apart from this, the interest rate can also be categorized as nominal or real.

Also, Oriavwote and Oyovwi (2012) note that interest rates are the cost of borrowing money. Interest rates are normally expressed as a percentage to the total borrowed. The rate of interest is the amount of interest per unit of time, typically one year. There is no one rate of interest, but, rather, a myriad of rates. Interest rates vary to reflect the ability and willingness of borrowers to meet their obligations and the ease with which a borrower's promissory note or bond, mortgage, debenture or other evidence of indebtedness can be turned into money (Attah-Obeng, Enu, Osei-Gyimah and Opoku, 2013).

In addition, Eze and Okpala (2014) defines the interest rate as the returns a lender expects by positing and parting with his/her liquidity. The interest rate is a double-edged sword in that if it is high, holders of surplus funds will part with some since they expect higher returns in the future. On the other hand, higher interest rates discourage borrowing. In a state of equilibrium, interest rate equates demand, investment and supply, saving into the capital market.

Inflation

According to Opaluwa, Umeh and Ameh (2016), inflation refers to the general increase in the price of commodities over a given duration. Inflation tends to push up the price of commodities without a corresponding increase in their real value. The inflation rate in Nigeria was recorded at 3.10 percent in January of 2015 and averaged 6.24 percent from 1997 until 2015. Nigeria's consumer price index (CPI), the main gauge of inflation, increased by 2.1 per cent year –on- year during the month of December 2014 compared to 3.6 per cent the previous year, a report indicated. The concept of inflation has been defined as a persistent rise in the general price level of broad spectrum of goods and services in a country over a long period of time. Inflation has been intrinsically linked to money, as captured by the often heard maxim, inflation is too much money chasing too few goods.

Ojo (2012) describes the term inflation as a general and persistent increase in the prices of goods and services in an economy. Inflation rate is measured as the percentage change in the price index (consumer price index, wholesale price index, producer price index and so on). Mussa (2014) opine that the consumer price index (CPI), for instance, measures the price of a representative basket of goods and services purchased by the average consumer and calculated on the basis of periodic surveys of consumer prices. Owing to the different weights the basket, changes in the price of some goods and services have an impact on measured inflation with varying degrees. There are several disadvantages of the CPI as a measure of the price level. First, it does not reflect goods and services bought by firms and/or government, such as machinery. Secondly, it does not reflect the change in the quality of goods which might have occurred over time. Thirdly, changes in the price of substitutable goods are not captured. Lastly, CPI basket usually does not change often. Despite these limitations, the CPI is still the most widely used measurement of the general price level. This is because it is used for indexation purposes for many wage and salary earners (including government employees).

Money Supply

As submitted by Ogunmuyiwa and Ekone (2012), money supply is the total stock of monetary media of exchange available to a society for use in connection with the economic activity of the country. According to the standard concept of money supply, it is composed of the following two elements: Currency with the Public and Demand deposits with the Public. Two things must be noted with regard to the money supply in the economy.

First, the money supply refers to the total sum of money available to the public in the economy in a given time period. That is, the money supply is a stock concept in sharp contrast to the national income which is a flow representing the value of goods and services produced per unit of time, usually taken as a year. Secondly, money supply always refers to the amount of money held by the public (Ogunmuyiwa & Ekone, 2012).

Money supply more or less influences or affects economic growth positively or negatively. From 1959, there have been two major phases in the pursuit of monetary policy, namely: direct monetary control phase and the market mechanism phase. These phases were all aimed at regulating the supply and cost of money optimally, such that certain desired national objectives (such as increased and sustainable output) were achieved. It has been observed that the quantity of money supplied in an economy influences the gross domestic product, or output over time (Odusola & Akinlo, 2012).

Literature Review

Given the potential impact of exchange rate on inflation, prices, investment, balance of payment, and interest rate, the issue of determination of optimal exchange rate becomes imperative for the successful implementation of development programs in the country. Yaqub (2014) argues that the objectives of exchange rate policy are to increase output and its optimal distribution. A necessary condition for the achievement of the above objectives is that the exchange rate should be as stable as possible. According to him, stability permits viability of the rate in response to changes in relative prices, international terms of trade and growth factors (Yaqub, 2014).

The exchange rate policy involves choosing an exchange rate system and determining the particular rate at which foreign transaction will take place. The exchange rate policy affects growth by determining capital flow, foreign investment and external balance for most developing countries. The inadequacy of foreign exchange constitutes a bottleneck in the process of development. In the course of development, the rate of growth of national output and the demand for imports tends to exceed export based capacity (Ojo, 2012).

Therefore, there is a conflict between accelerating internal development and maintaining external balance. This conflict is resolved by a realistic exchange rate policy. Exchange rate policy by devaluation or overvaluation has an implication for an economy. Devaluation helps to improve the external competitiveness either through a contraction in imports or expansion in exports and this influences both consumption and investment decisions. Overvaluation of foreign exchange exacerbate external borrowing, balance of payments disequilibrium and the distortion of the economy, while undervaluation results in income distortion detrimental to labor, trade, current account surpluses, standard of living and the growth of the economy (Akinlo and Lawal, 2014).

