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Inflation, Interest Rate, Exchange Rate in Nigeria: The Long Run Interactions and Monetary Policy Implications

Uduakobong S. Inam, *Ph.D* and Samuel E. Isaac
Department of Economics, Faculty of Social Sciences University of Uyo, P.M.B. 1017, Uyo, Akwa Ibom State, Nigeria
Department of Economics, Faculty of Social Sciences University of Uyo, P.M.B. 1017, Uyo, Akwa Ibom State, Nigeria

Abstract
This paper examines the long run relationships among inflation, interest rate and exchange rate in Nigeria along with money supply and output using quarterly data from 2010 to 2018. The study employs Vector Autoregression Cointegration technique in the analysis. The Study reveals that on the average a long run relationship exists among the variables. However, the interactions among inflation, interest rate and exchange rate was weak while money supply and output had significant links with inflation, interest rate and exchange rate. Money supply and output also had significant long run interactions with each other. The findings indicate that the long run path to price stability and economic growth using monetary policy will be through changes in monetary aggregates and increase in domestic production. The study concludes that money supply and output are optimal targets for achieving price stability and economic growth in Nigeria in the long run.
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I. Introduction

The study of essential economic relationships is a regular feature in economic analysis. Economists are interested both in the strength and the nature of economic relationships. Such relationships usually give insight to economic agents on their respective decisions and also serve as a guide to government policy makers. Various theories such as the International Fishers Effect (IFE) and the Purchasing Power Parity (PPP) have given insight into how inflation, interest rate and exchange rate are related and their possible effect on other macroeconomic variables. The conclusions of these theories have often been the basis for various monetary policy actions and targets, depending on which variable is considered most crucial.

During the era of the gold standard, most countries practiced exchange rate pegging. An exchange rate pegging country has the capacity to keep inflation under control by anchoring the inflation rate of traded goods to that of the anchor countries, usually their major trading partners. Countries that practiced this system had their currencies anchored against low-inflation countries with expected advantages such as; low inflation, minimization of exchange rate risks, reduced interest rates to stimulate economic growth, and a sound financial sector (CBN, 2016). However, that policy strategy reduced the power of the monetary authority to make discretionary policies in response to domestic random shocks that are not associated with those of the anchor countries (CBN, 2011).

With the end of the gold standard, countries favored more market-oriented policies and the desire of the monetary authorities to have more discretionary powers grew. Hence, flexible exchange rate system was adopted by most countries and the focus shifted to other strategies such as interest rate targeting. Interest rate targeting involves making the interbank rate the anchor rate for monetary policy. In this case, the central bank targets the interbank rate which is used as the policy rate (CBN, 2011). Such is expected to have a significant impact on inflation and exchange rate. The targeted interest rate is usually a reflection of the expected level of inflation and also meant to affect the flow of international capital and hence affect exchange rate.

Nigeria has adopted various monetary policy strategies over the years. Prior to 1986, the country practiced exchange rate pegging which was abandoned in favor of more market oriented policies leading to more focus on interest rate. In recent times, most discussion during the meeting of the Monetary Policy Committee is usually on whether or not there should be a change in the Monetary Policy Rate (MPR) and it has become one of the most anticipated meetings by economic agents. Currently, policy makers are recommending inflation targeting and a lot of studies are being conducted to determine the viability of that option.

While there are other monetary policy strategies, this brief historical trend indicates that inflation, interest rate and exchange rate are important monetary policy variables. It also shows that the choice between most monetary policy strategies depends, among other things on how the links among these variables is understood and which among the three variables is considered most crucial. The behavior of economic variables usually changes over time due to both endogenous and exogenous factors and hence the need for a continuous study of their behavior with the best possible techniques to be able to make more informed policy decisions.

