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# Monetary Policy Shocks and Output Growth in Nigeria: Which Shocks are more Important?

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## Abstract

**Purpose:** Recognizing the importance of effective policymaking requires an understanding of Monetary Policy Shocks and Output Growth in Nigeria. The purpose of the paper is to examine how interest rate and exchange rate channels of the transmission mechanism affect output growth in Nigeria in response to monetary shocks.

**Methodology:** The structural vector autoregression method is the empirical model. In the empirical analysis, quarterly data from 2000 to 2020 were used for the gross domestic product, nominal effective exchange rate, consumer price index, monetary policy rate, and open buyback.

**Findings:** The results of the impulse response function showed that in Nigeria, monetary policy shocks are more significant because they have a long-lasting impact on growth up to the sixteenth quarter of the forecast horizon.

**Originality/value**: The study's conclusions would enable Nigerian policymakers to anticipate consequences of monetary policy shocks through indirect demand-side Keynesian monetary policy transmission mechanism through the channels of exchange and interest rates. The study recommends that to move the economy toward pre-determined directions, monetary authorities should be cautious of the level/quantity of money in circulation rather than focusing on increasing or decreasing the monetary policy rate.

## Introduction

One of the mandates of central banks around the world is to ensure price stability, and monetary authorities' ability to achieve the right levels of prices suitable for growth is dependent on the effectiveness of the monetary policy instruments they employ. Economic models in advanced countries focus on central bank activities to recognize a response action for the monetary authorities in those economies, whereas central banks in emerging and developing countries do not receive the same consideration due to the misconception that they were established with the primary goal of financing the government deficit. (Kandil, 2014). Studies have shown that monetary policy has a greater influence on economic activity in developing countries than fiscal policy (including Nigeria), and that monetary policy actions should be given more weight. (Olayiwola, 2019).

Over time, the presence of macroeconomic shocks has been a discourse to monetary authorities and researchers as they seek to recognize their real effects on economy. Several episodes of macroeconomic shocks have succeeded in destabilizing the emerging economies with the recent COVID-19 Pandemic crippling global economic activities and have led to a contraction of global economic growth as countries-imposed restrictions to mitigate the way the Virus spreads across countries. During the pandemic, global oil prices came to their lowest in 2020 and jettisoned the efforts of the economy's pre-pandemic (OECD, 2020). Oil crisis, exchange rate volatility, capital flight, and sudden commodity price crashes are a few cases of external shocks that have the potential to influence output growth and create raising inflation in emerging economies and Nigeria. Nigeria has the largest economy in Africa, but on a global scale, the country can be measured as a small-open economy with a robust predisposition to respond to macroeconomic shocks globally. (Oyelami and Olomola, 2016).

Numerous observations advocate that global liquidity has a significant impact on international financial conditions, and that liquidity expansions in one financial institution can impact on financial conditions in another institution (Sousa and Zaghini, 2007). The effect of shock from global economy on emerging markets and developing economies such as Nigeria is heavily influenced by fluctuations in the currencies of the major economic powers like the United States (Adeoye and Saibu, 2014). Expansionary monetary policy shocks in the United States lower domestic and global interest rates,

weaken the local currency (the US dollar), and boost domestic investment, consumption, and production (Vargas-Silva, 2008). Reduced global real interest rates and nominal depreciation of the US currency translate into a drop in local terms of trade: both variables promote foreign consumption as well as investment. The rise in world output caused by demand enhances wellbeing in both nations (aggregate demand externality), raising stock prices and output both locally and internationally.

On other hand, there are domestic macroeconomic shocks that are generated due to the action of monetary policy or, to some extent fiscal policy action (Mountford and Uhlig, 2009). Therefore, although there are significant changes in output and inflation as a result of domestic shocks, empirical literature demonstrates that external shocks account for output fluctuation and inflation changes.

So, the paper aims to investigate the effect of monetary policy shock on output growth in the Nigerian economy through interest rate and exchange rate transmission channels. Notwithstanding, the study adopts newly identified method of imposing the structural restriction. Thus, SVAR and the recently introduced method of shock identification will be employed in analyzing the transmission channels of monetary policy in an all-inclusive context.

The study is structured as follows: in Section 1, the study's hypotheses, monetary shocks, and transmission mechanism are proposed; in Sections 2 and 3, the methodology, including a description of the data, is presented; and in Section 4, the analysis's conclusions are offered.

## Literature Review

### Monetary Transmission Mechanism and Monetary shocks

In small open economies the Investment-Saving (IS), Liquidity-Money (LM) and Balance of Payments (BP) curves may be relatively inelastic, thereby rendering both monetary and fiscal policies ineffective for stabilization purposes (Baksh and Craigwell, 1997). In this vein, evaluating the Monetary Transmission Mechanism (MTM) channels is crucial for policymakers to determine the effects of any action made. The process through which adjustments to monetary policy tools, such as monetary aggregates or short-term policy interest rates, influence aggregate demand and then inflation in an economy is known as the monetary transmission mechanism (Mukherjee and Bhattacharya, 2015). The

efficiency of the monetary transmission mechanism is a critical factor in determining how successful monetary policy will be (Mukherjee and Bhattacharya, 2015). Interest rate, credit, exchange rate, and other asset price impacts are the four (4) channels of monetary transmission described by Mishkin (1995).