The basic element of efficient exchange rate system is the assumption that exchange rate reflects the relative productivity of an economy (Obadan, 2015). In the long-term, the devalued Naira protects domestic industries, encourages domestic production, reduction in

the cost of imported raw materials and makes domestically produced goods competitive. Several factors influencing the choice of a particular exchange rate regime in a country, a major consideration is the internal economic conditions or fundamentals, the external economic environment and the effect of various random shocks in the domestic economy. Thus, countries like Nigeria which are vulnerable to unstable internal financial conditions and external shocks, (including terms of trade shocks, and excessive debt burden), which require real exchange rate depreciation, tend to adopt a regime which ensures greater flexibility (Obadan, 2015).

Rasaq (2016) examined the impact of exchange rate volatility on macroeconomic variables and with the help of Correlation Matrix, Ordinary Least Square (OLS) and Granger Causality test, the findings of the study show that exchange rate volatility has a positive influence on gross domestic product, foreign direct investment and trade openness, but with negative influence on the inflationary rate in the country. It was suggested by the author that there is a need for the country to improve their revenue base in term of increasing number of items meant for export and reduce over reliance on petroleum sector and also to reduce the importation of nonessential items, so as to improve their terms of trade. Also, an increase in domestic production will reduce the problem caused by exchange rate volatility.

Shehu and Aliyu (2016) estimated the long run behavioral equilibrium exchange rate in Nigeria. They used quarterly data from 1984 to 2014 and derive a Behavioral Equilibrium Exchange Rate (BEER) and a Permanent Equilibrium Exchange Rate (PEER). Regression results show that most of the long-run behavior of the real exchange rate could be explained by real net foreign assets, terms of trade, index of crude oil volatility, index of monetary policy performance and government fiscal stance. On the basis of these fundamentals, four episodes each of overvaluation and undervaluation were identified and the antecedents characterizing the episodes were equally traced to the archive of exchange rate management in the country within the review period. Among others, for instance, large inflow of oil revenues into the country and stable macroeconomic performance were discovered to account for undervaluation of the real exchange rate between 2001 and 2014 in Nigeria. The results further suggest that deviations from the equilibrium path are eliminated within one to two years.

Jimoh (2016) examines the Nigerian data from 1980 to 2014 to see what support it provides for the traditional theory of real exchange rate. The author used the well-known Johansson's (1992) methods for estimating models whose variables are non- stationary but co integrated. The study found that the decisive trade liberalization program of 1986 – 87 led to about 13 per cent depreciation in the Nigerian real exchange rate and made the real rate more responsive to changes in its terms of trade. Result established that less decisive changes in the trade regime produced no significant changes in the real exchange rate.

Onuoha (2015) examine the impact of exchange rate variation and inflation in the economic growth of Nigeria. Ordinary least square method was adopted to analyze the time series properties of the variables under consideration so as to determine the trend of the variations using annual data set on real GDP and inflation rate spanning 1980 to2010. The objective of this study among others is to examine the effect of exchange rate variation and inflation in the economic growth of Nigeria. The data sources were mainly from twenty-three years financial indications of exchange rate variations and inflation. The data sources were mainly from CBN Statistical Bulletin (various issues), CBN Annual Report (various issues), International Monetary Fund and International Financial Statistics Year Book (various issues). The interest rate variations were measured by three years, moving average of the standard deviation of the nominal exchange rate. The empirical analysis revealed that export and import showed a positive relationship, but not statistically significant at 3.4%. The coefficient of Exchange rate showed a positive relationship, but is statistically significant at 3.4%. This implies a positive relationship between inflation and exchange rate. This is because an increase in the volatility of exchange rate will lead to increase in inflation. Only economic growth recorded a negative relationship. The study contends that while the high rate of inflation and inconsistent exchange rates is detrimental to economic growth, moderate and stable inflation rate supplements return to savers, enhances investment and therefore economic growth of a country. Based on the strength of these findings, the researcher submits that macroeconomic policies aimed at enhancing sustainable economic development should not over concentrate on fighting inflation, but should on other areas of economic development such as factor input productivity and human capital development.

Devereux and Engel (2015) investigate the choice of exchange-rate regime fixed or floating in a dynamic, inter-temporal general equilibrium framework. They used an extended Devereux and Engel (2015) framework for investigating the implications of internationalized production. They examine the role of price setting, whether prices are set at the currency of producers or the currency of consumers in determining the optimality of exchange-rate regimes in an environment of uncertainty created by monetary shocks. They find that when prices are set in producers' currencies, floating exchange rates are preferred when the country is large enough, or not too risk averse. On the other hand, floating exchange rates are always preferred when prices are set in consumers' currencies because floating exchange rates allow domestic consumption to be insulated from foreign monetary shocks. The gains from floating exchange rates are greater when there is an internationalized production in this case.

From the above literature reviewed, the following issues have been observed. First, most studies on exchange rates either focused on the impact of exchange rate on trade or on growth. Second, the majority of the studies were done outside the shore of this country. This led us to venture into the research. Third, majority of the studies on exchange rate did not consider the possibility of long run relationship between exchange rate and their

macroeconomic variables. Although, Shehu and Aliyu (2016) estimated the long run behavioral equilibrium exchange rate in Nigeria using quarterly data from 1984 to 2014. Suffice it to say that this period is too short to access the long run behavior of exchange rates and its macroeconomic variables since most time series econometricians suggest the minimum of 25 years' observation of time series data.

