Impulse Response of Agricultural Performance to Monetary Policy Dynamics in Nigeria: VAR Model Analysis

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Abstract

This study investigates the impact of monetary policy shocks on agricultural performance in Nigeria from 1981 to 2021, employing impulse response and variance decomposition estimators. The impulse response results reveal that average agricultural performance responds positively to monetary policy rate initially, with a subsequent downturn, while lending interest rate shocks significantly boost performance in the short term but adversely affect it later. Liquidity ratio exhibits an initial increase followed by a decline, then a positive response for the remaining periods. Deposit money bank credit to agriculture initially elicits a negative response, followed by a steep rise and maintenance of a positive trend. Findings from the variance decomposition estimator indicate that monetary policy instruments, particularly monetary policy rate, liquidity ratio, lending interest rate, and deposit money bank credit to agriculture, collectively account for 23.79% of the total variation in agricultural performance. Monetary policy rate shock dominates with 44.35%, followed by liquidity ratio (32.64%), lending interest rate (18.78%), and deposit money bank credit to agriculture (4.32%). Recommendations include emphasizing expansionary monetary policies, easing access to credit for farmers, prioritizing affordable credit programs, and increasing budgetary allocations to the agricultural sector for sustained economic contributions.

Keywords: Monetary policy rate, lending rate, liquidity ratio, bank credit, agriculture output.

1. Introduction

The Nigerian Central Bank has implemented policies and programmes via monetary policy to stimulate economic development. However, most of these policies are characterized by discontinuity and mismanagement of resources over time (Alam and Waheed, 2006). Similarly, the high unemployment rate and poverty's prevailing problems continue despite the Nigerian government's attempts (Maku and Alimi, 2018). The Agricultural Policy was introduced in 2016 to cover the period from 2016 to 2020. The policy aimed to provide food security, encourage import substitution, create employment and economic diversification. Most of the policies and programmes were geared towards making the agricultural sector fundamental to dynamic structural effects and promote growth and development throughout the sector (Aremu *et al*., 2019).

The promotion of the agricultural sector in Nigeria is an avenue to accelerating economic development, reducing poverty and promoting broad-based growth. Oil and gas currently contribute to around 99% of exports and almost 85% of government revenue, while the employment contribution was estimated at only 4% in 2019. Exports from agriculture are negligible and accounted for an average of 0.2% of total exports in the last decade. Over the last few years, agricultural production has increased slowly. However, the growth rate in agricultural production in recent times was not enough to avoid a rise in rural deprivation. Subsequently, since the reduction of oil demand in the international market during 2016, Nigeria's economy continued its slow pace of recovery (Alimi and Yinusa, 2016); this was followed by tightening monetary measures by the Nigerian government to stabilize the economy.

The stability of the economy is an important prerequisite to ensuring sustainable development and growth. However, promoting the economy's growth rate via an improved standard of living with increased per capita consumption should be prioritized to achieve broad-based growth (Central Bank of Nigeria, 2017). The implications of monetary policy on agricultural performance have not been given adequate attention in literature, especially in connection with employment and export. However, studies have documented that monetary policy affects the economy through the money, interest rate, exchange rate, credit, asset

price and expectation channels (Edoumiekumo, MKarimo and Amaegberi, 2013).

The sector serves all other sectors in the economy especially the industrial sector and at the same time capable for generating broad based sustained growth necessary for development. It is equally fundamental to the sustenance of life and has remained the bedrock of economic development, especially in the provision of adequate and nutritious food vital for human development. More than 70% of Nigeria's population depends on agriculture, which contributes roughly 25% of GDP and 60% of non-oil exports (Ehionomen and Charles, 2012).

Monetary policy includes the selection of various monetary tools to impact the supply of money available for use to accomplish price stability, economic growth, employment and equilibrium balance of payment (Shobande and Alimi, 2016; Nwaokedibe, 2018). Monetary policy as the macroeconomic instruments with which the monetary authority of a nation controls the supply of money, frequently focusing on interest rate to advance economic growth and stability. Monetary authority forms rules directed towards the upgrade and improvement of strategy intended to guarantee optimal performance of the banking industry and furthermore to advance the macroeconomic objectives or goals (Areghan *et al*., 2018).

Monetary policy assumes significant part in accomplishing macroeconomic objective of price stability, equilibrium of balance of payment, full employment, output growth and sustainable development. These macroeconomic goals canbe accomplished either by expansionary or contractionary monetary policy. Expansionary monetary policy is generally formed to enhance the level of economic activities through the increment in money supply and decrease in monetary policy rate while contractionary monetary policy is embraced to direct the economy during boom or inflationary pressure through reduction in money supply and a reduction in the monetary policy rate (Arikpo, 2017).