In the economic theoretical framework, the Keynesian theory of monetary policy describes how monetary policy affects the economy and specifies four ways in which central banks' monetary policy decisions have an impact on it. Keynesians contend that the transmission mechanism of monetary policy causes the money supply to have an indirect impact on production and the overall price (Kelikume, 2014). According to the Keynesian perspective, a discretionary adjustment in monetary policy has an impact on the actual economy through the supply and demand sides of the market (Saibu and Nwosa, 2012). Demand-side monetary policy transmission can occur directly through the three channels of wealth, interest rates, and exchange rates or indirectly through the two channels of bank credit, bank lending and balance sheet. Worrell (1996), opined that the supply side formulation of the monetary transmission mechanism promotes the use of interest rate impacts on inventory carrying costs and other overhead as a route of influence. (Baksh and Craitgwell, 1997).

Across the developing economies, trend out output growth increases with the output response to monetary shocks (Kandil, 2014). For BRICS countries, while interest rates have a little impact on the exchange rate and money supply contributes significantly to exchange rate changes, variations in the exchange rate have the greatest impact on industrial production. (Kutu and Ngalawa, 2016). Because uncertainty shocks can easily give rise to co-movement with countercyclical markups arising from sticky prices, monetary policy is the most effective approach through which to offset the negative impact of uncertainty shocks, albeit during normal times (Basu and Bundick, 2017).

## Hypotheses Development

Policymakers in a country that implement macroeconomic stabilization measures must consider the impact of monetary policy shock transmission on the production of the economy. Decision-making in this field depends heavily on the routes via which shocks are propagated. Numerous studies have examined the ways that monetary policy in Nigeria is transmitted and how it affects the economy. According to empirical analyses of research, monetary policy is transmitted to the economy through a variety of channels,

including interest rates, credit channels, and currency rates (Uma, K., Ogbonna, B., & Obidike, P.) (2015). Adofu and Salami (2017) looked at the impacts of monetary policy shocks on a few chosen macroeconomic variables in Nigeria, while Ogunrinola (2019) studied the effects of monetary policy shocks on the economy.

The presence of a bank lending channel in the dissemination of monetary policy in Nigeria was examined by Ebire and Ogunyinka (2018). Similar to Ndekwu (2013), who discovered that the credit channel in the financial market, which provides credit supply and accessibility to the private sector, acts as a linchpin in the process by which monetary policy is transmitted to the real economy, is the most effective of all the channels. However, it seemed as though the actual economy was only marginally affected by interest rate and exchange rate channels. In contrast, Adekunle et al. (2018) investigated the most popular medium to be exchange rates. It is consistent with Ajayi's (2007) findings that the interest rate and credit channels were weak throughout the time period in Nigeria, whereas the exchange rate channel was highly robust. Saibu and Nwosa also conducted a thorough investigation of the pathways via which monetary policy impulses were transmitted to sectoral output growth (2012). The findings revealed that the exchange rate channel was most efficient at conveying monetary policy to the building/construction, mining, service, and wholesale/retail sectors while the interest rate channel was most effective at doing so to the agricultural and manufacturing sectors. The analysis came to the conclusion that the best monetary policy tools for promoting sectoral output development in Nigeria were interest rate and exchange rate policies. In this vein, Ishioro (2013), Obafemi and Ifere (2015), came to the conclusion that three channels—the interest rate, exchange rate, and credit channels, are operational in Nigeria, and it is suggested that the exchange rate and interest rate channels should serve as the cornerstone for inflation targeting in that country.

However, by keeping other channels through which changes in monetary aggregates influence output and prices constant, Kelikume (2014) examined the interest rate channel of monetary transmission in Nigeria to determine the stickiness or otherwise of interest rate in achieving the goals of macroeconomic policy. This is particularly troubling in light of recent research by Bernanke and Gertler (1989), which suggests that mechanisms other than the interest rate channel may be to blame for the wide variation in interest elasticity of consumption and interest elasticity on investment that affects an

economy's output and price changes. In this light, Adeoye and Shobande (2017) examined the impact of the interest rate channel of the monetary transmission mechanism on the real economy variables and came to the conclusion that manipulation of the money supply, expected inflation, real interest rate, and exchange rate is necessary for Nigeria's monetary policy to be effective.

On other hand, as a channel of the monetary transmission mechanism in Nigeria, bank assets were studied by Ogbulu and Torbira (2012) for the nature of their effects on them as well as their receptivity to shocks resulting from the monetary variables. This may be a result of the public's poor banking practices and the prevalence of the informal financial system, which allows the majority of people to save, lend, and borrow money, or it may be a sign of the interest-insensitive nature of financial intermediation in an emerging economy like Nigeria.

Theoretically, the relationship between changes in the money supply and the nominal interest rate and the economy is through the impact of the interest rate on total production and prices (Kelilume, 2014b). In particular, Olayiwola and Ogun (2019) used interest rate shocks to examine the asymmetric impact of positive and negative monetary policy shocks on production and prices in Nigeria. Furthermore, the interest rate channel communicates internal/domestic shocks that have an impact on output, whereas the exchange rate channel conveys outward shocks. Similar to developed nations, emerging nations depend on the success of monetary policy to manage exchange rates, maintain competitiveness, and anchor inflationary expectations toward attaining macroeconomic stability (Kandil, 2014).

Extensive body of literature examined, demonstrates that the monetary policy affects macroeconomic variables through transmission mechanisms. There are few studies on whether the monetary policy rate (anchor rate) has any significant effect on the economy or not. This is important considering the fact that the country had to deal with two periods of recession 2016 and 2020 as well as the COVID-19 Pandemic. Hence, by confirming Chuku (2009) finding that monetary policy shocks have minimal influence on output in Nigeria, this study aims to close this gap and also introduce sign restrictions as to the system for the identification of structural shocks.