Materials and Methods

The kinds of data required for this study were secondary data. This study used time series data from Nigeria. The data required in achieving the objective of the study are as follows: Nominal Exchange Rate (EXR), Lending Interest Rate (INR), Growth Rate of Money Supply (MS), Rate of Inflation (INF), Gross Domestic Product (GDP), and Trade Openness (TOP)

The data were sourced from several publications of the Central Bank of Nigeria (2013 and 2014) particularly the statistical bulletin. The data for this study were analyzed using both descriptive statistics and analytical tools. The descriptive statistics shows the mean of the variables, their standard deviations, the median, maximum and minimum values as well as the normality test. The analytical tools involved the use of vector error correction model, Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981), stability test, lag order selection criteria, Johansen co-integration test, impulse response analysis and the variance decomposition.

Following the argument of Williamson (1994) that a country's optimal exchange rate is determined by its macroeconomic variables and that the long-run value of the real exchange rate is determined by suitable values of these fundamentals, this study adopted the model used by Williamson (1994) as:

EXR □□F □INTR, INF, MOS□.....(1)

However, this study has modified the model by including trade openness and GDP. The empirical model is stated as:

$$EXR = \alpha_0 + \alpha_1 GDP + \alpha_2 INF + \alpha_3 INR + \alpha_4 MS + \alpha_5 TOP + \mu \text{.....(2)}$$

Where

EXR = Exchange Rate

GDP = Gross Domestic Product

INTR = Interest Rate

INF = Inflation Rate

Ms =Money Supply

Top = Trade Openness

α_0 = the constant term
α_1-α_5 = the parameters to be estimated
□□=error term
Dependent variable response to the set of the explanatory variables in the above model may not be automatic, in other words, it is rarely instantaneous. Sometimes, the dependent variable responds to the explanatory variables with a lapse of time (Gujarati, 2004). Hence, equation (2) is transformed into a dynamic model as follows:

$EXRt \square \alpha_0 \square \alpha_1 \square GDPRt \square i \square \alpha_2 INFt \square i \square \alpha_3 INRt \square i \square \square \alpha_4 Mst \square i \alpha_5 TOPt \square i \square \square$ .....(3)

Where *t-i* = the lag length. We shall use Akaike Information Criteria (AIC) to determine the optimal lag length of the model. This method has gained prominent recognition among econometricians. There may be a possibility of the model processing nuisance lag length after applying the AIC. If that occurs, the study shall introduce Granger–marginalization procedure so as to drop the redundant lag(s). On apriori ground, it is expected that the independent variables should have positive impact on the dependent variables. Symbolically it is as:$\alpha_1, \alpha_2\ \alpha_3, \alpha_4, \alpha_5 > 0$.

Results of the Findings

This section highlights the data used in analyzing the impact of macroeconomic variables on exchange rate in Nigeria. The data presented is in harmony with the stated objectives of the study. The data set identifies the variables that proxy the relationship between exchange rate and macroeconomic variables in Nigeria. Subsequent sections present the results of the Vector Error Correction Model (VECM) and other statistical estimations including pre-estimation and post-estimation techniques. The dataset was collected for a 31 year period spanning 1986 to 2017 and was sourced from Central bank of Nigeria (CBN) statistical bulletin.

Data on Exchange Rate and Macroeconomic Variables in Nigeria

The summary of the time series data is presented on the various proxies of exchange rate and macroeconomic variables in Nigeria. They include: Nominal Exchange Rate (EXR), Lending Interest Rate (INR), Growth Rate of Money Supply (MS), Rate of Inflation (INF), Gross Domestic Product (GDP), and Trade Openness (TOP). Nominal Exchange Rate, Lending Interest Rate, Growth Rate of Money Supply, Rate of Inflation, and Trade Openness are expressed in rates while Gross Domestic Product is expressed in billions of Naira. GDP was therefore transformed into logarithmic form to harmonize the units of measurement. The data are shown in table 4.1.

Table 1: **Descriptive Statistics**

	EXR	GDP	INF	INR	MS	TOP
Mean	97.21	26,206.10	20.21	23.19	24.52	0.24
Maximum	305.95	113,711.6	76.80	36.09	57.88	0.50
Minimum	2.02	134.60	0.20	12.00	1.20	0.07
Skewness	0.73	1.27	1.58	0.50	0.41	0.42
Kurtosis	3.24	3.09	4.34	3.73	2.22	2.50
Jarque-Bera	2.91	8.63	15.70	2.05	1.72	1.29
Probability	0.2329	0.0134	0.0004	0.3594	0.4237	0.5248
Observations	32	32	32	32	32	32

Source: Eviews 10 Output, 2019.

Table 1 shows the mean, maximum and minimum values of exchange rate and macroeconomic variables. The skewness, kurtosis and Jarque-Bera test of normality of the variables are also presented. It reveals that the exchange rate has an average exchange value of \$1=₦97.21 within 1986 and 2017. The maximum exchange rate for Nigeria was ₦305.95 in 2017 while the minimum was ₦2 in 1986. Similarly, GDP also recorded its maximum and minimum values in 2017 and 1986 which are found to be ₦113.71 trillion and 134.6 billion respectively. On average the value of domestic production in Nigeria is 26.20 trillion in the past 32 years.

There is a wide disparity between the maximum and minimum rate of inflation recorded within the study period. In 1995, the rate of inflation was 70.80%, which the highest ever recorded in the country. Conversely, the least recorded was 0.2% in 1999. On average, the mean inflation rate is 20.21% within the study period, which is still high for a developing country like Nigeria. Interest rates have been quite high with the highest seen to be 36.08% in 1993 while the least was 12% in 1986. Currently, interest rates still stands at 30% and averages 23.19% during the study period.

