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Inflation, Exchange Rate and Output Growth in Nigeria: An Examination of the Economic Consequences of Transitory Shocks

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Abstract
This study attempts to consider the implications of permanent shocks of inflation, exchange rate on economic output growth, in accordance with their relationships to other macroeconomic and financial variables in Nigeria. It follows the monetarist assumption that the macroeconomic variables represented, have no contemporaneous effects on policy variables due to information constraints. This assumption upholds the tenets of the financial programming constructs, which assumes the deviations from targets with respect to inflation. This is particularly true in an economy, such as Nigeria, where fiscal dominance has been persistent for a long period. These insights indicates that the Central Bank of Nigeria looks at the behaviors of these policy variables when conducting monetary policy adjustments. Thus, the structural VAR econometric technique is used to examine the shock impact of these variables. The lag length were obtained and the results of the impulse responses were observed and interpreted accordingly. The results indicates that lag periods exist between shocks on inflation, exchange and output growth. Subsequently, the responses of the monetary policy variables to adjust the consequential unanticipated changes are weak. The lag length from the result is about three quarters which is rather too long; thus, exhibiting the risk of effective delivery in monetary policy implementation. Also, the study concluded that the persistent inflationary pressures currently prevailing in the Nigerian economy do not seem to yield to the injected policy stimuli from monetary activities and the known responses are largely delayed by the present structure of the system.

Key Words: Exchange Rate, Inflation Rate, Output Growth, Money Supply.

I. INTRODUCTION

Generally, issues of macroeconomics such as output growth, inflation and exchange rate often dominate political debate (Schultze, 1992). Nigeria with an unbalanced fiscal-monetary policy mix has been highly susceptible to external shock which has led to inconsistencies in real GDP, high inflation rate and consistent exchange rate volatility (Laurens & Piedra, 1998; Baksay, Karvalits & Kuti, 2012: 183-188; Araujo, Azevedo & Costa, 2012: 99-102). Monetary policy (MP) in Nigeria over the past three decades is intended to attain price and exchange rate stability and by so doing attain internal and external balance. Despite the apparent emphasis of these policy objectives, Nigeria's inflation experiences since 1970 have been mixed (Debrun, Masson, & Pattillo, 2005; CBN, 2008; 2012). The explanation for Nigeria's inflation performance over these periods has been the weakness in Nigeria's fiscal policy framework.

Iyoha (1998) emphasizes that for a developing country like Nigeria which is highly dependent on trade; the exchange rate (EXR), which is the price of foreign exchange, plays a significant role in the ability of the economy to attain its optimal productive capacity. An unfavourable change in foreign currency price affects the EXR negatively which leads to fluctuations in commodity prices and volatility in domestic output as well as inflation. In addition, the EXR level has implications for balance-of-payments viability and the level of external debt. Hence, it is imperative for the EXR to find its equilibrium level, for a viable balance-of-payments position. Bamidele et al. (1998) opined that Nigeria's EXR policy's primary goal has been to maintain price stability, favorable external reserves, and the value of the country's currency in order to guarantee both internal and external balance as well as overall economic stability.

Relatively, the aim of macroeconomic policy is the achievement of output stabilization in the short-run, and a diversified, self-sustaining economic growth in the long run. This is why the Nigerian policy makers strive to stabilize economic fluctuations, and growth (per capita real GDP growth) and, balance of payments overtime in the economies of nations. Odusola and Akinlo (2001) asserts that empirical macroeconomics researchers/writers face a significant challenge in their research: figuring out the causes of output and inflation swings. This problem has already been the subject of several studies conducted in industrialized countries, Latin America, and Asia.

According to Olubusoye and Oyaromade (2008), the main sources of fluctuations in inflation in Nigeria is expected inflation, petroleum prices because of both the high dependence of Nigeria's economy on oil exports, high import of refined petroleum products and real EXR. These three significantly propagate the dynamics of inflationary process in Nigeria considering the fact that, oil exportation accounts for about 97 percent of our total government foreign earnings and about 82 percent of total annual government revenue. Consequently, the volatility in the global pricing of crude oil would constantly interfere with the monetary regulating authorities' attempts to regulate the domestic prices.

Although, some theoretical models suggest that MP stabilization strategies may be expansionary for high inflation countries like Nigeria such that if this outcome is anticipated, credible 'shock' treatment approaches to disinflation should be adopted. Others have argued that MP stabilization without recession is rather difficult to achieve. At the core of this issue is whether or not stabilization without recession is possible (Odusola & Akinlo, 2001).

The main hypothesis of this study is that there exist some levels of distortion in the EXR market that causes price instability and therefore makes returns on the levels of output growth in Nigeria unpredictable. This distortion lies in 'asymmetric reputation' that brings about substitution of the country's currency for the foreign currency in order to enhance investment thus causing systematic devaluation whose possible effect on output can be contractionary and then, ushers in a new era of domestic inflation, e.g. see Cooper (1971), Edwards (1989), Agenor (1991), and Morley (1992). Also, uncertainty in EXR market led to endemic devaluations, which depressed investment and hindered economic growth in Nigeria. They affirmed that this situation is likely to continue due to the parallel nature of asymmetric information and incomplete credit markets. Hence, the most appropriate policy intervention in asymmetric reputation driven incomplete exchange rate market, is by imposing and maintaining a restriction on EXR policy.

Indeed, in the real world, there is a perpetual state of dynamic disequilibrium that can make EXR uncertainty, a path dependent process with deleterious effects on output growth. Subsequently, the endemic nature of EXR in Nigeria and its adverse effects on growth are the result of a financial market that is incomplete (lack of a healthy financial system) and not properly regulated with a dismal monetary policy transmission. Even after the CBN was granted independent tools in 1998, Nigeria's economy was still characterized by fiscal irresponsibility, which had a negative impact on MP's ability to function effectively.

Numerous efforts have been undertaken to carry out methodical econometric analyses of the dynamics of output and inflation changes. However, with the exception of Odusola and Akinlo (2001), many of these earlier studies were based on either simulation analysis or regression approach (Cogley & Sargent, 2005; Dossche & Everaert, 2005; Bilke, 2004; Andolfatto, Hendry & Moran, 2002; Furhrer & Moore, 1995). Also, movements in output and inflation are basically driven by several fundamental disturbances such as monetary, EXRs (official and parallel), interest and income. Nevertheless, in this study, a VAR model of the Nigerian output levels, rate of inflation (INFR) and EXR will be formulated, estimated and tested.

At the core of the issue on the movements of output, inflation, EXR and their dynamics in Nigeria are if EXR and inflationary shocks distort output or not. Most theoretical models suggest that stabilization could be expansionary particularly for high inflation countries like Nigeria (Odusola & Akinlo, 2001). Others argue that stabilization without recession is rather difficult to achieve (Strongin, 1995; Davis & Kanogo, 1996). Besides, the following often arises, and we will investigate if there are causal effects emanating from the observed rates of output growth that influences the INFR and could be linked with the prevailing levels of volatility in EXR. We will seek to understand how EXR shocks influence the rates of output growth in Nigeria; whether the EXR has any causal relation with the levels of output growth in the economy; analyze if EXR and INFR are instruments of stabilization that promotes output growth. Also, we will find out if the present level of government commitment to low INFR cause volatility in the EXR and output growth.