The study of essential economic relationships such as this is crucial for policy making. For Nigeria, the desirable outcome of any effort to maintain stable prices are lower inflation, lower interest rate (lending rates) and high naira value (low exchange rate). These outcomes are desired to reduce the cost of living, encourage investment and maintain good external balance respectively. The effectiveness of any policy decision meant to affect the behavior of economic variables depends, among other things on how well such behavior is understood. Individuals and organizational investors around the world are deeply concerned about exchange rates fluctuations, interest rates disparities and inflation in the world economy. This is because long term profitability of investment, export opportunities and price competitiveness are all impacted by both short and long-term movements in exchange rates, interest rate and inflation (Shalishali and Ho, 2002). Hence domestic and international investors; and companies usually have to pay very close attention to the links among these variables across countries in both long and short term basis, in order to be able to make informed decisions.

In this paper, we examined the long run relationship among inflation, interest rate and exchange rate along with money supply and output and the policy relevance of such relationships. The rest of the paper is organized as follows; section two contains theoretical and empirical literature, section three contains the methodology and section four contains the estimated result and analysis while section five is the recommendations and conclusions.

II. Literature Review

2.1 Theoretical Literature

The theoretical bases of this study are the Purchasing Power Parity (PPP), Fishers Effect (FE), and International Fisher's Effect (IFE) theories.

2.1.1 Purchasing Power Parity (PPP) Theory

The purchasing power parity theory is traced to the work of Gustav Cassel who proposed PPP as a way of adjusting exchange rate or parities for countries who intended to return to the gold standard after the First World War (Lafrance and Schembri, 2002). The PPP is both a theory of exchange rate determination and a method of doing cross-country comparison. However, only the former is relevant for this study. As a theory of exchange rate determination, it states that exchange rate between two countries equals the ratio of the two countries price level.

$$E_{NG}/E_{US} = P_N/P_\$$$

This suggests a direct and proportional relationship between exchange rate and the price level. A fall in the purchasing power of the domestic currency (inflation) will lead to a proportional depreciation of the domestic currency in the foreign exchange market (increase in exchange rate).

Symmetrically, PPP predicts that an increase in the currency's domestic purchasing power will be associated with a proportional appreciation of the domestic currency in the Foreign Exchange (FOREX) market. The theory assumes that the action of importers and exporters, motivated by cross country price differences is what induce changes in the spot exchange rate. If prices in the domestic economy increases compared to prices in foreign countries, this will encourage import in relation to export. The increase in import will lead to an increase in demand for dollars in relation to naira in the FOREX market. Consequently, the price of dollar will rise and the value of naira will fall (increase in exchange rate) (Lafrance and Schembri, 2002).

It is observed that the PPP theory performs poorly when applied to empirical data. This is expected because of real world complexities. Transportation cost, trade restrictions and lack of perfect information about market conditions are factors that define the real world cross border trade which does not allow a one-to-one relationship between inflation and exchange rate to hold. Also, it is pointed out that PPP theory is based only on import and export activities which are current account transactions whereas investors activities in the foreign exchange market also determine exchange rate. In some cases, the amount of foreign exchange activity due to importers and exporters demands may be much less than the amount of activity due to investors demands.

Because of these limitations, the PPP theory could be thought of as a long run concept. We could assumed here that importers and exporters do not respond quickly to deviations in the prices of products between countries due to previously identified reasons such as lack of perfect information about market conditions. We could also recognize that exchange rate is not solely determined by trader's behavior but also by investor's activities. In this perspective, it could be imagined that traders will adjust gradually to price

differences causing an eventual adjustment of the spot exchange rate to the PPP rate (Coakley et al, 2005). However, since the long run is not some specified period of time, and since the PPP may be changing, the adjustment process may never allow the exchange rate to catch up with the PPP rate. Despite the limitations of the PPP theory, the theory has not been discarded by economists because it is logically plausible. The PPP theory is relevant to this study because it explains the link between exchange rate and inflation.

2.1.2 Fishers Effect (FE)

Fisher (1930) explained the relationship between nominal interest rate and inflation. This relationship which explains the response of nominal interest rate to inflation is known in the literature as the Fishers Effect (FE). He postulated that nominal interest rate in any period is the sum of real interest rate and expected inflation. This is because lenders in the economy usually include inflation premium to take care of the effect of expected inflation on real interest rate. In a world of perfect information, this implies a direct and proportional relationship between nominal interest rate and inflation. This means that a 1 percent increase in inflation will cause a 1 percent increase in nominal interest rate, leaving real interest rate unchanged (Mankiw, 2009).