Money supply has also been wobbling. In 2008, money supply grew by 57.88%, while in 2013 it grew by 1.20%, which represents the maximum and minimum values respectively. The average growth of money supply is 24.52%. Trade openness in Nigeria has been low with the highest index of openness as 0.50 in 2005 and the least as 0.07 in 1986. Trade openness is measured as the ratio of exports and imports (total trade) divided by GDP. The average level of openness of 0.24 shows that Nigeria's trade levels are still low.

The Jarque-Bera test of normality is conducted to determine the normality condition of the parameters under the assumption that the skewness has a value of 0 and kurtosis of

3. It is a necessary condition for the adoption of further testing to ascertain the statistical and econometric validity of the parameter estimates of the variables of interest. If K < 3, then it is platykurtic (flat or short-tailed), If K > 3 then it is leptokurtic (slim or long-tailed) and if K = 3, then it is mesokurtic (normal distribution). Since these conditions are not met from the above values, there is a need for further testing. From the above computation; exchange rate, GDP, inflation rate and interest rate are leptokurtic while money supply and trade openness are platykurtic.

In addition, all the variables are positively skewed. The test of normality also indicates that exchange rate, interest rate, money supply, and trade openness are normally distributed while GDP and inflation rate are non-normally distributed.

Data Analysis

Long-Run Impact of Macroeconomic Variables and Exchange Rate in Nigeria

Unit Root Test

In order to avoid nonsensical regression estimates which may lead to spurious results, the data are subject to unit root test to examine the stationarity of the data series. The unit root is used to examine the stationarity of the data series and since the data is time series, the ADF test is employed. It is important because it enhances validity of results and is also a prerequisite for further analytical tools. The result of the Augmented Dickey-Fuller (ADF) test is presented in Table 2:

Table 2: Stationarity Test

Variables	ADF Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	Prob.	Order of Integration
EXR	-4.84	-3.67	-2.96	-2.62	0.0005	1(1)
GDP	-3.65	-3.67	-2.96	-2.62	0.0105	1(1)
INF	-5.26	-3.67	-2.96	-2.62	0.0002	1(1)
INR	-6.10	-3.68	-2.97	-2.62	0.0000	1(1)
MS	-7.14	-3.67	-2.96	-2.62	0.0000	1(1)
TOP	-5.50	-3.67	-2.96	-2.62	0.0001	1(1)

Source: Eviews10 Output, 2019.

The ADF statistic values for EXR, GDP, INF, INR, MS, and TOP are -4.84, -3.65, -5.26, -6.10, -7.14, and -5.50 respectively. The result also shows that, the ADF test statistic is less than the critical values at all significant levels at 1%, 5%, and 10% for all the variables, which is evidenced further by the low probability values. Thus, the variables attained stationary at first difference series.

Blank Order Selection Criteria

An optimal lag of 1 was chosen for the empirical model based on Schwarz Information Criterion (SC), Akaike Information Criterion (AIC), Sequential Modified LR Test Statistic (LR), Final Prediction Error (FPE) and Hannan-Quinn Information Criterion (HQ) and the result is presented in Table 3.

Table 3: Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-805.2550	NA	1.24e+16	54.08	54.36	54.17
1	-693.5759	171.24*	8.42e+13*	49.04*	51.00007*	49.67*
2	-666.7274	30.43	2.12e+14	49.65	53.29	50.81

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Eviews 10 Output, 2019.

Johansen Cointegration Test

The finding that macroeconomic time series contains a unit root has spurred the non stationary time series analysis. Engle and Granger (1987) pointed out that a linear combination of two or more non stationary time series may be stationary. If such a stationary linear combination exists, the non-stationary time series is said to be co-integrated. The stationary linear combination may be interpreted as a long run equilibrium relationship between the variables. The Johansen system framework is employed to test for the presence of co-integrating relationships among the non-stationary variables.

The Johansen co-integration is analyzed via the Trace statistic and Maximum Eigen value. The decision rule is that if either is greater than the 5% critical value, we reject the null hypothesis of no co-integration among the variables. Their respective results are displayed in Table 4.4:

Table 4: Co-integration Test

Null Hypothesis	Trace Statistic	0.05 Critical Value	Null Hypothesis	Max-Eigen Statistic	0.05 Critical Value
r = 0*	97.78	95.75	**r = 0***	45.90	40.08
r ≤ 1*	61.89	69.82	**r ≤ 1**	21.92	33.88
r ≤ 2	39.96	47.86	**r ≤ 2**	17.41	27.58
r ≤ 3	22.55	29.80	**r ≤ 3**	13.20	21.13
r ≤ 4	9.35	15.49	**r ≤ 4**	6.48	14.26
r ≤ 5	2.87	3.84	**r ≤ 5**	2.87	3.84
r ≤ 6	97.78	95.75	**r ≤ 6**	45.90	40.08
r ≤ 7	61.88	69.82	**r ≤ 7**	21.92	33.88

Source: Eviews10 Output, 2019.

*Note: Both Trace statistic and Max-Eigen statistic indicates 1 co-integrating equation each. * denotes rejection at 0.05 significance level.*

The Trace test and Max-Eigen value test shows a long run equilibrium relationship between the variables. Thus, the null hypothesis of no co-integrating equation is rejected since their statistics are greater than their respective critical values of the co-integrating equations at 5% significance level. This implies a stationary linear combination, as such the non stationary time series are co integrated. The application of the VECM technique will therefore yield informative, non-spurious and dependable results.