II. Review of the Literature

Fundamentally, most economic literature could not give a clear distinction that could link the sources of fluctuations in output growth and inflation. Overtime, this difficulty has posed important challenges for empirical macroeconomics in this area of study. At the core of this issue is whether monetary policy stabilization is possible at all times as an economy progresses (Odusola & Akinlo, 2001). On a macroeconomic level, the main role of the Federal Government of Nigeria should be to provide a stable policy and business environment. Macroeconomic stability is a situation where key economic relationships are broadly in balance and sustainable. To safeguard macroeconomic stability, the government budget, including the country’s developmental strategies must as a matter of priority, be financed in a sustainable non-inflationary manner. In the long run, the major aim of macroeconomic policy is self-sustained economic growth over time. The achievement of this key objective, of course, presupposes the achievement of other goals like full and efficient utilization of resources overtime with inflation at a very low single digit level.

2.1 Conceptual Framework

Theories agree that monetary policy stabilization may take years if fiscal policies are not adjusted appropriately (Strongin, 1995; Davis and Kanogo, 1996; Berument and Gunay, 2003). Even when fiscal adjustment is implemented, it takes time to achieve low inflation, especially when money is used as the nominal anchor. Yet, in the short run, macroeconomic policy instruments are used to achieve the aim of income stabilization, often referred to as 'Macroeconomic Stability'. This is done by ensuring steady rise in output growth and low inflation; through a sharp reduction in fiscal deficit which is always a critical element of a stabilization program, regardless of the choice of monetary anchor.

Inflation became the major global economic problem of the 1970's with the rise in oil prices of that period. When austerity measures were implemented in Nigeria in the 1980s, inflation turned into a serious national emergency. It is still up for debate how much harm mild inflation causes, but there is no denying that hyperinflation, which renders money essentially worthless, has caused a great deal of suffering for people, causing social unrest and even overthrowing governments in certain instances (Odusola & Akinlo, 2001). A prolonged period of high and fluctuating inflation typically precedes hyperinflation, which rarely occurs overnight.

As such, much theoretical and empirical work has appeared on the causes of inflation. Therefore, a significant issue for empirical macroeconomists is to comprehend not just the causes of output and inflation fluctuations, but also the causes of output, inflation, and EXR fluctuations. Fiscal, monetary, and balance of payments factors are the three main causes of inflation, according to Odusola and Akinlo (2001). From a monetary perspective, inflation is said to be caused by an expansion of the money supply. However, from a budgetary perspective, the primary driver of inflation in nations with persistently high inflation is budget deficits. However, because government deficits in emerging nations are frequently funded by money creation, the fiscal component is strongly related to the monetary theories of inflation.

Odusola and Akinlo (2001), in the balance of payments aspect, emphasis is placed on the exchange rate. Simply, EXR collapse brings about inflation for developing countries like Nigeria either, through higher import prices and increases in inflationary expectations which are often accommodated or through an accelerated wage indexation mechanism. This leads to output volatility which subjects the real per capita GDP to the vagaries of fluctuating prices and uncertainty in EXR. Thus, fluctuations in real GDP returns in Nigeria can be viewed as systematic outcomes of the activities of the foreign exchange markets. The behaviour of EXR is a necessary anchor of foremost global economic processes and investment/production activities in Nigeria as it confirms the extent and direction of the effect of EXR volatility.

2.2 Theoretical Framework

Basically, it is rightly held that empirical macroeconomic models have some inherent difficulties in the estimation of structural parameters. Theoretically, the dynamic simultaneous equation models are known to be slightly different from the Structural Vector Auto-regression models (SVAR) in approach to identification (Favero, 2001). Representing these facts in accordance with the views outlined in the literature review of this study, the identification structure of the model used for this study is illustrated as follows:

$$\Gamma Y_t = \delta \beta_t + e_t \qquad - \quad - \quad - \qquad (2)$$

Where Y_t Y_t is a $(n \times 1)(n \times 1)$ vector of the endogenous variables, while $\beta_t \beta_t$ contains the exogenous and lagged endogenous variables and $\sum_e = \sum(ee')\sum_e = \sum(ee')$ gives the variance-covariance matrix of the structural innovations, a case where all variables are in their logarithm forms. It is necessary to note that the coefficients in Γ *and* $\delta\Gamma$ *and* δ are of utmost importance to the parameters.

Obviously, it will be difficult to directly estimate the stated structural model in equation (2) and derive the most appropriate values of the Γ *and* $\delta\Gamma$ *and* δ coefficients. This is because the sampling information most likely lacks some criteria that will necessitate researchers to identify further restrictions (Bagliano and Favero, 1998; Faust and Leeper 1997). These missing links within the data sets of Γ *and* $\delta\Gamma$ *and* δ may yield infinite sets of different values with the same probability distribution which may make it impossible for us to infer from the data alone what the appropriate values of Γ *and* $\delta\Gamma$ *and* δ could be, and this makes parameters 'unidentified'.

Consequently, the reduced-form equation of the stated model in equation (2) is derived as:

$$Y_t = \delta^* \beta_t + u_t \quad - \quad - \quad - \quad (3)$$

Equation (3) is a reduced-form equation that conveys the fact that each endogenous variable is an independent component of the equation as a function of predetermined variables (Hamilton, 1994).

With $\delta^* = \Gamma^{-1}\delta$ *and* $u_t = \Gamma^{-1}e_t; \delta^* = \Gamma^{-1}\delta$ *and* $u_t = \Gamma^{-1}e_t;$ the variance-covariance matrix of the reduced form is given by $\sum_u = \sum(uu')\sum_u = \sum(uu')$. Subsequently, we pre-multiply the model in equation (2) with a full rank of matrix labeled Q in order to obtain equation (4), thus:

$$Q\Gamma Y_t = Q\delta\beta_t + Q e_t \quad - \quad - \quad - \quad (4)$$

This can be rewritten as

$$\Gamma_Q Y_t = \delta_Q \beta_t + e_{Q_t} \quad - \quad - \quad - \quad (5)$$

Considering these views, it is necessary to state that

$\Gamma_Q = Q\Gamma,\ \delta_Q = Q\delta$ *and* $e_{Q_t} = Qe_t \Gamma_Q = Q\Gamma,\ \delta_Q = Q\delta$ *and* $e_{Q_t} = Qe_t$.

Therefore, the reduced-form of the model in equation (4) is given by:

$$Y_t = \Gamma_Q^{-1}\beta_Q X_t + \Gamma_Q^{-1} e_{Q_t} = \Gamma^{-1}Q^{-1}Q\beta X_t + \Gamma^{-1}Q^{-1}Q \quad e$$
$$= \Gamma^{-1}\beta X_t + \Gamma^{-1}e_t \quad - \quad - \quad (6)$$

Considering equation (4), in line with the reduced-form of equation (2), it should be noted that these equations are equivalent. This is the identification problem. Thus, it is clear that different structural models give the same reduce-form problem. This could be resolved by making unique sets of assumptions that will introduce identifying restrictions about the structural parameters of the 'true' model derived from the data.