This research study utilizes a Vector Autoregressive (VAR) model to assess the response of agricultural performance to monetary policy dynamics in Nigeria within the periods 1981-2021. The study illustrates the role of Nigeria's monetary policy tools in agricultural production growth and identifies the most suitable forecast model for agricultural performance. What is the reason for this? The contributions are crucial in

strategizing, guiding, and implementing a well-suited and adapted monetary policy to stimulate the increase of agricultural output. The subsequent sections of the paper are structured as follows: Section 2 examines the existing body of literature; Section 3 elucidates the data and technique employed; Section 4 outlines the findings and engages in a discussion of the results; and the final section presents conclusions and recommendations.

2. Literature Review

Past studies have examined the performance of the agricultural sector in Nigeria and the implication of different monetary policy tools with varying findings. Muroyiwa *et al.* (2014) examine the linkages between monetary policy, stock prices, macroeconomy and the agricultural sector in South Africa using a time series data from 1970 to 2011. Using the Vector Error Correction Model (VECM), the result of the estimation carried out was that inflationary shocks and the money market rate have an enormous negative impact on the performance of the agricultural GDP whereas, the manufacturing index and the stock market help to improve the agricultural GDP. The study concluded that it is imperative for South Africa's monetary policy authority and agricultural sector policy makers as well participants to carefully consider the interaction between the macroeconomic environment, agricultural sector and stock prices.

While observing the performance of the agricultural sector, Muftaudeen and Hussainatu (2014) investigate the impact of macroeconomic policies on the Nigerian agricultural output in relation to its role as a source of food supply. Time series data between 1978 and 2011 were used. The Multivariate Vector Error Correction approach was employed to examine both the short run and long run relationship between the variables of interest. The study finds a cointegrating relationship among agricultural output, government expenditure, agricultural credit, inflation, interest, and exchange rates. It was revealed that in the long run, agricultural output is responsive to changes in government spending, agricultural credit, inflation rate, interest rate and exchange rate. From the impulse response function analysis, the study found that one standard deviation on government expenditure and interest rate reduces the agricultural output thereby threatening food security in the short, medium, and long run. The variance decomposition result revealed that a significant variation in Nigeria's agricultural food output is due to changes in

exchange rate and government expenditure movements. The implication of this according to the researchers is that the imperative role played by both fiscal and monetary policy to ensure food security.

Ajudua, Ojima, and Osmond (2015) investigate the impact of monetary policies in determining the performance level of agriculture in Nigeria between 1986 and 2013. The technique of analysis employed in the study was the Ordinary Least Square (OLS) regression technique. The findings of the study revealed that there exists a relationship between monetary policy and agricultural sector performance in Nigeria with an increase in the budgetary allocation to agricultural sector, and the effective utilization of these allocated funds, an effective and prudent management of monetary policies with concessionary low interest rate to encourage investment in the sector all proffered as recommendations to improve the agricultural sector. It was therefore concluded that there exists a relationship between monetary policy and agricultural sector performance in Nigeria.

Athanasius (2017) examined the bank credits and its impact on agricultural output in Nigeria. This is because of inadequate capital which is considered as one of the major factors affecting Agricultural productivity in Nigeria and both previous and current governments in Nigeria do not seem to have harnessed properly availability of this capital to farmers and the institutions involved in its administration mostly the banking sector. The study employed Ordinary Least Square (OLS) and Error Correction Modeling (ECM) as the method of analysis from which it was discovered that that apart from interest rate that has a negative but significant relationship. Also, banks' credit to agriculture, foreign exchange rate, government expenditure on agriculture and money supply has a positive and significant relationship with agricultural gross domestic product.

Michael (2017) investigates the performance of agricultural sectors with respect to its influence on the Nigerian economic growth. The study specifically investigated the causality between agricultural sector and economic growth, as well as the impact of the sector on the growth of the Nigerian domestic economy. The study carried out cointegration test, Vector Error Correction Model (VECM) and granger causality test using the variables, real gross domestic product, value of agricultural output, foreign private investment, and financial development. From the analysis

of the study, it was observed that the value of agricultural output has positive and insignificant contribution to real GDP. It was further discovered that significant causality exists between the two variables, with causality running from agricultural output to RGDP. It, therefore, implies that agricultural sector output contributed positively and insignificantly to the growth of Nigerian domestic economy.