Vector Error Correction Estimates

The long run relationship and its accompanying short run relationship are presented in Table 5.

Table 5: Long and Short Run Error Correction Model

Variables	Coefficient	Standard Error	T statistics
		Long Run Model	
GDP (-1)	0.002	0.0003	-7.76
INF (-1)	-2.30	0.34	6.80
INR(-1)	-0.09	1.63	0.06
MS(-1)	-0.23	0.57	0.40
TOP(-1)	2.89	0.66	-4.35
C	-30.48		
		Short Run Model	
CointEq1	-0.52	0.14	-2.58
D(EXR(-1))	0.27	0.22	1.20
D(GDP(-1))	0.0008	0.0009	-0.86
D(INF(-1))	-0.42	0.35	1.20
D(INR(-1))	0.78	1.02	-0.77
D(MS(-1))	-0.08	0.28	0.28
D(TOP(-1))	1.12	0.75	-1.49
C	10.16	5.73	1.77

R^2 = 0.72, Adjusted R^2 = 0.60, F statistic = 8.81, $F_{0.05}$ =2.36

Source: Eviews 10 Output, 2019.

From table 5, the results show that in the long run, the coefficient of GDP reveals that with the influence of INF, INR, MS and TOP held constant, as GDP increases say, by 1%, the exchange rate will appreciate by 0.002%. Similarly, the exchange rate will appreciate by 2.89%, holding other variables constant, as trade openness increases by 1%. Conversely, as inflation changes by 1%, the exchange rate will depreciate by 2.30% other things being equal. Furthermore, a change in the coefficient of interest rate of 1% shows that the exchange rate will depreciate by 0.09%, holding all other variables constant. Similarly, the exchange rate will depreciate by 0.23% if ceteris paribus, growth of money supply increases by 1%.

The result further reveals that the coefficients of four of the explanatory variables conform to a priori having the expected signs, implying that GDP and trade openness have a positive relationship with exchange rate while inflation and money supply have a negative relationship with exchange rate. The coefficient of interest rate does not conform to a priori expectation, having a negative relationship instead of postulating a positive relationship with exchange rate. Also, the result shows that the coefficients of GDP, inflation and trade openness are statistically significant (i.e. $½b_i >$ S.E.) while money supply and interest rate are not statistically significant (i.e. $½b_i <$ S.E.).

From the results of the short run estimates of the VAR model in the table above, the coefficients of all the variables conform to a priori expectation – with GDP, interest rate and trade openness having the expected positive signs showing the presence of indirect relationship between the variables and exchange rate; while inflation and money supply postulates the expected negative signs. Unlike the long run model which shows four significant variables, none of the parameter estimates are statistically significant in the short run. The result also reveals that in the short run, a 1% change in GDP in the previous year will lead to an appreciation in EXR by 0.0008%. Similarly, a 1% change in INR and TOP in the previous year will improve the exchange rate by 0.78% and 1.12% respectively. Conversely, a 1% change in INF and MS in the past year will lead to depreciation in EXR by 0.42% and 0.08% respectively.

The error correction parameter is statistically significant and is also negative as expected. The magnitude of the co-integration term indicates that if there is any deviation, the long run equilibrium is adjusted moderately, where about 52% of the disequilibrium may be removed in each period. This shows that the speed of adjustment to where the exchange rate will equilibrate even when there is initial disequilibrium is at the rate of 54%.

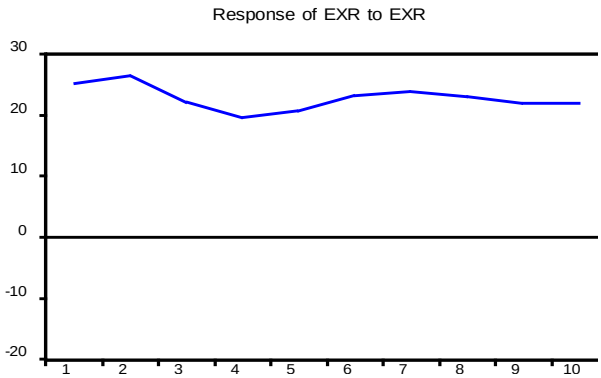
The adjusted R^2 value of 0.60 means that about 60% of the variations in EXR is explained by GDP, INF, INR, MS and TOP. This is high and shows that our regression line fits the data due to the fact that the maximum value of R^2 can at most be 1. The study also finds out that GDP, INF, INR, MS and TOP are jointly significant. The F statistic shows the overall significance of the estimated model. The result reveals that the likelihood of obtaining an F value of as much as 8.81 or greater is simultaneously less than zero, leading

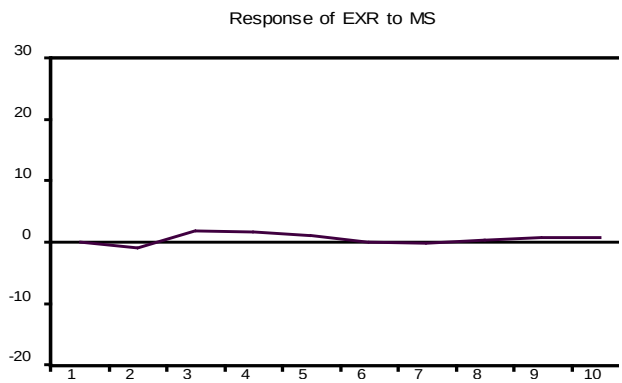
to the rejection of the hypothesis that together GDP, INF, INR, MS and TOP have no effect on exchange rate in Nigeria. This buttresses the overall goodness of fit of the models. Thus, the overall prediction power of the econometric model is statistically significant.