To correct this problem, we followed the traditional approach to identifying dynamic simultaneous equation models (Hansen, 1991 pp.337-399; Khan , 1975 pp.355-362; Khan and Senhadiji, 2001). Therefore, equation (7), a simple bivariate model which consists of the rates of inflation (Inf_t) and Output growth (OGW_t) was proposed and presented, thus:

$$\eta_t = \delta_1 OGW_t + \beta_{\eta\eta}(L)\eta_t + \beta_{\eta OGW}(L)OGW_t + e_{P_t} \quad - \quad - \quad (7)$$
$$OGW_t = \delta_2 \eta_t + \beta_{OGW\eta}(L)\eta_t + \beta_{OGWOGW}(L)OGW_t + e_{OGW_t} \quad - \quad - \quad (8)$$

In this case, $\beta(L)$ $\beta(L)$ denotes polynomials in the lag operator L, where $\beta(L) = \alpha_1 L + \alpha_2 L^2 + \cdots + \alpha_n L^n \beta(L) = \alpha_1 L + \alpha_2 L^2 + \cdots + \alpha_n L^n$ and the total sum of e is the proposed variance-covariance matrix of the structural disturbances.
Equation (2) shows the effect of related monetary control mechanisms on the persisting INFR in the Nigerian economy, while equation (3) is the proposed money supply (MS) model which identifies the influence of MP to control economic shocks induced by the rising levels of the rates of inflation and other related monetary pressures. In view of this fact, this study has put in place a structure which proposes that the CBN fixes bands for aggregate MS in accordance with reactions for the feedback mechanism from the other key variables in the economy as reflected by the model. These reactions are represented by: $e_{OGWt} e_{OGWt}$.
Therefore, in order to obtain the estimates of the structural parameters with the identifying restrictions in view, the reduced-form equation in equations (7) and (8) would transform:

$$\eta_t = \beta^*_{\eta\eta}(L)\eta_t + \beta^*_{\eta OGW}(L)OGW_t + u_{d_t} \quad - \quad - \quad (9)$$

$$M2_t = \beta^*_{OGW\eta}(L)\eta_t + \beta^*_{OGWOGW}(L)OGW_t + u_{OGWt} \quad - \quad - \quad (10)$$

Here, $\beta^* = \Gamma^{-1}\beta \;\; and \; u = \Gamma^{-1}e \;\; \beta^* = \Gamma^{-1}\beta \;\; and \; u = \Gamma^{-1}e$. Using the lag length selection criteria, if we arrive at a specified lag length of **Ω**, the stated reduced form equation represented by equation eight and nine most probably has four **Ω** coefficients while the structural model represented by equation six and seven will have four **Ω** plus two coefficients. Therefore, an identified restriction for each equation is needed to obtain estimates of the structural parameters from the data. It is most necessary to note that these restrictions are imposed on the model on a priori grounds, based on firm theoretical foundation (Greene, 2002; Bagliano and Favero,1998; Favero, 2001).
Variables in equation (10) can be represented in matrix form as follows;

$$\begin{bmatrix} \eta_t \\ \vdots \\ OGW_t \end{bmatrix} = \begin{bmatrix} U_{\eta t} \\ \vdots \\ U_{OGWt} \end{bmatrix} + \begin{bmatrix} \psi_{dd,1} & \psi_{dOGW,1} \\ \vdots & \vdots \\ \psi_{dOGW,1} & \psi_{OGWOGW,1} \end{bmatrix} \begin{bmatrix} U_{d,t-1} \\ \vdots \\ U_{dOGW,t-1} \end{bmatrix} + \begin{bmatrix} \psi_{dd,2} & \psi_{dOGW,2} \\ \vdots & \vdots \\ \psi_{dOGW,2} & \psi_{OGWOGW,2} \end{bmatrix} \begin{bmatrix} U_{d,t-2} \\ \vdots \\ U_{OGW,t-2} \end{bmatrix} + \cdots \qquad (11)$$

This matrix notation expresses the polynomial matrix of the VAR relationship between the rate of inflation and the levels of output growth in the economy. Note that $\psi_{dd,2}\psi_{dd,2}$ represents $\frac{\partial\eta_{t+2}\partial\eta_{t+2}}{\partial u_{d,t}\;\partial u_{d,t}}$ This signifies the responses of the rates of inflation in period t+2 to a unit innovation in the disturbance term Ud occurring in period t, with the assumption that all other innovations in this model over the same observations are held constant (Hamilton, 1994).

2..2.1 VAR Order Selection

The order of the vector autoregressive model can be selected by model selection criteria such as the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) or by means of a sequence of log-likelihood ratio tests (LL).
The values of the AIC and SBC for model (3.8) are:

AIC = - - (12)

and SBC = - (13)

Where;

S = mp+q+2

as defined by the equation

P = the maximum order of the VAR model

The log-likelihood ratio statistic for testing the hypothesis that the order of the VAR is p against the alternative the its is P(P>p) are given by;

$$LR_{p,\,p} = n \quad - \quad - \qquad (14)$$

For p = 0, 1, 2, 3, p-1

Where;

p = Selected maximum order for the VAR model

as defined by the equation

ML estimator of the system co-variance matrix in the regression of z_t on t_n, t_d and R_t.

Where:

p = selected maximum order for the VAR model

as defined by the equation

ML estimator of the system co-variance matrix in the regression of z_t on t_n, t_d and R_t.

Note, that under the null hypothesis, the LR statistic in (13) is asymptotically distributed as a chi-squared variate m2 (P-p) degree of freedom. Also, in some cases, the LR statistic result over-rejects the null hypothesis. Therefore, the adjusted LR statistics are computed;

$$LR^*_{p,\,p} = \quad - \quad - \qquad (15)$$

For $_p$ = 0, 1, 2, 3, p-1

Note that the adjusted LR statistics have the same asymptotic distribution as the unadjusted statistics in equation 13.

2.2.2 The Generalized Impulse Responses

Considering the VAR model in equation (8), the generalized impulse response function for a system-wide shock, $U^o{}_t$, is defined by;

$$- \quad - \qquad (16)$$

Where;

= The conditional mathematical expectation taken with respect to the VAR model in equation (8).

= A particular historical realization of the process at time t-1

With a view of its moving average, the above equation will like become;

$$- \quad - \qquad (17)$$

This equation is independent of the 'history' of the process. Therefore, it is specific to linear systems and does not carry over to non-linear dynamic models. Practically, the choice of the vector of shocks, $U^o{}_t$, is arbitrary. To improve this situation, the empirical distribution function of $A_N U^o{}_t$ for all these shocks, in the case were $U^o{}_t$ is drawn from the same distribution as U_t, a multivariate normal distribution with zero means and a constant covariance matrix $\sum$ we have the analytical result that;

$$\sim \quad - \quad - \qquad (18)$$

The elements $A_N \sum A^1{}_N$, if appropriately scaled are the 'persistence profiles' that analyses the speed of convergence to equilibrium (Lee and Pasaran, 1993; Pasaran and Shin, 1996). Also, note that when the VAR model in equation (9) is stable, the limit of the 'persistence profile' as N □ ∞ tends to the spectral density function of R_t (without the W_ts) at zero frequency (apart from a multiple of Л) (Sims, 1981; 1986).

To find the effect of the variable specific shocks on the evolution of the R's and that for a given U_t, the VAR model in equation (3.8) is hit by the shock of size to the ith equation at time t. This will change the Impulse Respond equation to;

- (19)

Expressing the equation above in a moving average, we have;

~ - - (20)

This equation is 'history invariant', that is, it does not depend on. To compute (the conditional expectations), depends on the nature of the multivariate distribution assumed for the disturbances, U_t. Then, as ~ , we have;

= - - (21)

From above, the unit shock is defined as, . Therefore, the General impulse responds will become:

i,j, = 1, 2, ..., m (22)

Where,

e_t = selection vector.

This is the generalized impulse response function of a unit shock to the ith equation in the VAR model.

2.3 Empirical Literature on Output, Inflation and Exchange rate

Romer (1996) empirically investigated the belief that INFLR depended strongly on the growth rates of output. The study disclosed that in recent times, output growth deviated from expected trends has become the predominant determinant of inflation. Facts show that the behavior of inflation trends depict weakness in the effect of output growth (OGR) overtime.

Despite perceived ambiguous theoretical postulations, Ghosh and Ostry (1996) empirical evidences suggested that there is a strong link between EXR, INFLR and OGR. The effect of the expected relation depends on the choice of the EXR policy. They noticed that a pegged EXR policy led to lower inflation, but slower OGR.