It has been pointed out that the major problem that arises when testing the Fisher's theory is lack of a direct measure of expected inflation. For this reason, a lot of approaches have been used to derive proxies of expected inflation. Most early works of the Fisher's effect used some form of distributed lags of inflation to proxy expected inflation as in Cagan (1956), Meiselman (1962), Sargent (1969) and Gibson (1970). In subsequent studies, the theory of rational expectation was incorporated into the process of modeling inflation expectations as in Fama (1975), Lahiri and Lee (1979). These two approaches to modeling inflation expectations have continued to be used in recent studies. In this study, the FE theory provides the basis for establishing a link between inflation and interest rate.

2.1.3 International Fishers Effect (IFE)

The IFE is an extension of the FE theory and could thus be regarded as an open economy version of the FE theory because it links interest rate, inflation and exchange rate. According to the IFE hypothesis, the exchange rate of any country with a relatively higher interest rate will depreciate because high nominal interest rates reflect high expected inflation and the high expected inflation reduces the real value of a country's currency as explained in the PPP theory (Madura, 2010). The IFE could thus be regarded as a combination of the PPP and FE theories. This means that changes in exchange rate is not only explained by changes in inflation according to the PPP, but also by changes in interest rate. The main point of the IFE is that an increase in nominal interest rate leads to exchange rate depreciation (Shalishali, 2012).

The simplest understanding of the theoretical underpinning of IFE is that nominal interest rate differential between countries due to inflation will lead to arbitrage activities between financial markets in form of international capital flows which will eventually lead to equality of real interest rates. With real interest rate equality, it implies that the country with the higher nominal interest rate should also have a higher inflation rate which, in turn, makes the real value of the country's currency to decrease. The IFE is based on the assumptions that domestic assets are perfect substitutes, and therefore, investors do not include risk premium in their decision; that the capital markets are perfectly integrated with no regulatory asymmetries and psychological barriers so that free flow of capital is achieved across countries. As often the case, the non-fulfillment of theoretical assumptions will cause a divergence between theory and empirics.

Krugman, Obstefeld and Melitz (2012) noted that the IFE is a rather paradoxical prediction of the link between interest rate and exchange rate. Steinar (2002) explained that higher nominal interest rate attract portfolio investment from foreign countries, increasing demand for the domestic currency leading to exchange rate appreciation. This appears to be a more plausible reasoning. However, it is also observed that some countries such as Nigeria with higher nominal interest rate have weaker currencies in the world market. The IFE may not be accurate in predicting daily spot exchange rate, but its usefulness lies in the fact that it illustrates the possible relationship between interest rate and exchange rate. Therefore, in this study, the IFE is a reference point in the examination of the link between interest rate and exchange rate.

2.2 Empirical Literature

Madesha, Chidoko and Zivanomoyo (2013) examined the empirical relationship between exchange rate and inflation in Zimbabwe during the period 1980 to 2007. They adopted Granger Causality and Cointegration test. The results showed a long run relationship between inflation and exchange rate. Inflation and exchange rate were also found to Granger-cause each other during the period under consideration. They recommended export promotion, reactivation of international cooperation, and synergy between fiscal and monetary policy as viable policy options that will produce a more stable exchange rate and inflation in the Zimbabwean economy.

Enoma (2011) studied the effect of exchange rate depreciation on inflation in Nigeria using annual data from 1986 to 2008. He used Auto Regressive Distributed Lag (ARDL) Co integration procedure. He found that

exchange rate depreciation has a positive and significant long-run effect on inflation in Nigeria and that exchange rate depreciation is the main determinants of inflation in Nigeria. This implies that exchange rate depreciation can bring about an increase in inflation rate in Nigeria. The paper also found that inflationary rate in Nigeria has a lagged cumulative effect. He recommends that although Naira depreciation is relevant in ensuring an improvement in the production of exportable commodities, it must not be relied upon as a potent measure for controlling inflation in Nigeria. He also recommends the need for policy-makers to employ exchange rate depreciation as a measure to compliment other macro-economic policies to stabilize the volatile inflationary rate.