Response of Exchange Rate to Shocks from Macroeconomic Variables
Impulse Response Analysis

A shock to the *i*-th variable not only directly affects the *i*-th variable but is also transmitted to all other endogenous variables through the dynamic (lag) structure of the VAR. An impulse response function traces the effect of one-time shock to one of

the innovations on current and future values of the endogenous variables. This is shown in Figure 1:





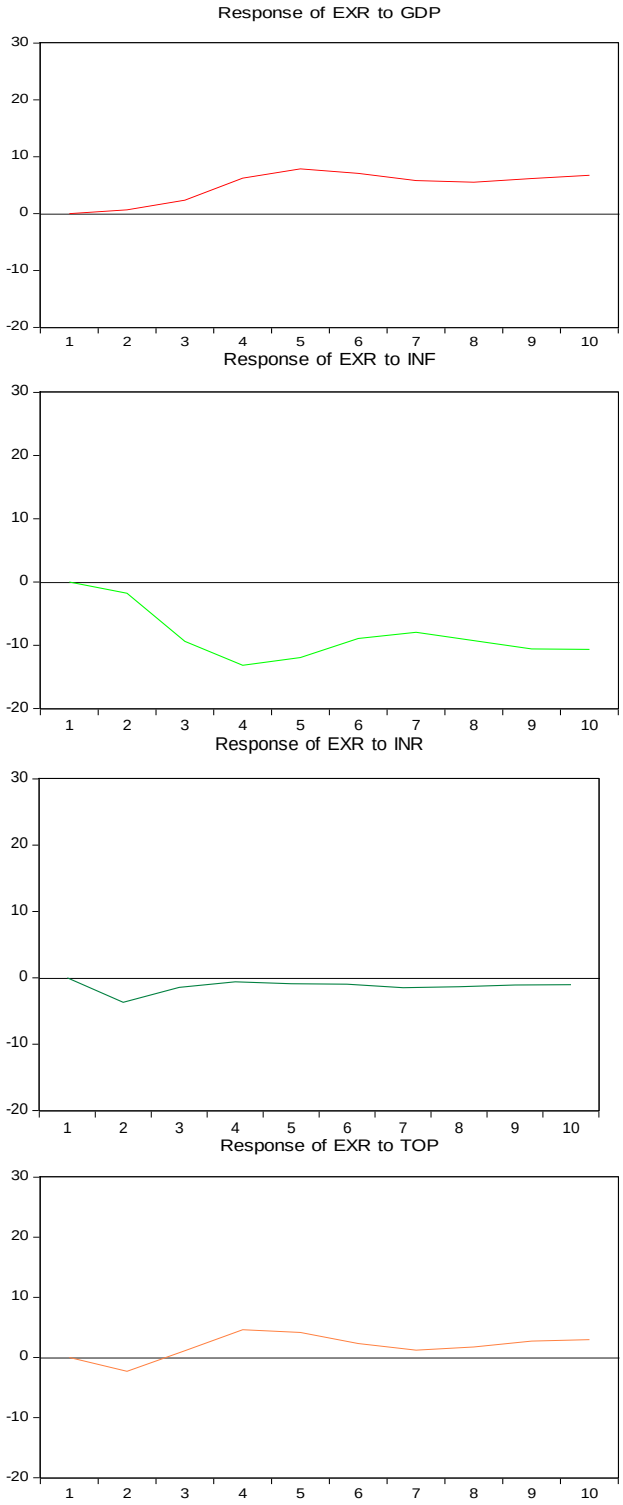

Response of EXR to GDP
30
20
10
0
-10
-20
1 2 3 4 5 6 7 8 9 10
Response of EXR to INF
30
20
10
0
-10
-20
1 2 3 4 5 6 7 8 9 10
Response of EXR to INR
30
20
10
0
-10
-20
1 2 3 4 5 6 7 8 9 10
Response of EXR to TOP
30
20
10
0
-10
-20
1 2 3 4 5 6 7 8 9 10

Figure 1: Response of Exchange rate to Macroeconomic Variables
Source: Eviews 10 Output, 2019.

Figure 1 reveals that exchange rate responds positively to its own shock. The impact of the shock also appears to be permanent as there is no evidence of long run convergence to equilibrium. Exchange rate responds positively to the shocks from GDP. The impact of the shocks also appears to be permanent implying that an increase in productive activities has the tendency to lead to an appreciation in the exchange rate. The impulses from interest rate and inflation have a negative impact on exchange rate in all the periods. The impact of interest rate appears to be temporary and will fizzle out in the long run; however, that of inflation to be permanent and long lasting. The innovations from the money supply and trade openness have a negative impact on the exchange rate. The impact is however not permanent.

Variance Decomposition Analysis

While impulse response functions trace the effects of a shock to one endogenous variable on to the other variables in the VAR, variance decomposition separates the variation in an endogenous variable into the component shocks to the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR. The summary of the variance decomposition is presented in a table 6.