In view of the literature reviewed, we developed the following hypotheses:

H1. Monetary policy shocks have a significant influence on output growth through the interest rate channel of transmission mechanism.

H2. Monetary policy shocks have a large effect on output growth via the exchange rate channel of the transmission mechanism.

## Research Methodology

### Empirical Model

According to empirical investigations, there are numerous research papers that employed the SVAR model to analyze the effects of the financial shocks on developed, emerging, and developing economies. Primarily, whereas simultaneous equation models are better suited for policy simulations, Gottschalk (2001) opined that a theoretical component of the SVAR technique, which analyzes the dynamics of a model by submitting it to an unanticipated shock, is worth noting. Balke and Emery (1994), and Blanchard and Perotti (2002) made use of different forms of the SVAR model to describe the relationship between macroeconomic variables. A statistical model of this type links each variable to its previous values for all other variables and to an error term that accounts for unexplained changes (Van Zandweghe, 2015). Mumtaz and Theodoridis (2015) empirically explored transmission channels of the unpredictability of shocks to real economic activities of U.S on the UK economy. Liu et al. (2011) estimated the transmission of international shocks to the UK using a time-varying factor augmented VAR (FAVAR).

Cesa-Bianchi et al (2011) quantified by employing GVAR how the rising importance of China in world trade affects the transmission of shocks across Latin American countries. Cross et al (2018) estimated the effects of domestic and international sources of macroeconomic uncertainty in three inflation targeting countries of "Canada, Australia and New Zealand" by means of large panel of flexible Bayesian Vector Autoregressive model with a mutual stochastic volatility in its mean component. Atabaev and Ganiyev (2013) applied VAR model to examine the impact of monetary policy transmission on real output and price levels in the Kyrgyzstan.

Sugiarto (2015) examined the importance of the impact of Indonesian monetary policy on domestic macroeconomic variables using a structural model for the short and long terms that is part of an SVAR model. Huang et al. (2018) utilized Structural Vector Autoregression (SVAR) to examine spillovers of macroeconomic uncertainty between the

U.S. and China. Aastveit et al (2017) investigated the potential impact of economic uncertainty on macroeconomic influence of monetary policy, using SVAR, and found that shocks from the U.S monetary policy tend to have less effect on economic activities during high uncertainty. Van Zandweghe (2015) employed SVAR to examine the dynamic responses of labor efficiency and other macroeconomic variables to shocks in monetary policy.

## Data Analysis

The paper examines Monetary Policy Shocks and Output Growth in Nigeria using quarterly time series data from 2000 to 2020. The data set included the following variables:

- GDP (Gross Domestic Product);
- NEER (Nominal Effective Exchange Rate);
- CPI (Consumer Price Index);
- MPR (Monetary Policy Rate);
- OBB (Open Buy Back).

The data statistics were taken from the Annual Statistical Bulletin of the Central Bank of Nigeria (CBN) and the data set of National Bureau of Statistics (NBS).

The Structural Vector Autoregressive (SVAR) Model was used to identify between macroeconomic shocks and output growth which shocks are important in Nigeria through interest and exchange rate channels of transmission mechanism. SVAR methodology is built from the reduced form standard VAR (Trenkler et al., 2008) given below;

$$A_0 Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_P Y_{t-P} + \varepsilon_t \qquad (1)$$

$$E = (e_t e_t^I) = \Sigma \qquad (2)$$

where $Y_t$ is a vector of n endogenous variables, Ai the coefficient matrices, $e_t$ the error terms, and Σ the covariance matrix of the errors. Though, the reduced form VAR above does not allow for connections between variables to exist in the present as required by economic theory rather it allows for only arbitrary lag lengths as the error term from the convention VAR is likely to be correlated.

Amisano and Giannini (1997), Martin, et al. (2013) suggests that the SVAR converts VAR mistakes or errors into uncorrelated structural shocks by using extra identification constraints and estimate of structural matrices.

We begin our specification of the SVAR below as;

$$AY_t = A_1^s Y_{t-1} + A_2^s Y_{t-2} + \ldots + A_p^s Y_{t-P} + Bu_t \quad (3)$$

Where $A_0$ *and* $A_i^s$ are structural coefficients and $\varepsilon_t$ is the othornormal unobserved structural innovation with $E = (u_t u_t^l) = I_k$. The equation is rewritten to capture the link between the reduced form VAR and the SVAR. this is done with the assumption that A is invertible.

$$Y_t = A^{-1}A_1^s Y_{t-1} + A^{-1}A_2^s Y_{t-2} + \ldots + A^{-1}A_p^s Y_{t-P} + A^{-1}Bu_t$$

$$= A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_P Y_{t-P} + \varepsilon_t \quad (4)$$

The reduced form matrices $A_i = A^{-1}A_1^s$ and the reduced form structural error is given by;

$$\varepsilon_t = A^{-1}Bu_t = Su_t \quad (5)$$

$$E = (e_t e_t^l) = \Sigma = A^{-1}BB^I AA^{-1^I} = SS^I \quad (6)$$

Where $S = A^{-1}B$.

The matrices are not recognized until further limitations are utilized since the SVAR estimate assumes that there are only $k(k+1)/2$ moments in Σ and more than $k(k+1)/2$ elements in $A$ *and* $B$ or $S$. This is a problem faced with its estimation. Hence, the Cholesky Identification Strategy is adopted.