Omotor (2008) studied the consequence of exchange rate reforms on inflation in Nigeria using annual data from 1970 to 2003. He estimated a Vector Error Correction (VEC) and slop-dummy model to determine the effect of exchange rate reforms on inflation. The result shows that exchange rate policy reforms are significant in the determination of inflation in Nigeria. He recommends that although a stable, consistence and complementary policy on exchange rate and money supply is required to stabilize inflation, domestic expansion of output is needed to meet up with aggregate demand and to reduce the effect of import induced inflation.

Inam (2014) investigated the existence of Fishers Effect (FE) in Nigeria by exploring the long run and short run relationship between interest rate and inflation using annual data between 1970 to 2011. The study employed Co-integration test, Granger causality test and Error Correction model (ECM). The findings of the study shows that there is a positive long run relationship between interest rate and inflation, a unidirectional causality that runs from inflation to interest rate and a partial existence of FE. The study recommends that given the crucial role of interest rate in determining investment, policy makers should maintain low inflation in order to maintain a reasonably low level of interest rate.

Mahdi and Mosood (2011) studied the long run relationship between interest rate and inflation in Iran using quarterly data between 1989 to 2007 with the aim of testing the Fishers hypotheses. They applied Johanssen Co integration and a Vector Error Correction Model (VECM). The result shows the existence of long run relationship between interest rate and inflation. Their finding also shows that inflation has a more significant effect on interest rate than interest rate has on inflation.

Adam and Oferi (2017) investigated the validity of the International Fishers Effect (IFE) theory in the West African monetary zone (WAMZ) using monthly data of nominal interest rate and exchange rate from 1998 to 2012. They applied Engel Granger Co integration test and Fractional Co integration. They observed Co integrating relationship in fifteen out of the twenty country pairs; indicating evidence of common stochastic drift in nominal exchange differentials and exchange rates changes. Evidence of weak IFE was shown in the case of Ghana/Sierra Leone and Ghana/Cape Verde. They recommend macroeconomic coordination as a necessary condition for currency union.

Ajao(2015) studied the determinants of exchange rate volatility in Nigeria using annual data between 1981 to 2008. He used co integration analysis, Error Correction Model (ECM) and a Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model. His findings shows the existence of a long run relationship between exchange rate and the variables identified as possible determinant of exchange rate volatility. The study shows that interest rate among other variables is a significant determinant of exchange volatility in Nigeria. The study recommends that exchange rate stability should be a policy focus of the monetary authority because of its significance influence on other macroeconomic variables.

Shalishali (2012) tested the IFE theory for eight selected Asian countries namely; China, India, Japan, South Korea, Malysia, Thailand, Vietnam and Indonesia. He used quarterly data between 1990 to 2009. Each of these countries was used interchangeably as home and foreign countries. He applied OLS regression and the result shows that the theory holds when some countries were used as home countries and fail to hold when they were used as foreign countries. He explains that these finding suggest that there may be impediments to foreign trade that may affect exchange rate adjustment apart from interest rate differential. He recommends the exercise of caution in the use of IFE theory to explain export opportunities and price competitiveness of foreign commodities.

Ebiringa and Anyoagu (2014) studied the long run relationship between inflation, interest rate and exchange rate in Nigeria using Autoregressive Distributed Lag (ARDL) model and annual data from 1971 to 2010. Their findings shows that in the long run, inflation has a positive influence on exchange rate while interest rate and exchange rate are not significantly related in the long run. They recommended multi-variable targeting when making policy decisions.

Morosan and Zubas (2015) also studied the relationship among inflation, interest rate and exchange rate in Romania using quarterly data from 2005 to 2011. They use ordinary least squares (OLS) regression in their analysis with the aim of testing the fishers' hypothesis. Their result shows that exchange rate has a delayed effect on inflation; the relationship between interest rate and inflation was positive according to the fisher's hypothesis but less than parity while interest rate and exchange rate were inversely related.