Ekine and Nwaokedibe (2018) investigated the effect of monetary policies on agricultural output in Nigeria between 1981 and 2016. Thus, it determines the effect of money supply, prime lending rate and deposit money bank loans and credit on Nigeria's agricultural output. The techniques employed in the study were the ADF test and the Ordinary Least Squares (OLS), co-integration and ECM methods. The study found that money supply and deposit money banks' credits to agriculture are important drivers of agricultural output while inflation rate contracted agricultural output during the period covered. It was further discovered that the lending rate does not significantly influence the output of the agricultural sector. It was therefore concluded that the effectiveness of monetary policy in the agricultural sector is mirrored by the monetary aggregates and credit channels.

Iyoboyi, Okereke, and Musa-Pedro (2018)explored the role of macroeconomic policy on agricultural value chain in Nigeria using the time series data covering the period between 1980 and 2016. The study employed the autoregressive distributed lag (hereafter ARDL) bounds testing approach technique of analysis. The result of the study showed a long run a long-run equilibrium relationship was found among the variables used in the investigation. The result further showed that government expenditure and broad money supply were found to have significant positive impact on the agricultural value chain. Energy was also found to also have a direct statistically significant impact on the agricultural value chain. The study concluded that macroeconomic policy is critical to agricultural value chain in Nigeria.

Ogunrinola and Ifeoluwa (2019) examined how policy induced shocks by monetary agents impacts the Nigerian economy. Specifically, the scholar seeks to identify the actual effect of monetary policy changes, in the face of macroeconomic disturbances on real economic outcomes in Nigeria between 1980 and 2018. The study used quarterly time series data from 1980:Q1 to 2018:Q4. The econometric technique applied in the study is

the small and open-economy structural vector autoregression (SVAR). The result of the study indicated that monetary policy innovations estimated on the quantity based nominal anchor, M2, is the most significant source of variation in output and prices with a very fast speed of adjustment while other policy variables were insignificant.

Mashinini, Dlamini and Dlamini (2019) examined the effect of monetary policy on agricultural output in Eswatini using annual data for the period starting from 1980 to 2016. Using the Vector Error Correction model (VECM) approach, the study found that in the long run, agriculture GDP, exchange rate, interest rate, inflation, broad money supply, and agriculture credit have a negative effect on agriculture GDP in Eswatini. However, the study showed that the variation in agriculture GDP is largely significant caused by the lagged agricultural GDP, interest rate, exchange rate as well as inflation in the short run. The study concluded that lagged agriculture GDP, the exchange rate and interest rates are the main contributors to the variation in agriculture GDP.

Adongo *et al.* (2020) analyze the impacts that the monetary policies have on the performance of agricultural sector in Kenya using an annual data covering the period of 1981 to 2019. Ordinary least square estimation technique was employed in the study to determine the relationship between monetary policy and agricultural domestic product. The monetary policy tools selected by the researcher were broad money supply, monetary policy rates, cash reserve ratio and exchange rate. The result of the analysis showed that broad money supply has a positive influence on agricultural GDP while exchange rate displayed a negative impact on the performance agricultural sector. It was therefore concluded that the monetary policy instruments have an impact on the performance of agricultural sector in Kenya.

The reviewed literature had attempted to show evidence of the impact of monetary policy on agricultural performance. Monetary policy instruments have been shown to be a core variable in determining the level of agricultural output of a nation given the increasing role of government in the economy, especially developing countries. However, studies which have been carried out in Nigeria are very few and generally based on output. It is therefore the aim of this study to contribute to the existing literature in Nigeria, using time series data by exploring the

impact of monetary policy on agricultural performance in Nigeria between the periods of 1981 to 2021.

3. Methodology

This study built an equation that involves specifying a multiple regression equation to estimate the economic relationship between agricultural performance as the dependent variable, with agriculture gross domestic product (AGDP) as a proxy, and the independent variables which comprises of monetary policy variables (lending interest rate, liquidity ratio, monetary policy rate and deposit money bank credit to agriculture).The model is therefore expressed as:

$$\ln AGDP_t = \alpha_0 + \alpha_1 INT_t + \alpha_2 LR_t + \alpha_3 MPR_t + \alpha_4 \ln DMA_t + \varepsilon_t \qquad (3.1)$$