## The Cholesky Identification

A widespread procedure of identification which satisfies the order condition is to set $A = I$ and B to a minor triangular matrix with the exception of the entries above the diagonals to be replaced with zeroes hence placing $N_2$ restrictions on A and N(N-1)/2 limitations on B. This results to;

$$BB^I = \Sigma \quad (7)$$

The description above represents the Cholesky identification for the reason that matrix B is gotten through taking a Cholesky breakdown of Σ. Similarly, we can set B=1 and A to be a lower triangular. These methods impose a causal ordering on the variables in the sense that shocks to one equation contemporaneously affects variables below the equation and not variables above it except with a lag. Hence, with respect to exogeneity

of shocks, ordering of variables in Cholesky identification is important as rearranging the variables will rearrange/alter the entries in Σ which in turn will produce different B matrices. The sequence of the variables determines the impulse responses.

To determine which shocks are more important between monetary shocks and output growth, we use the direct channels of interest and exchange rates in writing the matrices by following theoretical framework of Keynesian demand side monetary policy transmission mechanism.

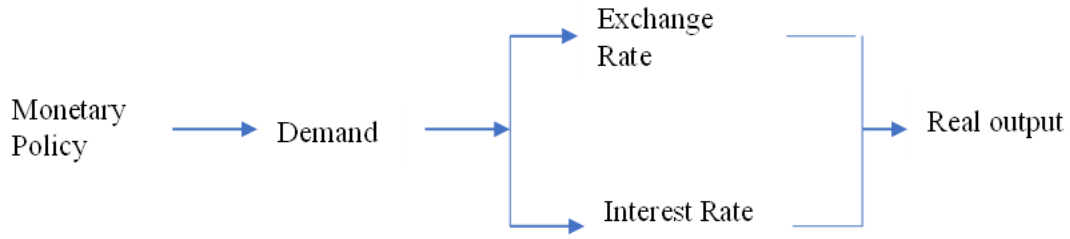


*Figure 1. Indirect Channels of the Keynesian Demand-side Transmission Mechanism of Monetary Policy (exchange and interest rates)*

For the channel of interest rate, we use the ordering as follows: Monetary Policy Rate (MPR), Consumer Price Index (CPI), and Gross Domestic Product (GDP) and then specify our matrices below.

Interest Rate Channel

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ -\alpha_{21}^{0} & 1 & 0 & 0 \\ -\alpha_{31}^{0} & -\alpha_{32}^{0} & 1 & 0 \\ -\alpha_{41}^{0} & -\alpha_{42}^{0} & -\alpha_{43}^{0} & 1 \end{bmatrix} \begin{bmatrix} e_t^{MPR} \\ e_t^{OBB} \\ e_t^{CPI} \\ e_t^{GDP} \end{bmatrix} = \begin{bmatrix} \sigma_1 & 0 & 0 & 0 \\ 0 & \sigma_2 & 0 & 0 \\ 0 & 0 & \sigma_3 & 0 \\ 0 & 0 & 0 & \sigma_4 \end{bmatrix} \begin{bmatrix} U_{1t} \\ U_{2t} \\ U_{3t} \\ U_{4t} \end{bmatrix} \quad (8)$$

Using the ordering (MPR, OBB, CPI, GDP), shocks to the Monetary Policy Rate (MPR) equation affects all other variables contemporaneously but shocks to Open Buy Back (OBB) does not affect MPR contemporaneously while shocks to Gross Domestic Product (GDP) and Consumer Price Index (CPI) affects neither MPR, OBB nor CPI contemporaneously.

Exchange Rate Channel

$$\begin{bmatrix} 1 & 0 & 0 \\ -\alpha_{21}^{0} & 1 & 0 \\ -\alpha_{31}^{0} & -\alpha_{32}^{0} & 1 \end{bmatrix} \begin{bmatrix} e_t^{MPR} \\ e_t^{EXR} \\ e_t^{GDP} \end{bmatrix} = \begin{bmatrix} \sigma_1 & 0 & 0 \\ 0 & \sigma_2 & 0 \\ 0 & 0 & \sigma_3 \end{bmatrix} \begin{bmatrix} U_{1t} \\ U_{2t} \\ U_{3t} \end{bmatrix} \quad (9)$$

For the exchange rate channel, the variables are ordered as follows; (Monetary Policy Rate (MPR), Nominal Effective Exchange Rate (NEER), and Gross Domestic Product (GDP)), shocks to the MPR equation affects all other variables in the equation contemporaneously while shocks to Nominal Effective Exchange Rate affects the NEER equation and GDP contemporaneously but not MPR. Finally, shocks to GDP only affects the GDP equation.

Finally, following intuition from economic theory, sign restrictions were imposed on each of the model above which results to;

Interest Rate Channel

$$\begin{bmatrix} e_t^{MPR} \\ e_t^{OBB} \\ e_t^{CPI} \\ e_t^{GDP} \end{bmatrix} \begin{bmatrix} \times & + & + & + \\ \times & \times & + & + \\ \times & \times & \times & + \\ \times & \times & + & + \end{bmatrix} \begin{bmatrix} U_{1t} \\ U_{2t} \\ U_{3t} \\ U_{4t} \end{bmatrix} \quad (10)$$

Exchange Rate Channel

$$\begin{bmatrix} e_t^{MPR} \\ e_t^{EXR} \\ e_t^{GDP} \end{bmatrix} \begin{bmatrix} \times & + & \times \\ \times & \times & + \\ \times & \times & + \end{bmatrix} \begin{bmatrix} U_{1t} \\ U_{2t} \\ U_{3t} \end{bmatrix} \quad (11)$$

SVAR model was chosen for this paper because it relies on economic theory to determine the current relationship between the model's components. Again, it allows for imposition of an ad-hoc structure that will prevents researchers from reaching wrong conclusions.