From the review of literature, there is a lot of interest in the relationship among inflation, interest rate and exchange rate likely because of its huge policy significance. However, the reviewed literature shows that there are methodological and objective gaps that can still be explored for better understanding of the linkages and their policy relevance. For example, most of the studies reviewed focus on the relationship between two of the three variables at a time either to validate a specific theory or to better understand how their trends impact on the economy and some policy objectives. But to be able to have a better perspective towards achieving a broader macroeconomic goal of price stability and economic growth, there is need to trace the links among the three variables simultaneously along with variables such as money supply and GDP because no perspective on monetary policy is complete if these variables (inflation, interest rate and exchange rate, GDP, money supply) are not taken into consideration

III. Methodology

3.1 Data and Sources

All data used in this study are purely secondary. They are; average quarterly prime and maximum lending rates, average quarterly official and Bureau De Change exchange rate. This averaging is done to reflect all activities in the money and foreign exchange market. Others are; quarterly inflation rates, quarterly money supply, and quarterly GDP. Quarterly data is used to reveal the relationships usually hidden when annual data is used. They are sourced from the Central Bank of Nigeria (CBN) online data base.

3,2 Model Specification

The linkages among inflation interest rate and exchange rate in this study are described in a Vector Autoregressive (VAR) model. According to Sims (1980), VAR is a theory-free model used in estimating economic relationships and thus serve as an alternative to most economic models usually restricted by a particular theory. The unrestricted VAR model is expressed in its reduced form as follows:

$$Y_t = ci + \sum_{n=i}^{n} \Phi i \, Y_{t-i} + E_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where

Y_t = vector matrix (n x 1) of all endogenous variables in the VAR system
Ci = vector matrix (n x 1) of all intercept in the VAR system
Φi = square matrix (n x n) of the autoregressive coefficients
Y_{t-i}= square matrix (n x n) of the lags of all variables in the VAR system
Et = vector (n x 1) of error terms

Equation (1) can also be expressed in its structural form to show all the specific variables of the VAR system for this study as follows;

$INFt = \delta_1 + \Sigma\delta_2 INFt\text{-}i + \Sigma\delta_3 INTt\text{-}i + \Sigma\,\delta_4 EXRt\text{-}i + \Sigma\,\delta_5\, M2\ t\text{-}i + \Sigma\delta_6\ GDP\ t\text{-}i + U1t \ldots\ldots\ldots (2)$

$INTt = \beta_1 + \Sigma\beta_2 INTt\text{-}i + \Sigma\beta_3 INFt\text{-}i + \Sigma\,\beta_4 EXRt\text{-}i + \Sigma\,\beta_5\, M2\ t\text{-}i + \Sigma\beta_6\ GDP\ t\text{-}i + U2t \ldots\ldots\ldots\ldots (3)$

$EXRt = \phi_1 + \Sigma\phi_2 EXRt\text{-}i + \Sigma\,\phi_3 INFt\text{-}i + \Sigma\,\phi_4 INTt\text{-}i + \Sigma\,\phi_5\, M2\ t\text{-}i + \Sigma\phi_6\ GDP\ t\text{-}i + U3t \ldots\ldots\ldots (4)$

$M2t = \psi_1 + \Sigma\psi_2 M2\ t\text{-}i + \Sigma\psi_3 INFt\text{-}i + \Sigma\psi_4 INT\ t\text{-}i + \Sigma\psi_5 EXR\ t\text{-}i + \Sigma\psi_6 GDP\ t\text{-}i + U4t \ldots\ldots\ldots (5)$

$GDPt = \omega_1 + \Sigma\omega_2 GDPt\text{-}i + \Sigma\omega_3 INFt\text{-}i + \Sigma\omega_4 INTt\text{-}i + \Sigma\omega_5 EXRt\text{-}i + \Sigma\omega_6 M2t\text{-}i + U5t \ldots\ldots\ldots (6)$

Where:

INFt= inflations rate at time t
INTt=lending rate at time t
EXRt= exchange rate at time t
M2t = money supply at time t
GDPt = current GDP
INFt-i = lag inflation rate
INTt-i = lag interest rate
EXRt-i = lag exchange rate
M2t-i = lag money supply
GDPt-i= lag GDP
$\delta, \beta, \phi, \psi, \omega$ = parameters of the model
U1t, U2t, U3t are the error term.