The quest to sustain economic growth and low inflation rates, led Gokal and Hanif (2004) to used the Keynesian aggregate demand and aggregate supply framework to test the potency of inflation and economic growth. They detected a weak negative correlation between inflation and growth. Also the causal impact is transmitted through a unidirectional perspective, through economic growth to inflation. This suggests that MP should be geared to maintaining low inflation, to strengthen economic growth prospects. Similarly, Dibooglu (2003) vector auto-regressive (VAR) dynamic aggregate supply and demand model revealed that such interactions have implication for capital mobility and economic stabilization.

To investigate variability in nominal and real uncertainty in inflation and output, Karanasos and Kim (2005) used the conditional variances of these variables to estimate their bidirectional effects. Their empirical procedure introduced the bivariate G-ARCH. The results revealed that although inflation has a significant effect on output volatility, there were not causal relations between nominal and real uncertainty.

Vinh and Fujita (2007) examined the impact real exchange rate depreciation on economic performance in Vietnam using VAR analysis. Their research work disclosed that the variations in output and inflation are own shocks. Also, the levels of shocks from the real rates of exchange account for a stronger portion of the variation in output, while its effect on inflation is weak. They noted that the real rates of exchange do not have significant effect on the levels of output on the long-run.

Ncube and Ndou (2011) derived the theoretical inflation equation and used the Bayesian

VAR sign restriction approach to identify the transmission channels between real interest rate, INFLR, EXR and real OGR. Their results reveal that interest rate reacts negatively to inflation rate shocks. Policies meant to guide inflation targeting decreases in OGR. Subsequently, flexible inflation targeting policies linked with real effective EXR precede increase in OGR.

In the light of INFLR and EXR instability after financial and economic crisis, Muhammad, Mazen and Nikolay (2013) empirically compared the performance of the policies before and after the crisis, considering non-neutrality of money and EXR policy efficiency. Their result showed a lack of coherence between both policy periods in terms of stabilization in inflation and output growth.

2.4 Gap in Literature

A large range of literature on inflation and output growth; real exchange rate, output and inflation and inflation targeting, exchange rate shocks and output exist. Although these articles are based on various aspects of the subject matter, contemporary literature on the associated effects of these macro-economic variables in the developing countries are rare. This study will follow a unique perspective in order to fill a gap in both literature and existing empirical research by introducing vector auto regressive model, in order to measure the expected shock effects. Also, it will make it possible to understand the aggregate of these shocks on the key variables and analyze its significance for policy monitoring. Subsequently, it will evaluate the impulse response shock-induce effects of these equations to justify the stated results.

III. RESEARCH METHODs

3.1 Model Specification

Based on all the theoretical and empirical works in the foregoing section, a number of MP transmission channels has been identified, which may potentially determine the impact of MS, maximum lending rate, real effective EXR and fiscal deficits on inflation control in Nigeria for the period, 1972 to 2024. In this sense, the general function of the model specified for this research study is presented as follows:

$$INF = f(MS, OGW, REER, FISCD) \quad \dots \quad \dots \quad \dots \quad (1)$$

Where, INF = Inflation Rate, MS = Money Supply, OGW = Output Growth, REER = Real Effective Exchange Rate, FISCD = Fiscal Deficits

In equation (1), INF constitutes the dependent variable while MS, OGW, REER, and FISCD serve as the independent or explanatory variables. The vector autoregressive (VAR) approach will be used to estimate the relationships among the above stated variables.

IV. DISCUSSION OF FINDINGS

4.1 Empirical Analysis

The empirical analysis of this research work seeks an in-depth thought of the study in accordance with the results obtained from the statistical and econometrical test after estimating the proposed model specified in section three.

4.2 Descriptive Statistics

Table A1: Descriptive Statistics

Statistics	M2	INF	LR	EXR	FD
Mean	1012973.	20.34806	14.76194	38.49968	8876.441

Median	49174.90	13.65500	16.50100	7.703500	3442.750
Maximum	10767378	89.57000	29.80100	150.9162	53039.54
Minimum	767.2000	-4.980000	6.001000	0.533800	156.5800
Std. Dev.	2169497.	20.00224	6.625118	52.85436	13883.66
Skewness	2.854075	1.585677	0.223281	1.018789	2.233431
Kurtosis	10.67298	4.997569	2.019540	2.217883	6.663585
Jarque-Bera	609.7172	93.65180	7.738137	31.75620	222.4980
Probability	0.000000	0.000000	0.020878	0.000000	0.000000
Sum	1.62E+08	3255.690	2361.911	6159.949	1420231.
Sum Sq. Dev.	7.48E+14	63614.24	6978.858	444179.8	3.06E+10
Observations	160	160	160	160	160

Table A1 reports the descriptive statistics of the sampled data. The average inflation rate for the period is 20.35 percent, which is a very high value over the years. Therefore, it seems that inflationary pressure has been rife in Nigeria for a long time; the medium inflation value of 13.66 is much lesser than the mean value. This suggests dissimilarities among the entire data sample size. The degree of variability of inflation over the period has been high since the table reports a high standard deviation value for inflation. The Jarque-Bera (J-B) value of 93.65 is very high and it passes the significance test at the 5 per cent level. Based on this outcome, it could be inferred that the data series for inflation is not normally distributed.
The proposed MP instruments of M2, however, show different characteristics in terms of distribution. OGW seems to be much uniformly distributed, with lower standard deviation and skewness value close to zero. This indicates that interest rate progression has been more sequential over the period. This is a plausible outcome because, before 1986, interest rate was highly fixed with well ordered and predictable changes but after deregulation, the rate has generally remained very high without any frequent adjustment over the years.
On the other hand, money supply seems to be very unstable and variable. The standard deviation value is high and the J-B statistics is highly significant. Frequent changes in monetary policy stance and the predominance of fiscal operations over monetary policy may be the reasons behind the highly unstable money supply regime. The other variables, namely: EXR and FD, both have high variability with non-normally distributed functions.

1. Unit Roots Analysis

Generally, unit root test involves the test of stationarity for variables used in the regression analysis. The importance of stationarity of time series used in regression borders on the fact that, with a non-stationary time series, it is not possible to generalize other time periods apart from the present. This makes forecasting based on such time series to be of little practical value. Moreover, regression of non-stationary time series on another non-stationary time series may produce spurious result.

The Augmented Dickey Fuller (ADF) test is employed in order to analyze unit roots. The results are presented in levels and first difference. This enables us determine, in comparative terms, the unit root among the time series and also to obtain more robust results. Table A3 presents results of the ADF test, and those results are in their level forms, without taking into consideration the trend in variables. The reason for this is that an explicit test of trending pattern of the time series has not been carried out. In the results, the ADF test statistic for

INF, M2 and EXR are all greater than the 95 per cent critical values. This indicates that the variables are stationary in levels and are not time dependent. Each of the other variables (OGW and FD) has ADF values that are less than the 95 per cent critical ADF values. The implication of this is that the time series for these variables are non-stationary in their levels.

Table A3: Unit Root Test for Variables at Levels

Variable	ADF Test Statistic	95% Critical ADF Value	Remarks
INF	-3.877	-2.880	Stationary
M2	-5.962	-2.880	Stationary
OGW	-1.464	-2.880	Non-stationary
EXR	-11.229	-2.880	Stationary
FD	-1.217	-2.881	Non-stationary

Empirical results obtained by author, using Eviews 10.

Furthermore, this study takes the first differences of the respective variables and performs the unit root test on each of the resultant time series. The rationale behind this procedure is that Box and Jenkins (1976) have argued that differencing non stationary time series will make it attain stationarity.