The variables were logged/transformed to get around the unit root issue. Hence, the data generating process of the variables used in the study were subjected to standard transformation process. Again, the ideal lag duration for the model was determined using the Akaike Information Criterion (AIC).

The paper will be subjected to typical SVAR model checks while the result of shocks that are mutually (or not) associated will be examined using the impulse response function and forecast error variance decomposition, as well as the dynamic reaction of the variables to shocks of one standard deviation. Additionally, the Forecast Error Variance

Decomposition will be used to break out the role that shocks play in explaining changes in macroeconomic variables by looking at the forecast mean squared error over a range of time horizons.

## Findings and Discussion

### *Stationarity Test*

To prevent the suspicious regression difficulties, we first assessed the stationary of all variables using enhanced Dickey-Fuller and Phillips-Perron tests. The unit root test above showed that variables in the model CPI, EXR_I, GDP, MPR and OBB exhibits a mixed order of integration and thus, contains a unit root i.e. at level and the first difference, they are all non-stationary. Hence, for each of the variables in our investigation, we accept the null hypothesis. Though, the variables were at 5% significance level, made stationary at first difference. Thus, the basis for estimating the SVAR model.

*Table 1. Result of the Unit Root Test.*

| **TABLE FOR (PP) UNIT ROOT TEST** | | | | | | |
|---|---|---|---|---|---|---|
| | **Levels** | | | | | |
| | | CPI | EXR_I | GDP | MPR | OBB |
| With Constant | t-Statistic | 8.6797 | 0.4960 | -0.5536 | -1.9684 | -5.4722 |
| | ***Prob.*** | ***1.0000*** | ***0.9856*** | ***0.8739*** | ***0.3001*** | ***0.0000*** |
| | | n0 | n0 | n0 | n0 | *** |
| | | | | | | |
| | **At First Difference** | | | | | |
| | | d(CPI) | d(EXR_I) | d(GDP) | d(MPR) | d(OBB) |
| With Constant | t-Statistic | -4.5980 | -6.1009 | -8.9361 | -8.0739 | -14.2033 |
| | ***Prob.*** | ***0.0003*** | ***0.0000*** | ***0.0000*** | ***0.0000*** | ***0.0001*** |
| | | *** | *** | *** | *** | *** |
| | | | **TABLE FOR (ADF) UNIT ROOT TEST** | | | |
| | **At Level** | | | | | |
| | | CPI | EXR_I | GDP | MPR | OBB |
| With Constant | t-Statistic | 2.4452 | -0.1417 | -0.6276 | -1.8437 | -5.3936 |
| | ***Prob.*** | ***1.0000*** | ***0.9404*** | ***0.8576*** | ***0.3571*** | ***0.0000*** |
| | | n0 | n0 | n0 | n0 | *** |
| | | | | | | |
| | **At First Difference** | | | | | |
| | | d(CPI) | d(EXR_I) | d(GDP) | d(MPR) | d(OBB) |
| With Constant | t-Statistic | -5.3530 | -6.2513 | -8.9094 | -8.0813 | -10.5399 |
| | ***Prob.*** | ***0.0000*** | ***0.0000*** | ***0.0000*** | ***0.0000*** | ***0.0001*** |
| | | *** | *** | *** | *** | *** |
| * One-sided p-values from MacKinnon (1996). | | | | | | |

To get around the unit root issue, the variables were converted. For SVAR estimation, Alkaike Information Criteria (AIC) Lag Length of 1 was chosen (Table 2).

### *Table 2. Lag Order Selection Criteria of the VAR.*

VAR Lag Order Selection Criteria
Endogenous variables: MPR OBB INF LGDP EXR
Exogenous variables: C
Date: 09/21/21 Time: 07:45
Sample: 2000Q1 2020Q4
Included observations: 78

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -1018.324 | NA | 171049.9 | 26.23909 | 26.39016 | 26.29957 |
| 1 | -784.3765 | 431.9039* | 807.2126* | 20.88145* | 21.78788* | 21.24431* |
| 2 | -769.0787 | 26.28093 | 1043.462 | 21.13022 | 22.79200 | 21.79546 |
| 3 | -752.1877 | 26.85229 | 1310.654 | 21.33815 | 23.75528 | 22.30577 |
| 4 | -732.6673 | 28.52992 | 1567.595 | 21.47865 | 24.65114 | 22.74865 |
| 5 | -714.7011 | 23.95488 | 2002.236 | 21.65900 | 25.58685 | 23.23139 |

* 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

The AIC was chosen because it has the smallest figure in the VAR estimation when compared to the other lag criterion. Hence, it produces more efficient lag.

## Result of the Impulse Response Function (IRF).

### *Interest Rate Channel*

As seen in Figure 2's result of the impulse response function, a one standard deviation shock to monetary policy rate (MPR) will lead to an initial increase of about 0.84 per cent in interest rate, although statistically insignificant. However, after the initial period, an expansionary monetary policy will cause interest rate to fall and to be statistically significant up to the seventh quarter (hypothesis 1 is confirmed). This means that if money supply increases this will stimulate investment activities and effect on bonds market which implies that cost of borrowing will fall as there are too much money in circulation. The immediate impact on inflation is that due to the initial effect of expansionary monetary policy, inflation rises but because the cost of borrowing falls, inflation falls drastically in response to it. However, after the second quarter, the effect of the shock fizzles out. In this line, the effect of the falling cost of borrowing causes GDP to

fall as inflation falls, production activities reduce resulting to a fall in GDP although not at a drastic rate as there may still be some investment activities. The effect seems to fizzle out after the seventeenth quarter of the forecast horizon.