The VAR model is adopted because it treats all variables as both endogenous and exogenous variables. This is suitable because, theoretically, inflation, interest rate and exchange rate are interdependent and can therefore serve both as endogenous and exogenous variables. Also, the VAR model considers the effect of the lag values of one variable on the other. This also makes the model appropriate for the study because the effect of

a change in one variable on the other is not always instantaneous but requires some time for adjustment to take place.

3.3 Estimation Technique

In this study, Cointegrating-VAR technique is adopted**.** This is used to test for the existence of a long run relationship among variables and to estimate the coefficients of the long run relationships. Johansson cointegration technique is chosen among other co integration techniques because it is a multivariate co integration technique which is most suitable when the variables involve is more than two and also make use of the Vector Autoregressive (VAR) framework (Nkoro and Uko, 2016). Moreover, the technique uses two likelihood ratio test statistics (trace and maximum statistics) to detect the number of co integrating equations among variables. Data was subjected to Augmented Dickey Fuller (ADF) and Phillip Perron(PP) unit root test which are pre estimation test for cointegration.

IV. Results and Discussions

4.1 Unit Root Test Results

In this study, Augmented Dickey Fuller (ADF) and Philip Perron (PP) unit root tests were used and the results are presented as follows:

Table 4.1.1: ADF Unit Root Test Result

Variables	ADF stat	Critical Values			P Value	Remarks
		10%	5%	1%		
INF	-3.185994	-2.614300	-2.951125	-3.639407	0.0296	I(1)
INT	-3.660564	-2.614300	-2.951125	-3.639407	0.0095	I(1)
EXR	-3.711400	-2.617434	-2.957110	-3.653730	0.0087	I(1)
M2	-7.151765	-2.614300	-2.951125	-3.639407	0.0000	I(1)
GDP	-18.56881	-2.617434	-2.957110	-3.653730	0.0001	I(1)

Source: Author's computation using Eviews 9

Table 4.1.2: PP Unit Root Test Result

Variables	PP stat	Critical Values			P Value	Remarks
		10%	5%	1%		
INF	-3.176707	-2.614300	-2.951125	-3.639407	0.0303	I(1)
INT	-3.559626	-2.614300	-2.951125	-3.639407	0.0122	I(1)
EXR	-3.841608	-2.614300	-2.951125	-3.639407	0.0060	I(1)
M2	-11.59038	-2.614300	-2.951125	-3.639407	0.0000	I(1)
GDP	-8.826842	-2.614300	-2.951125	-3.639407	0.0000	I(1)

Source: Author's computation using Eviews 9

The unit root test result above using ADF and PP test shows that all variables are stationary at first difference (I (1)) at 5% level of significance.

4.2 Cointegration Test Result

Since all the variables are differences stationary, the test for cointegration was carried out to check for the existence of a long run relationship among the variables.

Table 4.2.1: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.782585	103.0092	69.81889	0.0000
At most 1*	0.529264	52.65293	47.85613	0.0166
At most 2	0.394122	27.78881	29.79707	0.0838
At most 3	0.238625	11.25329	15.49471	0.1964
At most 4	0.066094	2.256510	3.841466	0.1331

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
Source: Author's computation using Eviews 9

Table 4.2.2: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.782585	50.35631	33.87687	0.0003
At most 1	0.529264	24.86412	27.58434	0.1073
At most 2	0.394122	16.53552	21.13162	0.1951
At most 3	0.238625	8.996776	14.26460	0.2864
At most 4	0.066094	2.256510	3.841466	0.1331

Max-eigen value test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Source: Author's computation using Eviews 9