Table A4: Unit Root Test for Variables at First Difference

Variable	ADF Test Statistic	95% Critical ADF Value	Remarks
DINF	-9.976	-2.880	Stationary
DM2	-5.395	-2.882	Stationary
DOGW	-9.898	-2.880	Stationary
DEXR	-11.229	-2.880	Stationary
DFD	-3.667	-2.881	Stationary

Empirical results obtained by author, using Eviews 10.

The result of the unit root test on these variables in first difference is reported in Table A4 From the results, it could be seen that the ADF test statistic for each of the variables is greater than the 95 per cent critical ADF values (in absolute values). With these results, the estimated variables are adjudged to be stationary. This implies that only OGW and FD are actually difference-stationary, attaining stationarity after the first differences of the variables. Thus, we would accept the hypothesis that OGW and FD possess unit roots. Indeed, the variables are integrated of order one (i.e. I [1]). On the other hand INF, EXR and M2 do not possess unit roots, and are not time dependent.

4.4 The lag order selection

The order or length of the lags to be used in estimating the VAR is selected based on empirically determined criteria. Table A4.4 shows the results of the lag length selection based on certain criteria. Some of the selection criteria use the minimum value for its optimum order while others use maximum value. In the result displayed in Table A4.4, only FPE and AIC criteria selected similar order of four. The other criteria selected a wide range of lag length. Since two of the criteria have selected the lag order of four, we take this on the optimum lag order for the VAR in the analysis.

Table 4.4: Lag Order Selection Test
Lag Length Criteria

VAR Lag Order Selection Criteria						
Endogenous variables: DINF DLR DEXR DFD						
Exogenous variables: C						
Date: 04/10/23 Time: 08:44						
Sample: 1970Q1 2022Q4						
Included observations: 151						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2718.438	NA	5.37e+10	36.05878	36.13871*	36.09125*
1	-2711.841	12.75653	6.09e+10	36.18333	36.58297	36.34568
2	-2710.026	3.413362	7.35e+10	36.37121	37.09056	36.66345
3	-2706.858	5.791054	8.72e+10	36.54117	37.58023	36.96329
4	-2635.471	126.6993	4.20e+10*	35.80757*	37.16634	36.35957
5	-2630.224	9.035349	4.85e+10	35.94999	37.62847	36.63188
6	-2622.197	13.39539	5.42e+10	36.05560	38.05379	36.86737
7	-2614.895	11.80068	6.13e+10	36.17079	38.48870	37.11244
8	-2575.447	61.65327*	4.53e+10	35.86022	38.49785	36.93176
* 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: Result extracted from the Eviews 10 output

4.5 The VAR Estimate Results

The analysis of the dynamic behaviour of inflation with exchange rate policy influence is performed within a VAR framework. The lag order selection test has revealed that order four is optimal. However, we begin the analysis using lag order of four so as to compare the results with those of the selected lag.

4.5.1 The Impulse Response Results

This analysis generated the impulse response functions (IRFs) which are presented in tables 5.1 and 5.2.

Table 5.1 – Generalized Impulse Responses
VAR Result at the second difference, taking into consideration the fourth lag

Vector Autoregression Estimates					
Date: 04/20/23 Time: 08:56					
Sample (adjusted): 1971Q3 2021Q4					
Included observations: 154 after adjustments					
Standard errors in ( ) & t-statistics in [ ]					
	DDEXR	DDFD	DDINF	DDOGW	DDM2
DDEXR(-1)	-0.715490	-6.322389	-0.149379	-0.031010	-3459.944

	(0.09026)	(26.2624)	(0.13815)	(0.02962)	(5267.23)
	[-7.92694]	[-0.24074]	[-1.08130]	[-1.04679]	[-0.65688]
DDEXR(-2)	-0.546464	-20.72217	-0.191457	-0.028099	-9966.101
	(0.10535)	(30.6541)	(0.16125)	(0.03458)	(6148.04)
	[-5.18692]	[-0.67600]	[-1.18733]	[-0.81262]	[-1.62102]
DDEXR(-3)	-0.391202	-35.70223	-0.146898	-0.031793	-1971.577
	(0.10760)	(31.3084)	(0.16469)	(0.03532)	(6279.26)
	[-3.63561]	[-1.14034]	[-0.89195]	[-0.90024]	[-0.31398]
DDEXR(-4)	-0.199918	17.93236	-0.159860	-0.040577	821.2163
	(0.09310)	(27.0885)	(0.14249)	(0.03056)	(5432.92)
	[-2.14735]	[0.66199]	[-1.12187]	[-1.32795]	[0.15116]
DDFD(-1)	-0.000104	-0.956577	-0.000720	9.11E-06	34.85062
	(0.00032)	(0.09305)	(0.00049)	(0.00010)	(18.6631)
	[-0.32451]	[-10.2798]	[-1.47117]	[0.08674]	[1.86736]
DDFD(-2)	-5.33E-05	-0.939665	-0.000678	6.13E-05	-52.19702
	(0.00038)	(0.11199)	(0.00059)	(0.00013)	(22.4616)
	[-0.13857]	[-8.39035]	[-1.15107]	[0.48512]	[-2.32383]
DDFD(-3)	-0.000192	-0.812869	-0.001150	4.61E-05	-30.44103
	(0.00043)	(0.12603)	(0.00066)	(0.00014)	(25.2760)
	[-0.44290]	[-6.45000]	[-1.73474]	[0.32417]	[-1.20434]
DDFD(-4)	-2.12E-05	-0.060238	-0.000360	-7.77E-05	9.579035
	(0.00037)	(0.10666)	(0.00056)	(0.00012)	(21.3910)
	[-0.05771]	[-0.56479]	[-0.64125]	[-0.64601]	[0.44781]
DDINF(-1)	0.027626	-13.34011	-0.529276	-0.009105	252.9827
	(0.05346)	(15.5543)	(0.08182)	(0.01755)	(3119.59)
	[0.51677]	[-0.85765]	[-6.46874]	[-0.51892]	[0.08109]
DDINF(-2)	0.033765	-21.01683	-0.391255	-0.016330	-2214.212
	(0.05890)	(17.1369)	(0.09015)	(0.01933)	(3437.01)
	[0.57328]	[-1.22641]	[-4.34025]	[-0.84475]	[-0.64423]
DDINF(-3)	0.027961	-2.249714	-0.246645	0.025844	3079.920
	(0.05951)	(17.3164)	(0.09109)	(0.01953)	(3473.01)
	[0.46983]	[-0.12992]	[-2.70771]	[1.32308]	[0.88682]
DDINF(-4)	0.006491	-6.440168	-0.310928	0.037449	-1293.408
	(0.05269)	(15.3308)	(0.08065)	(0.01729)	(3074.78)
	[0.12320]	[-0.42008]	[-3.85551]	[2.16549]	[-0.42065]
DDLR(-1)	0.026775	-8.864523	0.262713	-0.575928	3043.424
	(0.24374)	(70.9203)	(0.37306)	(0.08000)	(14223.9)
	[0.10985]	[-0.12499]	[0.70420]	[-7.19920]	[0.21397]
DDOGW(-2)	0.007793	-10.92837	-0.574562	-0.339801	-10421.10
	(0.28623)	(83.2825)	(0.43809)	(0.09394)	(16703.3)
	[0.02723]	[-0.13122]	[-1.31151]	[-3.61707]	[-0.62390]
DDOGW(-3)	-0.145985	5.000292	-0.818903	-0.129323	-2949.223