It is also important to note that there are other macroeconomic factors that influence the performance of the agricultural sector which include government expenditures and inflation. Integrating these, into the model and expressing it statistically, the model is therefore re-expressed as:

$$\ln AGDP_t = \alpha_0 + \alpha_1 INT_t + \alpha_2 LR_t + \alpha_3 MPR_t + \alpha_4 \ln DMA_t + \alpha_5 \ln GE_t + \alpha_6 INF_t + \varepsilon_t \quad (3.2)$$

Where: *AGDP* is the log of agricultural contribution to GDP; *INT* is the interest rate; *LR* is the liquidity ratio; *MPR* is the monetary policy rate; *DMA* is the log of deposit money bank credit to agriculture; *GE* is the log of government expenditure; *INF* is the inflation; $\propto_0$is the intercept; $\propto_{1\text{-}6}$ are the coefficient of the independent variables; *t* is time; ε is the error term.

The study adapts the unrestricted vector autoregressive (VAR) approach developed by Sims in estimating five-variable VAR models using $agdp_t, int_t, lr_t, mpr_t, ge_t, inf_t, dma_t$to provide an empirical insight on the response of agricultural performance to shocks in monetary policy in Nigeria (Sims, 1980). The model is stated as:

$$X_t = u + A_1 X_{t-1} + \ldots + A_p X_{t-p} + u_t \qquad (3.3)$$

Where: X_t is an 7×1 vector matrix incorporating $agdp_t, int_t, crr_t, mpr_t, ge_t, inf_t, dma_t$ as variables; A is a matrix polynomial for the lag operator of considered variables; and u_t is a vector of un-estimated shocks for each of the oil revenue and other controlling variables and it is

assumed to be serially uncorrelated structural disturbance for Var (u_t) = Ω. where Ω is a diagonal matrix, so the structural disturbances are assumed to be mutually uncorrelated.

Prior to the estimation of the model, the variables were subjected to the test of stationarity using the Augmented Dickey-Fuller test which uses non-parametric statistical methods to take care of the serial correlation in the error terms without adding lagged difference terms. Afterward, the co-integration test by Johansen was then employed to test for the presence of a long-run relationship among the variables. The VAR model offers several advantages. Firstly, it is compatible with the research being conducted. Secondly, there is no need to concern oneself with distinguishing between endogenous and exogenous variables, as all variables in the VAR model are considered endogenous. Additionally, the sample size is suitable for estimating the model. Lastly, the method can be applied to equations.

For this study, time series (annual) data on inflation rate, cash reserve ratio, interest rate, liquidity ratio, government expenditure and deposit money bank credit to agriculture, were obtained from the CBN Statistical Bulletin and the World Bank's World Development Indicators. The scope of the study spanned between 1981 and 2021.

4. Results and Discussion of Findings

4.1 Descriptive and Correlation Analysis

The descriptive statistics of agriculture expenditure as a ratio of GDP (agdp), monetary policy indicators monetary policy rate (mpr), lending interest rate (int), liquidity ratio (lr), deposit money bank credit to agriculture as a ratio of GDP (dma), and other controlling variables, government expenditure as a ratio of GDP (ge), and inflation rates (inf) between the year 1981 and 2021 are presented in Table 1. The summary statistic of the variables in the table shows that the average of agriculture contribution to GDP stood at 22.87%. This implies that the actual economic activities of the agricultural sector have increased and consequently improvement in income generation has also been recorded over the years as it grows at an average of 22.87%. This is also evident that the average monetary policy rate of 13% has grown from minimum value of 6% to maximum value 26%. The average annual lending interest

rate of 17.45% showed that it has a maximum rate of 31.65% and a minimum of 8.92% in Nigeria.

Table 1: Descriptive Statistics

Variables	Measurements	Mean	Std. Dev.	Max.	Min.	Kurtosis	Skewness	Jarque-Bera	Prob.
agdp	Agriculture Expenditure (% of GDP)	22.866	4.589	36.97	12.24	4.741	0.450	6.564	0.038
mpr	Monetary Policy Rate (%)	13	3.959	26	6	4.543	0.734	7.751	0.021
int	Lending interest rate(%)	17.446	4.811	31.65	8.917	3.646	0.319	1.409	0.494
lr	Liquidity Ratio	49.067	14.67	104.2	26.39	6.402	1.465	34.43	0.000
dma	Deposit Money Bank Credit to Agriculture (% of GDP)	0.593	0.223	1.004	0.163	2.189	0.114	1.212	0.546
ge	Government Expenditure (% of GDP)	8.408	2.532	17.29	5.089	5.872	1.533	30.15	0.000
inf	Inflation, consumer prices (annual %)	18.949	16.66	72.84	5.388	5.307	1.854	32.58	0.000

Note: Std. Dev. – standard deviation; Max. – maximum; Min. – minimum; Prob. – probability. Observation is 41.
Source: Author's computation (2022).