Table 6. Variance Decomposition

Variable	S.E.	EXR	GDP	INF	INR	MS	TOP
1	25.09	100.00	0.00	0.00	0.00	0.00	0.00
2	36.77	98.29	0.03	0.24	1.002	0.05	0.39
3	44.06	93.65	0.31	4.69	0.81	0.19	0.34
4	50.62	85.94	1.76	10.33	0.62	0.26	1.09
5	56.72	81.85	3.33	12.66	0.52	0.25	1.41
6	62.35	81.47	4.04	12.53	0.46	0.20	1.30
7	67.54	81.99	4.19	12.06	0.44	0.17	1.14
8	72.20	81.92	4.25	12.21	0.42	0.16	1.06
9	76.52	81.18	4.43	12.78	0.39	0.15	1.07
10	80.65	80.46	4.69	13.25	0.37	0.14	1.28

Source: Eviews 10 Output, 2019.

The table format displays the variance decomposition of RGDP to the endogenous variable. The second column, labelled “S.E.”, contains the forecast error of the variable at

the given forecast horizon. The source of this forecast error is the variation in the current and future values of the innovations to each endogenous variable in the VAR. The remaining columns give the percentage of the forecast variance due to each innovation, with each row adding up to 100.

Table 6 reveals that the shock exerted by EXR to itself is 100.00% in the first period. In the 10^{th} period, EXR exerts a shock of 80.86% to itself. The innovations from GDP, inflation, interest rate, money supply, and trade openness account for the remaining 19.14% of shocks affecting exchange rates. Amongst the explanatory variables, inflation accounts for the highest (13.25%) proportion of the shocks affecting the exchange rate while the least is money supply accounting for 0.14% of the shocks affecting exchange rates. GDP accounts for 4.69% of the shocks affecting the exchange rate, interest rate accounts for 0.37% of the shocks while trade openness accounts for 1.28% of the shocks.

Discussion of Findings

The paper evaluated the impact of exchange rate on selected macroeconomic variables in Nigeria. Six variables were used to estimate this relationship and are: exchange rate, interest rate, inflation rate, gross domestic product, money supply and trade openness. Moreover, GDP, interest rate and trade openness were expected to have a positive relationship with exchange rate while inflation and money supply is expected to have a negative relationship. The result revealed that the coefficients of GDP, inflation rate, money supply and trade openness conformed to a priori expectation while interest rate did not. This implies that as GDP rise, i.e. An increase in productive activity, the exchange rate will appreciate. This is because as the country produces more goods, it means there would be an increase in exports, which boosts the exchange rate of a country.

Similarly, an improvement in exports will also increase the level of openness of the economy, which affects the exchange rate positively. Conversely, as inflation rises, the value of money erodes, which leads to a depreciation of the exchange rate, because the exchange rate is computed using relative commodity prices of different countries. Inflation arises as a situation of too much money chasing too few goods, thus when there is an increase in money supply, inflation increases which also affects exchange rate, hence the negative sign. The study found that, GDP, trade openness and inflation significantly affect the exchange rate in Nigeria. Interest rate and money supply do not significantly affect the exchange rate in Nigeria. These results corroborated the work of Rasaq (2016) which showed that exchange rate volatility has a positive influence on Gross Domestic Product, Foreign Direct Investment and Trade Openness, but with negative influence on the inflation rate in the country. It was suggested by the author that there is a need for the country to improve its revenue base in terms of increasing number of items meant for export and reduce over reliance on petroleum sector and also to reduce the importation of nonessential items, so as to improve its terms of trade. Also, an increase in domestic production will reduce the problem caused by exchange rate volatility.

The result of the impulse response shows that exchange rate responds positively to shocks from GDP, money supply, trade openness and itself. Meanwhile, it responds negatively to shocks from inflation and interest rate. The variance decomposition analysis revealed that exchange rate responds to 80.86% of the shocks emanating from itself with the other macroeconomic variables accounting for 19.14%. Out of the 19.14%, inflation accounts for the highest impulses while money supply accounts for the least.

The VECM result shows that there is a strong positive relationship between macroeconomic variables and exchange rate. It also buttresses the overall goodness of fit of the model, implying that the explanatory variables are jointly significant.

Conclusion

The summary of the findings revealed that macroeconomic variables significantly affects the exchange rate in Nigeria. Out of these macroeconomic variables, GDP and trade openness affects the exchange rate positively. While inflation exerts a negative effect on the exchange rate. On the other hand, money supply and interest rate do not significantly affect exchange rates. Furthermore, apart from exchange rate itself, inflation accounts for the highest shocks that affect exchange rates while money supply accounts for the least of such innovations. The study, therefore, concludes that while some macroeconomic variables are instrumental in exchange rate appreciation, others are detrimental to it and leads to exchange rate depreciation.

Recommendations

On the basis of these findings, the following recommendations are hereby made:

i. The government of Nigeria should focus on expanding productive activities so as to improve the exports of the nation which can lead to a reduction of exchange rate depreciation.
ii. The monetary authorities should avoid rapid variations in the growth of money so as to avoid frequent increases in the rate of inflation which is detrimental to exchange rate appreciation.
iii. Furthermore, the government should curtail the interest rate which is so high as to encourage investors to borrow funds for investment purposes; this will boost productive activities and reduce exchange rate fluctuations.