	(0.28696)	(83.4951)	(0.43921)	(0.09418)	(16745.9)
	[-0.50872]	[0.05989]	[-1.86449]	[-1.37309]	[-0.17612]
DDOGW(-4)	0.254317	4.359274	-0.523037	-0.412713	-2962.026
	(0.24662)	(71.7584)	(0.37747)	(0.08094)	(14392.0)
	[1.03119]	[0.06075]	[-1.38563]	[-5.09873]	[-0.20581]
DDM2(-1)	-6.09E-07	0.000494	-4.90E-07	-2.92E-07	-1.285465
	(1.4E-06)	(0.00041)	(2.2E-06)	(4.6E-07)	(0.08214)
	[-0.43236]	[1.20516]	[-0.22754]	[-0.63194]	[-15.6498]
DDM2(-2)	-1.99E-07	0.000691	1.61E-06	-6.24E-07	-1.108820
	(2.1E-06)	(0.00062)	(3.3E-06)	(7.0E-07)	(0.12444)
	[-0.09341]	[1.11339]	[0.49227]	[-0.89192]	[-8.91081]
DDM2(-3)	-2.87E-07	0.000876	2.22E-06	-5.92E-07	-0.674869
	(2.0E-06)	(0.00059)	(3.1E-06)	(6.6E-07)	(0.11737)
	[-0.14294]	[1.49729]	[0.72130]	[-0.89619]	[-5.75005]
DDM2(-4)	6.17E-07	0.000195	2.51E-06	-1.31E-07	-0.408309
	(1.3E-06)	(0.00038)	(2.0E-06)	(4.3E-07)	(0.07644)
	[0.47125]	[0.51149]	[1.25128]	[-0.30500]	[-5.34169]
C	0.072463	-51.89464	-0.021928	0.017287	10550.50
	(0.52944)	(154.046)	(0.81033)	(0.17377)	(30895.8)
	[0.13687]	[-0.33688]	[-0.02706]	[0.09949]	[0.34149]
R-squared	0.371344	0.679099	0.346739	0.489940	0.779018
Adj. R-squared	0.276810	0.630843	0.248505	0.413239	0.745787
Sum sq. resids	5720.906	4.84E+08	13401.74	616.2599	1.95E+13
S.E. equation	6.558531	1908.283	10.03817	2.152564	382728.4
F-statistic	3.928127	14.07289	3.529704	6.387686	23.44293
Log likelihood	-496.8661	-1370.538	-562.4129	-325.2937	-2186.911
Akaike AIC	6.725534	18.07192	7.576791	4.497321	28.67416
Schwarz SC	7.139664	18.48605	7.990921	4.911450	29.08829
Mean dependent	-0.006178	0.213636	0.013117	0.003896	8500.198
S.D. dependent	7.712235	3140.778	11.57955	2.810125	759088.2
Determinant resid covariance (dof adj.)		8.61E+21			
Determinant resid covariance		4.14E+21			
Log likelihood		-4925.169			
Akaike information criterion		65.32686			
Schwarz criterion		67.39751			

Table 5.2: Impulse Response Table

Response of DDM2:				
Period	DDM2	DDEXR	DDFD	DDOGW
1	381236.1	-28634.79	29723.48	-6955.636
	(21722.9)	(30677.5)	(30674.2)	(30718.3)
2	-490026.7	-2839.426	29494.71	-9989.200

	(41953.6)	(51227.9)	(51487.3)	(49746.2)
3	203267.8	30054.79	-214170.0	24767.25
	(56965.9)	(58238.0)	(54778.6)	(54240.9)
4	16869.78	11996.46	249333.9	-11485.52
	(60975.5)	(62335.5)	(55497.8)	(55214.0)
5	-68841.55	-35768.23	-53973.60	-5619.127
	(59887.6)	(64885.8)	(57708.5)	(54780.9)
6	129772.6	14328.82	-48335.45	463.4322
	(58091.6)	(67917.5)	(59157.4)	(55745.1)
7	-172408.7	-7331.832	-59226.19	16979.19
	(57905.7)	(58264.7)	(55246.4)	(52837.0)
8	113138.2	8388.842	90852.18	-17321.38
	(54320.0)	(44963.9)	(45790.0)	(51454.2)
9	-24724.98	7029.767	43370.53	-1694.282
	(52637.5)	(36950.6)	(39775.3)	(47694.5)
10	-26395.19	-11432.91	-81916.52	12049.33
	(49723.3)	(32280.0)	(35697.8)	(45771.7)
Response of DDEXR:				
Period	DDM2	DDEXR	DDFD	DDOGW
1	-0.485844	6.468397	-1.939541	1.411171
	(0.52050)	(0.36857)	(0.50939)	(0.51500)
2	0.068140	-4.536105	1.080520	-0.908903
	(0.63830)	(0.60415)	(0.66067)	(0.62140)
3	0.454986	-0.324678	0.338538	-0.180378
	(0.65789)	(0.66225)	(0.59670)	(0.61284)
4	-0.312075	0.178716	-0.164426	-0.221612
	(0.63432)	(0.66027)	(0.57398)	(0.58590)
5	0.356473	0.597007	-0.065420	1.012239
	(0.59851)	(0.70252)	(0.61693)	(0.57920)
6	-0.575540	0.412765	-0.149700	-0.664641
	(0.58405)	(0.70649)	(0.62517)	(0.57269)
7	0.246935	-0.572285	0.020988	0.043027
	(0.54094)	(0.38823)	(0.51130)	(0.37462)
8	0.221178	-0.040253	0.141506	0.143247
	(0.35923)	(0.25210)	(0.41939)	(0.35667)
9	-0.257107	-0.083498	0.109026	-0.423758
	(0.34949)	(0.23709)	(0.41993)	(0.35478)
10	0.179927	0.346771	-0.261699	0.610384
	(0.32241)	(0.23907)	(0.42207)	(0.35532)
Response of DDFD:				
Period	DDM2	DDEXR	DDFD	DDOGW
1	147.5484	-567.4550	1892.470	-433.2970
	(152.268)	(149.032)	(107.833)	(150.488)

2	29.79891	472.5628	-1767.991	389.3657
	(209.405)	(212.632)	(191.087)	(204.367)
3	-121.5139	-49.78421	1.920951	-22.46186
	(217.467)	(218.118)	(202.154)	(200.570)
4	69.58721	-60.32451	94.82775	1.040512
	(212.012)	(217.548)	(189.432)	(191.868)
5	-202.7278	54.70327	1148.527	-176.3894
	(221.077)	(250.129)	(214.192)	(214.663)
6	272.4718	-51.71697	-1107.597	140.6279
	(241.225)	(274.510)	(245.305)	(231.611)
7	-43.98730	22.44199	42.86862	13.87842
	(228.602)	(199.820)	(236.419)	(133.822)
8	-100.1430	-60.97421	-1.224722	-33.51780
	(149.814)	(156.698)	(225.008)	(99.1533)
9	-20.00415	89.09868	748.3077	-49.41601
	(138.837)	(176.686)	(240.111)	(119.000)
10	52.63638	-4.696225	-677.7082	62.14253
	(149.992)	(190.548)	(264.151)	(132.676)
Response of DDOGW:				
Period	DDM2	DDEXR	DDFD	DDOGW
1	-0.039812	0.476054	-0.499609	2.182094
	(0.17582)	(0.17373)	(0.17352)	(0.12434)
2	-0.060419	-0.458806	0.365937	-1.303803
	(0.20579)	(0.21083)	(0.21369)	(0.18634)
3	-0.055755	0.066461	0.059971	-0.071346
	(0.21073)	(0.21276)	(0.18899)	(0.19751)
4	0.107542	0.034155	-0.085077	0.175740
	(0.20099)	(0.21192)	(0.18394)	(0.18825)
5	0.083774	-0.243601	0.024253	-0.748368
	(0.19893)	(0.23091)	(0.20433)	(0.18810)
6	-0.124660	0.391127	-0.038738	0.893077
	(0.20151)	(0.24125)	(0.21650)	(0.20175)
7	0.024552	-0.173759	-0.005263	-0.231256
	(0.19812)	(0.15058)	(0.16039)	(0.18421)
8	-0.018139	-0.014032	0.080541	-0.149575
	(0.17459)	(0.12696)	(0.11208)	(0.18261)
9	0.017682	0.087382	-0.146579	0.332012
	(0.17304)	(0.12826)	(0.10358)	(0.18355)
10	0.046577	-0.181709	0.147542	-0.453601
	(0.16733)	(0.13642)	(0.09463)	(0.18541)
Generalized Impulse				
Standard Errors: Analytic				