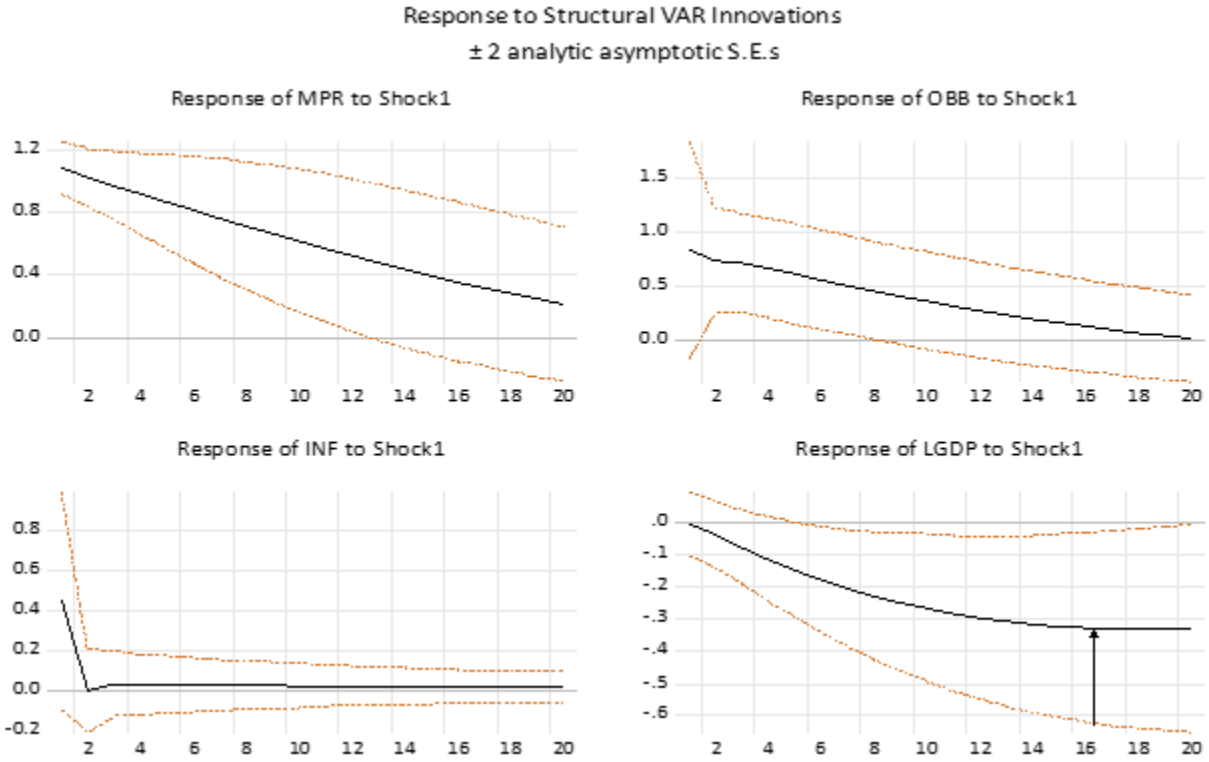


*Figure 2. Structural Impulse Response to Monetary Policy*

Following Keynesian view, the money neutrality theory as opined by Sims (1992) in a simplest term says that monetary variables affect macroeconomic variables only in the short run. Arguments against this theory exist as Fisher and Seater (1993) and James Bullard (1999), reveal contrasting results stressing that macroeconomic factors are impacted by monetary variables both immediately and over time. The study results are in consonant with the propositions by Fisher and Seater (1993), as it found evident against the short run effect of monetary neutrality by Sims (1992) because Monetary Policy shock transmitting through OBB which is a short-term instrument seems to have a lasting effect on GDP[1]. Therefore, Money disruptions have substantial practical consequences that extend longer than real business cycle models imply (Habimana, 2019).

[1] *The do-file for the analysis is available on request as the generated VAR results can also be obtainable on request. All SVAR model estimation & diagnostics test were carried and results obtainable.*