References

Akinlo, O and Lawal, Q. A. (2014). Impact of Exchange Rate on Industrial Production in Nigeria (1986-2010). *International Journal of Business and Management sciences*. 10 (1): 104-110

Attah-Obeng, P, Enu, P., Osei-Gyimah, F., &Opoku, C.D. (2013). An econometric analysis of the relationship between gross domestic growth Rate and Exchange Rate in Ghana. *Journal of Economics and sustainable development*. 4 (9):1-8

Bakoulas, J.T., Baum, C. and Caglayan, M. (2012). Exchange rate effect on the volume and volatility of trade Flows. *Journal of International Money and Finance*. 21(1): 481-486.

CBN (2013). Statistical Bulletin. Abuja: Central Bank of Nigeria

CBN (2014). Annual Report and Statement of Account, Central Bank of Nigeria.

Deverux, M. and Engel, C. (2015). 'Fixed floating exchange rates: how price setting affects the optimal choice of exchange-rate regime,' *National Bureau of Economic Research (NBER) working paper* 6867.

Dickey, D.A. and Fuller W. A. (1981), Likelihood Ratio Statistics for Autoregressive Time Series with a unit Root.

Ehinomen, C. and Oladipo, T.I. (2015). "Exchange Rate Management and the Manufacturing Sector Performance in the Nigerian Economy" *Journal of Humanities and Social Science*.5(5): 1 – 12.

Engle, R.F and Granger, C.W.J. (1987). Co-integration and Error Correction: Representation, Estimation and testing Econometrica, 15 (4); pp 337-358.

Eze, L. and Okpala, O. (2014). Quantitative Analysis of the Impact of Exchange Rate Policies on Nigeria's Economic Growth: a Test of Stability of Parameter Estimates. *International Journal of Humanities and Social Science,* 4(7); 265-272.

Gbosi, A. (2015). Fiscal Policy and Macroeconomic Stability in a Developing economy: Lessons from Nigeria Experience. *First Bank of Nigeria Review* 5(2); 38-40.

Gujarati, D. (2004), *Basic Econometrics*, Tata McGraw-Hill Publishing Limited New Delhi.

Jimoh, S.O. (2016). "Traditional Theory of Real Exchange Rate and Options" Unpublished Thesis submitted to the Department of Banking and Finance, Enugu State Science and Technology.

Johanson, S (1992): Statistical Analysis of Co-integration Vectors. Journal of Economic Dynamics and Control Vol. 12, 231-254

Masha, I. and Adamgbe, E. (2015). Issues in Exchange Rate Policy: Economic and Political Considerations In: Nnana, O.J., Alade, S.O. and Odoko, F.O. ed. *Contemporary Economic Policy Issues, Abuja, Central Bank of Nigeria*.

Mussa, M. (2014). Nominal Exchange Rate Regimes and the Behavior of Real Exchange Rates: Evidence and Implications. *Carnegie-Rochester Conference Series on Public Policy,* 25 (1); 117-214.

Nouri, M. and A. Samimi (2012). The Impact of Monetary Policy on Economic Growth In Iran. *Middle-East, Journal of Scientific Research,* 9(6): 740-743.

Obadan, M. I. (2015). "Overview of Exchange Rate Management in Nigeria from 1986 to Date", In the Dynamics of Exchange Rate in Nigeria, Central Bank of Nigeria Bullion. 30 (3), 1-9.

Odusola, A.F. and Akinlo, A.E. (2012). "Output, Inflation and Exchange Rate in Developing Countries: An Application to Nigeria" *Journal of Development Economics*. 39(2); 32-49

Ogunmuyiwa, M.S. and Ekone, A. F. (2012). Money Supply and Economic Growth Nexus in Nigeria. *Journal of Social Sciences,* 9(3): 199-204.

Ojo, M.O. (2012). The Role of the Autonomy of the Central Bank of Nigeria (CBN) in Promoting macroeconomic stability. *Central Bank of Nigeria Economic and Financial Review*, 38(1); 1-27.

Oladipupo, A.O. and Ogheneov, O.F. (2014). Impact of Exchange Rate on Balance of Payment in Nigeria" *African Research Reviews*.5 (4): 73-88

Olowe, R.A. (2015). Modeling Naira/Dollar Exchange Rate Volatility: Application of GARCH and Asymmetric models. *International Review Journal of Business Research Papers*. 5(3): 377-398.

Onuoha I. P. (2015). Impact of Exchange Rate Variation and Inflation on the Economic Growth of Nigeria: An Empirical Approach. *Research Journal of Finance and Accounting*, 5(22); 1-12.

Opaluwa, D., Umeh, C. and Ameh, A. (2016). The Effect of Exchange Rate Fluctuations on theNigerian Manufacturing Sector.*African Journal of Business Management.* 4(14): 2994-2998

Oriavwote, V.E. &Oyovwi, D.O. (2012). The Determinants of Real Exchange Rate in Nigeria. *International Journal of Economics and Finance*. 4 (8): 150-161

Rasaq, A. D. (2016). The Impact of Exchange Rate Volatility on the Macroeconomic Variables in Nigeria. *European Scientific Journal* 9 (7): 152-165

Shehu, A. and Aliyu, M. (2016). "Naira Exchange Rate and Policy Management" Unpublished *Thesis Submitted to the Department of Economics, University of Benin*.

Williamson, J. (1994). "Advice on the Choice of an exchange rate policy". In E.M.Classen, ed. Exchange Rate Policies in Developing and Post SocialistCountries. San Francisco, California: ICEG Publications.

Yaqub, J.O. (2014). "Exchange Rate Changes and Output Performance in Nigeria: A Sectorial Analysis" *Pakistian Journal of Social Sciences*. 7(5): 12-19.