Source: Authors estimation using E-view 10

The general outcome of the VAR at the fourth order lag, reveal that the IRFs time path fizzle out very quickly, providing little effect. The impulse response output in table 5.1, shows that the response of inflation to shocks in LR shows that inflation drops immediately and then it tends to settle after 5 quarters. This suggests that inflation responds to changes in exchange rate in Nigeria.

In this result, the responses of inflation to a shock in both M2 and OGW are similar. No significant adjustment is noticed in inflation after a shock in either M2 or OGW. This shows that after an appropriate lag length, inflation rate does not seem to respond to impulses arising from changes in monetary policy tools. Indeed, the response of inflation to all the variables in the models is very minimal except for the responses to shocks to itself – where it took over eight months for consistency to be restored.

Moreover, we consider the responses of the monetary policy variables to shocks to inflation in order to evaluate how monetary policy reacts to inflation in Nigeria. Furthermore, the second part of this figure shows that M2 impact with inflation shock had a slow effect which initially remains stable for over two quarters. It then rises slightly but falls again before the fifth quarter. Consequently, it becomes stable once again. In the case of exchange rate, the initial impact of inflation shock leaves it stable for the first three quarters, it then rises slightly, remain stable for about a quarter; before it falls back and become stable again.

Thus, it can be seen that a lag period exist between a shock on inflation due to shocks from the rates of exchange. Basically, this is due to the response of monetary policy adjustment as a result of shocks from the rates of exchange. The lag length of the result is about 3 quarters. Ideally, this shows that the implementation feedback time length is rather long. Subsequently, the associated risk of delivery ineffective has serious consequences for the responses of inflation and exchange rate to monetary policy tools.

Finally, we consider the generalized impulses of the relevant variables in terms of second-differenced data. It provided more details with regard to the persistence of the variations on each variable over time. The result of the second–differenced VAR is presented in figure 3 in the appendix. With respect to shock in both M2 and OGW, the responses of inflation to OGW seem to be more pronounced than those of money supply. This outcome is not surprising since we have already shown that money supply does not possess unit roots. Thus, a second–differenced outcome of inflation shock to M2 has produced highly insignificant responses. Money supply does not have quite dynamic behavioural effect like interest rate largely because of the institutional tilt to the determination of M2.

However, the responses of both OGW and M2 to shock in inflation indicate a less effective outcome. Both variables do not seem to respond well to inflationary shock. The time path remains flat along zero in virtually all the periods for both variables. Thus, it is seen that persistent inflationary pressures do not seem to stimulate output growth, exchange rate and react less to monetary policy interventions.

4.5.2 Variance Decomposition Results

The variance decomposition outcomes of the percent of output growth (OPG) variance due to the independent variables in the model are minimal with frail consistent decompositions. The inflation (INF) variance due to exchange rate has a persistent positive values less than zero. The decomposed percent of EXR variance due to INF is also positively weak and consistent. Also, the decomposed percent of EXR variance due to INF was positively low, consistent over the specified horizons. For the other variables in the model, fiscal deficit (FD) has a weak consistent low positive decomposed variance with EXR and INF. The variance decomposition of M2 variance due to LR and EXR are low, weak and consistent. For the variance decomposition of M2 variance due to FD has a consistent progressive increase that consistently rise from a weak positive position close to zero to approximately 20%. For M2 variance due to INF, it stayed below the two percent and raised to five percent were it remained consistently. The lending rate (LR) variable also had frail positive variance decomposition with EXR and INF. These results show that INF and EXR are economic variable that have persistent variance decomposition influence on other variables in the model.

Table 5.3: Variance Decomposition Table

Variance Decomposition of DDEXR:						
Period	S.E.	DDEXR	DDFD	DDINF	DDOGW	DDM2
1	6.558531	100.0000	0.000000	0.000000	0.000000	0.000000
2	8.027173	99.71030	0.096540	0.104892	0.004925	0.083348
3	8.043696	99.46360	0.139661	0.105259	0.007922	0.283556
4	8.056018	99.19618	0.151116	0.107853	0.163985	0.380866
5	8.140334	97.76157	0.162047	0.197983	1.259483	0.618914
6	8.202940	96.47399	0.161094	0.211129	2.124740	1.029047
7	8.225769	96.35256	0.189005	0.215729	2.168053	1.074656
8	8.235857	96.11802	0.199173	0.330754	2.233359	1.118695
9	8.249876	95.80335	0.202042	0.346763	2.459759	1.188081
10	8.275499	95.36186	0.220175	0.407140	2.759874	1.250951
Variance Decomposition of DDFD:						
Period	S.E.	DDEXR	DDFD	DDINF	DDOGW	DDM2
1	1908.283	8.671214	91.32879	0.000000	0.000000	0.000000
2	2619.025	7.953929	91.30562	0.219979	0.005452	0.515019
3	2624.091	7.962201	90.95347	0.224047	0.005486	0.854800
4	2636.143	7.962647	90.18015	0.916906	0.026457	0.913843
5	2929.800	6.511762	90.78808	0.940073	0.027840	1.732249
6	3182.364	5.553682	90.69026	0.800025	0.065122	2.890912
7	3183.104	5.555299	90.65095	0.799779	0.067422	2.926552
8	3187.110	5.628360	90.43450	0.828612	0.073367	3.035165
9	3287.268	5.475091	90.70480	0.779103	0.130177	2.910832
10	3363.890	5.232038	90.93776	0.757582	0.157005	2.915614
Variance Decomposition of DDINF:						
Period	S.E.	DDEXR	DDFD	DDINF	DDOGW	DDM2
1	10.03817	0.038850	2.026727	97.93442	0.000000	0.000000
2	11.39382	0.111999	1.919218	97.71746	0.224482	0.026841
3	11.68657	0.506446	2.972784	93.47751	2.524673	0.518584
4	11.73195	0.858477	3.165109	92.81121	2.548472	0.616730
5	11.91530	0.992272	4.195243	91.46508	2.742675	0.604733

6	12.26458	1.638872	4.585354	90.40487	2.650091	0.720817
7	12.33937	1.628205	4.567874	90.12852	2.937781	0.737624
8	12.37979	1.925842	4.579546	89.54170	3.101796	0.851117
9	12.41253	1.940329	4.605041	89.12870	3.206262	1.119670
10	12.44104	1.942920	4.648679	88.86952	3.213445	1.325441
Variance Decomposition of DDOGW:						
Period	S.E.	DDEXR	DDFD	DDINF	DDOGW	DDM2
1	2.152564	5.246338	3.472170	0.544675	90.73682	0.000000
2	2.517229	7.500099	3.572168	0.398528	88.33416	0.195050
3	2.521259	7.540872	3.718438	0.477996	88.06187	0.200828
4	2.562901	7.301420	3.822329	2.987323	85.62365	0.265274
5	2.678332	7.567843	3.632669	2.845017	85.62537	0.329100
6	2.855572	8.693079	3.360533	4.309390	83.28365	0.353343
7	2.883493	9.001017	3.326836	4.501388	82.82318	0.347577
8	2.893171	8.940980	3.472223	4.907487	82.33259	0.346722
9	2.918656	8.918896	3.542610	4.940117	82.25730	0.341078
10	2.955304	8.974709	3.455323	5.255059	81.97496	0.339947