Table 4.2.1 and 4.2.2 shows that the trace and maximum eigenvalue test indicates 2 and 1 co-integrating equations respectively at 5% significance level, indicating that on the average a long run relationship exist among all variables**.** However, the long run relationship between specific variables is indicated in the normalized co-integration coefficients as shown below**;**

Table 4.2.3: Normalized Cointegration Coefficients

Normalized cointegrating coefficients (standard error in parentheses)

INF	**INT**	**LOG(EXR)**	**LOG(M2)**	**LOG(GDP)**
1.000000	0.209774	-0.439840	**-44.77574*** **	**127.1517*** **
SE	(0.68397)	(2.61777)	**(7.79394)**	**(14.8612)**
t- Stat	0.30670	-0.168021	**-5.74494**	**8.55595**
INT	**INF**	LOG(EXR**)**	**LOG(M2)**	**LOG(GDP)**
1.000000	**4.767037*** **	-2.096733	**-213.4476*** **	**606.1370*** **
SE	**(1.11266)**	(16.8823)	**(34.0133)**	**(81.8864)**
t- Stat	**4.28436**	-0.12420	**-6.27542**	**7.40217**
LOG(EXR)	**INF**	INT	**LOG(M2)**	**LOG(GDP)**
1.000000	**0.137098*** **	0.033778	**-0.000469*** **	**0.001191*** **
SE	**(0.02840)**	(0.11229)	**(7.2E-05)**	**(0.00016)**
t- Stat	**4.82739**	0.30081	**- 6.51389**	**7.44375**
LOG(M2)	**INF**	INT	LOG(EXR)	**LOG(GDP)**
1.000000	**-0.022334*** **	-0.004685	0.009823	**-2.839746*** **
SE	**(0.00520)**	(0.01395)	(0.07990)	**(0.22937)**
t- Stat	**-4.29500**	-0.33584	0.12294	**-12.38063**
LOG(GDP)	**INF**	INT	LOG(EXR)	**LOG(M2)**
1.000000	**0.007865*** **	0.001650	-0.003459	**-0.352144*** **
SE	**(0.00159)**	(0.00538)	(0.02961)	**(0.03675)**
t- Stat	**4.94654**	0.30669	- 0.11681	**-9.58215**

Critical Values of T-distribution at 29 df: $t_{0.1}$=1.311 $t_{0.05}$=1.699 $t_{0.01}$=2.462

* indicates 10% statistical significance
** indicates 5% statistical significance
*** indicates 1% statistical significance

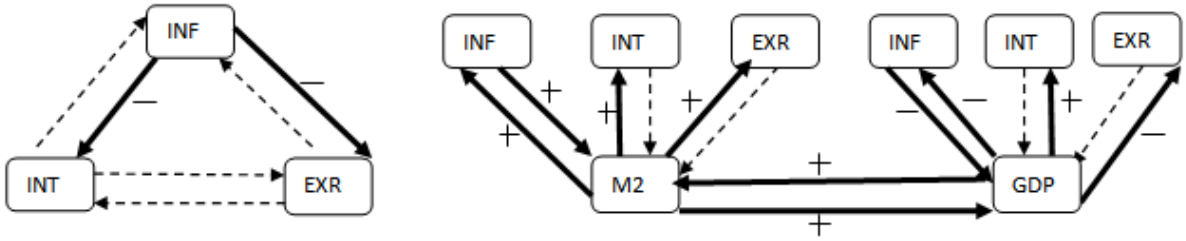
Source: Author's computation using Eviews 9

The normalized co-integrating coefficients which are interpreted by reversing their signs (equating each expression to zero and taking the coefficients to the right hand side) shows that money supply and GDP have significant positive and negative long run effect on inflation respectively while interest rate and exchange rate have no significant long run effect on inflation. Inflation and GDP have significant negative long run effect on interest rate while money supply has significant positive long run effect on interest rate.

Inflation and GDP have a significant positive long run effect on exchange rate; money supply has a significant negative long run effect on exchange rate. Inflation and GDP have a significant positive long run effect on money supply while interest rate and exchange rate have no significant long run effect on money supply. Inflation has a negative long run effect on GDP while money supply has a positive long run effect on GDP. Interest rate and exchange rate have no significant long run effect on GDP.