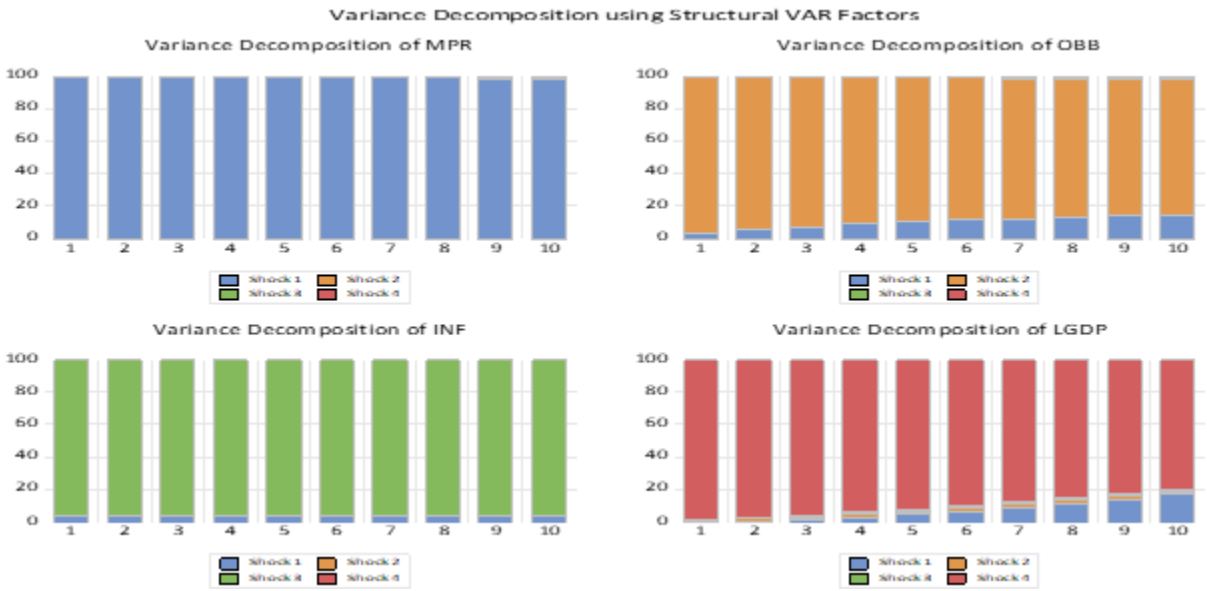


*Figure 3. Forecast Error Variance Decomposition*

The impact of each kind of shock to the prediction error variance of an endogenous variable is shown in the forecast error variance decomposition in (figure 3). Hence, it is expected that at the initial period, the series will account for all variations and if the other variables are truly endogenous, they are expected to account for variation in the model.

Up until the tenth (10th) quarter, the majority of the fluctuation is explained by the monetary policy rate. The responses from the other variables are relatively low in explaining the Policy Rate. The variation in Monetary policy rate explained by the open buy back (OBB) is 1.1 per cent and 2.1 per cent in the second and tenth quarters respectively. The variation of MPR explained by Inflation (INF) is 12.4 per cent and 12.3 per cent in the second and tenth quarter separately while the variation of MPR explained by output (GDP) is 3.25 in the second quarter and 169 per cent in the tenth quarter of the forecast horizon.

Based on the results of the forecast error variance decomposition, it is obvious that the GDP's susceptibility, which is the real indicator of economic activity, may be responsible for a sizable percentage of Nigeria's economy's volatility following a shock to the monetary policy.

### *Exchange Rate Transmission*

In this analysis, the study assesses the form of the endogenous economic variables' impulse responses. (Exchange Rate Transmission Channel).