Variance Decomposition of DDM2:						
Period	S.E.	DDEXR	DDFD	DDINF	DDOGW	DDM2
1	382728.4	0.625525	0.181730	0.191868	0.003789	98.99709
2	623099.9	0.236943	0.501541	0.170534	0.023556	99.06743
3	695282.8	0.334417	10.13443	0.222807	0.272242	89.03610
4	746239.0	0.340403	20.42007	1.401735	0.545547	77.29225
5	757000.0	0.599889	20.35282	2.757586	0.559122	75.73058
6	770963.6	0.628893	20.10340	2.809036	0.584672	75.87399
7	792472.3	0.599524	19.75599	2.710020	0.628080	76.30639
8	807738.9	0.579274	20.86710	2.750936	0.639706	75.16299
9	811053.0	0.660576	20.91504	3.063913	0.660552	74.69992
10	818723.1	0.706438	21.77990	3.542543	0.650137	73.32098
Cholesky Ordering: DDEXR DDFD DDINF DDOGW DDM2						

Source: Authors estimation using E-view 10

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

1. Summary and Finding

This research study carried out an empirical analysis of the shock interaction of output, EXR and inflation in Nigeria for the period, 1970 to 2021. The variables in the model include OGR, EXR, INFLR, MS and federal government's fiscal deficits (FD) acting as control variables. The motivation for the study stems from the fact that INFLR in Nigeria maintained a double-digit nature almost throughout the period covered by the study. MS also surged during this period; while output maintained a steady rise within specified dimensions. EXR depreciation also maintained continuous pattern during the period, while the expansionary budget deficits of the federal government arising from fiscal dominance prevailed throughout the period covered by the study. These outcomes combined have become worrisome to all stakeholders including the government, the monetary authorities, the academics and commentators. Hence, the need to study the underlining policy implications associated with the shock response of these variables.

The vector auto-regressive (VAR) methodology was used to trace the isolated impact of shocks to MP variables on the control of inflation in the Nigerian economy for the period, 1972 to 2024. This approach focused primarily on a reduced –form, relating a small number of variables which were capable of capturing the various channels of monetary policy transmission in Nigeria. In applying the approach, this research made certain decisions as to whether to take the variables at levels or differenced forms, and whether to consider the unrestricted VAR or the VECM. These decisions were informed by the fact that data credibility, availability and reliability posed a challenge in Nigeria and, hence, data properties were of great important to the study.

The empirical findings /results of the study are summarized, thus:

i. The mean INFLR for the period, 1972 – 2024 stood at 20.35 per cent while the median INFLR recorded 13.66 per cent which is much less than the mean value. This suggests dissimilarities among the entire sample size. These outcomes suggest that inflation is not normally distributed.
ii. Both M2 and EXR exhibited different characteristics in terms of distribution. While exchange rate tended to be uniformly distributed, M2 tended to be unstable and variable; thus, suggesting that the variable is not normally distributed.
iii. Both EXR and OGR exhibit high variability; thus, resulting in non-normally distributed functions.
iv. The ADF tests suggested that INF, M2 and EXR were stationary at levels, while Output and FD were not. However, all the variables became stationary after first differencing.
v. The INFLR shocks respond to exchange rate shock significantly.
vi. Inflationary shock responds to both output and money supply are similar.
vii. No significant adjustments were noticed in inflation after a shock in money supply or output growth.
viii. Inflation does not respond to impulses due to change in OGR or MS.
ix. Present levels of inflation respond favorably to previous INFLR, this shows that inflation responded to own shock asymmetry.
x. EXR shocks have strong consistent impact on inflation and it distorts output levels.
xi. The responses of inflation to all the variables of our models were minimal except for responses to shocks on itself, where it took 8 months for consistency to be restored.
xii. The variance decomposition results shows weak positive consistent variables among the variable in the model.

2. Conclusions

The major assumption in this research study is based on the fact that macro-variables represented, have no contemporaneous effects on policy variables due to information constraints. This assumption upholds the tenets of the financial programming constructs, which assumes the deviations from targets with respect to inflation. This is particularly true in an economy, such as Nigeria, where fiscal dominance has been persistent for a long period of time. Impliedly, therefore, the Central Bank looks at the behaviors of these policy variables when conducting monetary policy adjustments.

Based on the foregone findings, it is the conclusion of this research study that lag periods exist between shocks on inflation, exchange and output. Subsequently, the responses of the monetary policy to adjust the consequential unanticipated changes are weak. The lag length from the result is about 3 quarters which is rather very long; thus, exhibiting the risk of delivering ineffective in implementation. The study also concluded that the persistent inflationary pressures currently prevailing in the Nigerian economy do not seem to yield to stimuli from monetary policy responses.

As has been documented in the extent literature as well as in this research study, both the money supply and inflation constitute the two most significant variables that can determine the efficacy and non-efficacy of monetary policy stabilization. In fact, the band-wagon-effects of the two variables are quite strong on the other variables in the model. Also, the variance decomposition output shows that the rates of inflation and exchange have persistent variance decompositions influence on other variables in the model. Accordingly, the following recommendations are proffered.

3. Recommendations

Based on the theoretical and empirical findings of the present research study, the following recommendations are put forward:

i. That the current high and rising inflation rate that prevailed in the Nigerian economy, which assumed double-digit dimensions for the larger part of the period covered by this research study, calls for the argent attention of the fiscal and monetary authorities. In this regard, it is strongly recommended that the Federal Government and the other two tiers of government in Nigeria reduce the current fiscal dominance in the country. In situations where budget deficits are financed by seigniorage and banking sector credit, the private sector and the households are crowded out and this fuels inflation.

ii. That the Nigerian economy experienced continued increases in the broad money supply (M2) variable throughout the period covered by the research study. Accordingly, it is recommended that the Central Bank of Nigeria should, as a matter of utmost priority and deliberate policy, introduce appropriate policy actions that would ensure that only the level of money supply needed to finance the economy is in circulation. This is in realization that too high money supply leads to inflation, while too low money supply leads to recession.

iii. That the exchange rate that prevailed in the Nigerian foreign exchange market throughout the period covered by this research study experienced steady and significant depreciation. This scenario has the tendency to have fueled inflationary pressures in Nigeria during the same period. It is therefore strongly recommended that the relevant authorities in the country should as much as possible endeavor to introduce strategies that would serve to stem the current and persistent depreciation of the naira exchange rate so as to make monetary policy effective in the control of inflation.

iv. Output levels assumed a steady increasing dimension. In some cases higher than 6 per cent during the period covered by this research study. As a result of this high intermediation figures, only the government was able to disburse credit and facilitate contracts. The private sector and multinationals -the globally perceived sector that leads economic development efforts - were crowded out of the credit market. This is a clear sign of monetary policy ineffectiveness which was noticed to be inimical to output and economic development.

Therefore, it is strongly recommended that the Central Bank of Nigeria should, as a matter of urgency and deliberate policy, reduce its current seemingly high monetary policy rate (i.e. the rate at which the Central Bank of Nigeria lends money to the deposit money banks (DMBs). Stabilize the increasing rates of exchange and seek reasonable means to adjust the lending rate to manifest visible monetary policy effectiveness.

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