4.3 Discussion of Findings

The findings of this study could be summarized and discussed from the following diagrammatic representation;



Note: *Tick arrows indicates statistically significant relationships*
Dotted arrows indicates statistically insignificant relationships
The signs show the nature (positive or negative) of relationship

The analysis indicates that interest rate has no long run effect on inflation whereas inflation has a negative long run effect on interest rate. Lenders of financial resources usually take into consideration the expected inflation while setting their lending rates by incorporating inflation premium. However, the long run negative effect of inflation on interest rate indicates that on the average inflation premium may not have been adequate to offset the expected inflation resulting in a negative effect in the long run. No significant long run relationship exists between interest rate and exchange rate. These findings are at variance with the fishers' hypothesis.

The finding shows that exchange rate has no significant long run effect on inflation whereas inflation has a negative long run effect on exchange rate. This also shows the non existence of long run PPP within the period of our study. Inflation impacted negatively on exchange rate in the long run likely because the economy may have adjusted such that inflation has a reducing effect on exchange rate conditions. Higher prices usually serve as incentives for producers to increase production. The effect of such increase is usually felt after some time since production and supply is not instantaneous. The increase in domestic production may have had some reducing effect on import and hence some reducing effect on exchange rate. The above point is further supported by the fact that GDP affect exchange rate negatively in the long run which entails that in the long run, increase in production is associated with lower exchange rate (naira appreciation) and this indicates that in the long run, domestic production may have had some reducing effect on import or increase export to improve exchange rate conditions. Thus higher prices which usually serve as incentives for producers to increase production led to better exchange rate conditions in the long run.

In the long run, increase in money supply contributes significantly to increase in the general price level, indicating that overtime the growth in money supply may have been faster than the growth in economic output resulting in a rise in the general price level. Increase in prices also induces increase in money supply in the long run. One of the possible explanations to why inflation induce increase in money supply could be that as the value of money depreciates, assets are liquidated and deplored for transactions leading to increase in narrow money supply (currencies and demand deposit). But GDP also has a significant negative effect on inflation in the long run, indicating that increase in production leads to increase in aggregate supply and hence a fall in the general price level.

In the long run increase in money supply leads to increase in exchange rate (naira depreciation) while increase in GDP has a reducing effect on exchange rate. This shows that increase in domestic production may have reduce the demand for some foreign goods, thus reducing the demand for dollar. Also, a rise in GDP is an indication of increase in the size of the economy which usually attract foreign capital, leading to increase in demand for domestic currency and hence naira appreciation (fall in exchange rate). Increase in money supply stimulates domestic production and increase in production also leads to increase in money supply in the long run.

4.4 Policy Implications of Findings

As shown in the findings, inflation, interest rate and exchange rate have weak long run interactions whereas money supply and output have greater long run effect on inflation, interest rate and exchange rate. The findings of this study indicates that the long run path to price stability and economic growth using monetary policy will be through changes in monetary aggregates and increase in domestic production

V. Recommendations and Conclusions

The findings of this study have highlighted the key monetary policy variables in Nigeria and their level of influence on each other in the long run. The study has equally given an insight into monetary policy options and the effects of such policy options on the economy in the quest to achieve long term solutions. While inflation, interest rate, exchange rate, money supply and GDP remains policy targets across economies, the findings of this study suggest that money supply and output are optimal targets for achieving price stability and economic growth in Nigeria in the long run.

The study has revealed that an increase in money supply leads to increase in output and increase in output leads to lower inflation and lower exchange rate (naira appreciation) in the long run. The study recommends that monetary authorities should use innovative ways to increase money supply to boost domestic production. This could be done by giving special and low cost credit to firms that make use of more domestic inputs in production to ensure that the increase in money supply does not lead to increase in import. Indeed, the long run path to price stability and economic growth using monetary policy will be through changes in monetary aggregates and increase in domestic production.

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