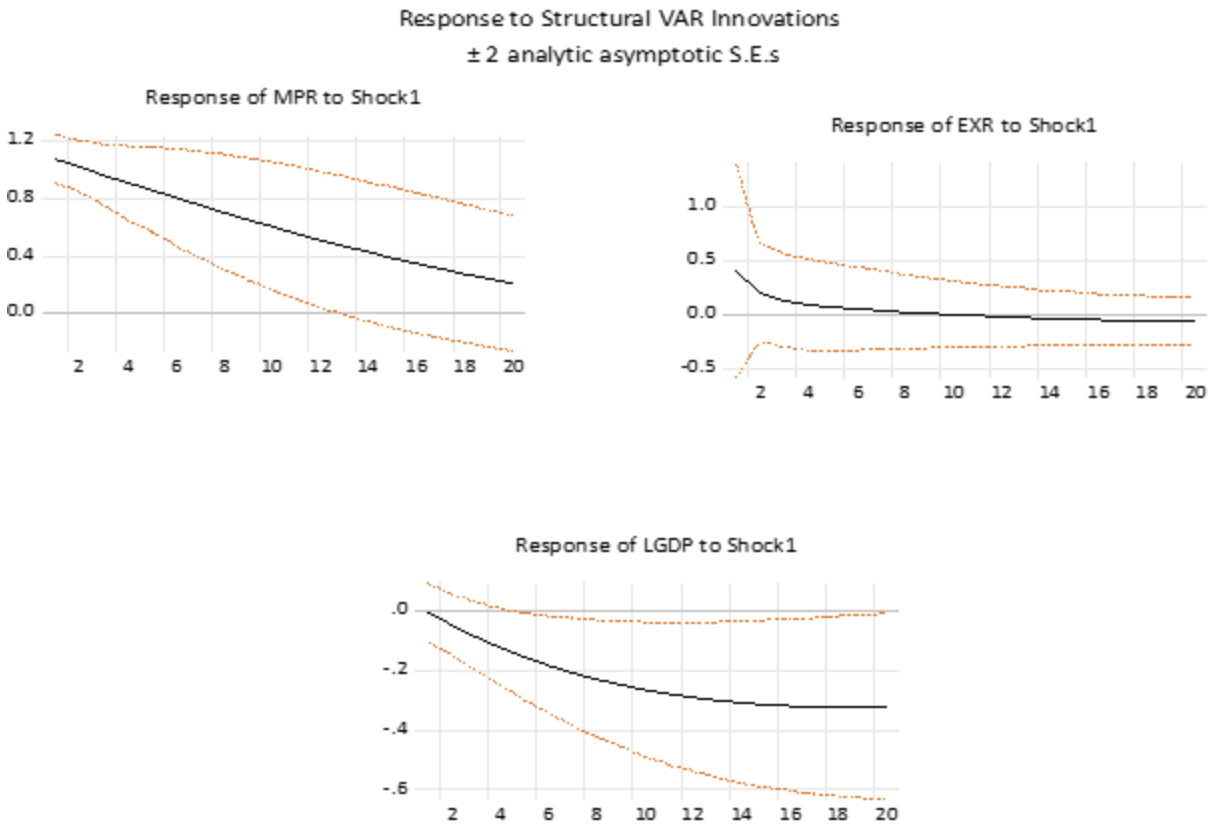


*Figure 4. Structural Impulse Response to Monetary Policy*

The study can infer information about the dynamic reactions of each component vector of the endogenous variables from the plots of the responses of the major macroeconomic variables (figure 4). Using the exchange rate channel, a one standard deviation shock to the monetary policy rate will initially cause the exchange rate to increase by around 0.41%, however this increase is statistically insignificant. After the first period of the prediction horizon, the influence starts to fade. Up until the sixteenth quarter (of the 20$^{th}$ horizon), the effect of the monetary policy shock on GDP is still noticeable (hypotheses 2 is confirmed).

The immediate impact on output growth is transient as it is not different from zero, negative and statistically insignificant. As a result, a one standard deviation in monetary policy will initially cause the GDP to drop by around 0.01 per cent.

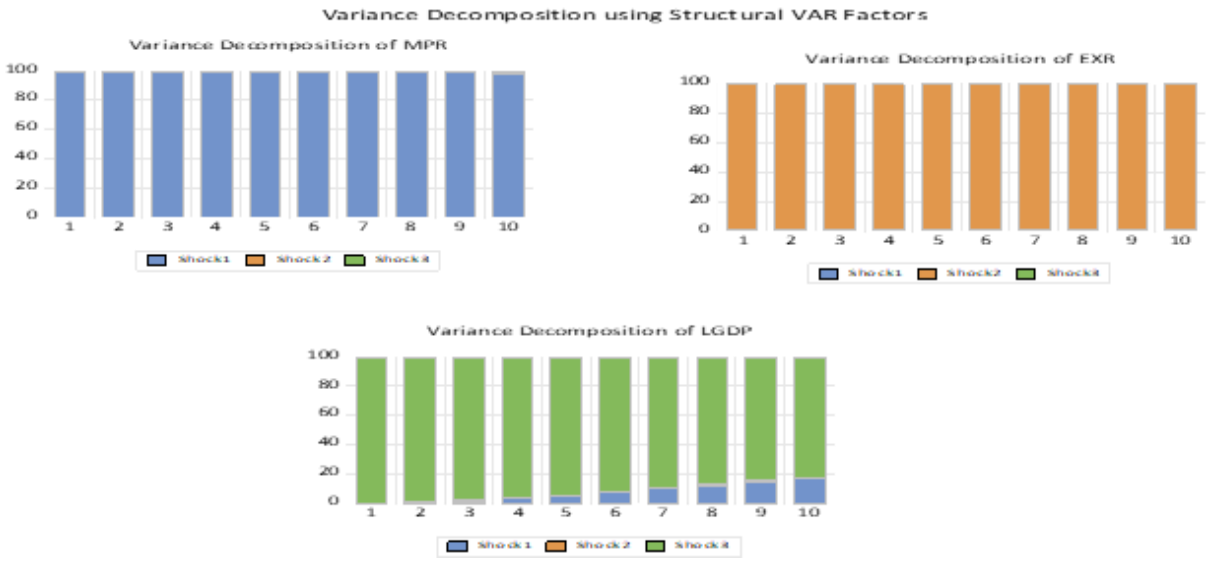


*Figure 5. Forecast Error Variance Decomposition*

Estimates of the forecast error variance decomposition with shock to the monetary policy rate under the exchange rate channel are shown in Figure 5. As the time spans go farther into the future, we may observe that the contribution of the GDP becomes significant in the economy while exchange rate remains insignificant. This could be justifiable as exchange rate is exogenously determined and the MPR does not exert a major impact on it.

From figure 5, it can be seen that at the initial forecast horizon, the role of GDP can be strongly felt by the economy as the variation in MPR explained by GDP is 3.6 per cent at the initial period, although marginal, but exact greater influence in the economy than exchange rate. Its contribution remained strong in the economy till the last end of the forecast error.

## Conclusion and Policy Recommendation

The study revealed that monetary policy shocks is most important because it persist for the 10 periods. However, if you improve or increase the horizon using the interest rate channel, it persists onto the sixteenth quarter while the exchange rate channel persists onto the 16$^{th}$ quarter. This is justifiable because exchange rate channels are kind of external shocks while the interest rate channel are internal/domestic shocks which affects production. Although exchange rate affects production too, we can see that the interest rate in terms domestic production is more important.

Given a forecast horizon of 20 quarters, it is interesting to note that the time in which the series reverts to its mean or the effect of the shock fizzles out is shorter in the exchange rate channel (16th quarter) than in the interest rate channel (17th quarter). This is because a shock to monetary policy will result in a decline in output growth at the initial period in both the interest and exchange rate channels. This is justifiable since the effect of monetary policy shock to exchange rate is insignificant and has little impact (It is not different from zero). Therefore, policies geared towards a stabilized interest rate should be at the center of discuss for monetary authorities since shocks to monetary policy seems to persist and have lasting impact on domestic activities. A control of the monetary policy shock with appropriate use of the right policy instrument is required with strong policies to mitigate the effects of the shock persisting.

It is recommended that in order to move the economy towards pre-determined directions, monetary authorities should be cautious of the level/quantity of money in circulation rather than focusing on increasing or decreasing the monetary policy rate.

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