As for liquidity ratio and deposit money bank credit to agriculture sector as a ratio of GDP were 49.067 and 0.59% respectively. The maximum and minimum values of liquidity ratio were 104.2 and 26.393 whereas that of deposit money bank credit to agriculture sector as a ratio of GDP were 1.00% and 0.163% correspondingly. Concerning other co-founding factors, the mean of government expenditure as a ratio of GDP and inflation rate were 8.41% and 18.95% respectively. Meanwhile, their respective maximum values are 17.29% and 5.39%, whereas the minimum values are 5.87% and 5.31% respectively. Also, the standard deviation of the variables is low in relations to their mean values. More so, all the variables are positively skewed, implying rightward skewed variables.

Of all the variables, the kurtosis showed that average of deposit money bank credit to agriculture sector as a ratio of GDP is less than three, indicating a platykurtic form of distribution, while other variables agriculture expenditure as a ratio of GDP, monetary policy rate, lending interest rate, liquidity ratio, government expenditure as a ratio of GDP (ge), and inflation rateswere higher than three and they displayed leptokurtic form in distribution. Thus, this means that all of the variables

are not normally distributed. More so, the Jarque-Bera statistics revealed that five variables are significant at 0.05 critical values while others are not. The implication is that there is presence of outliers in the values of some variables, indicating some level of asymmetry and discreteness in the data sets.

The correlation analysis presenting the level of association between monetary policy variables and agricultural performance for the empirical analysis between 1981 and 2021 is reported in Table 2. The magnitude of the various relationships of the economic performance and overall behaviour of monetary policy variables are moderate but none of them is up to 0.8. Monetary policy indices have positive correlation with agricultural performance except deposit money bank credit to agriculture to GDP which has negative coefficient. Similarly, the level of associations between the variables of agricultural performance was reported in the table. Summarily, the correlation values suggest the absence of perfect multicollinearity among the predictive variables, as positive and negative relationships were reported among the variables of interest in varying magnitudes and signs.

Table 2: Correlation Matrix

	agdp	*mpr*	*int*	*lr*	*dma*	*ge*	*inf*
agdp	1						
mpr	0.3339	1					
int	0.5640	0.7988	1				
lr	0.0211	0.0653	-0.1897	1			
dma	-0.1369	0.4166	0.1411	-0.1015	1		
ge	0.2509	0.6665	0.6101	-0.1433	0.3501	1	
inf	0.0510	0.3608	0.3744	-0.2540	0.5088	0.2224	1

Note: agdp - agriculture output to GDP; mpr - monetary policy rate; int - interest rate; lr – liquidity ratio; dma - deposit money bank credit to agriculture; ge – government expenditure; inf - Inflation rate.
Source: Author's computation (2022).

4.2 Unit Root and Co-integration Test Results

This test is necessary to examine the stationarity level of individual variables. It indicates whether the variables are stationary or non-stationary. Shocks in stationary time series will be temporary and its effects over time eliminated as the series revert to their long run mean

values. Meanwhile, non-stationary time series contain permanent components of shocks and its means and variances depend on time. In this current study the conventional Augmented Dickey-Fuller unit root test was employed to carry out the test and the result is reported in Table 3.

So, before applying the VAR test, the study determines the order of integration of all variables using the unit root tests. The objective is to ensure that the variables are not I(2) so as to avoid spurious results. The ADF unit root tests under the conventional methods revealed the following decision on stationary level of variables of interest at varying significant levels for monetary policy rate, liquidity ratio and inflation rate which were found to reject the null hypothesis "not stationary at level" at 5% McKinnon significance levels. It shows that monetary policy rate, liquidity ratio and inflation rate stationary and integrated of order zero. However, the time series variable of agricultural performance, interest rate, deposit money bank credit to agriculture, and government expenditure were found not to reject the null hypothesis "unit root at level" but reject the null hypothesis of "unit root at first difference" at 5% significance level. This indicates that at first difference, the time series agricultural performance, interest rate, deposit money bank credit to agriculture, and government expenditure were stationary at first difference and integrated of order one.

Table 3: Conventional unit root test for the time series data, 1981 - 2021

Variables	**Level**	**First Difference**	***I*(d)**
	ADF	**ADF**	
agdp	-2.5686(3)[-3.6156]	-6.9636(1)[-3.6156]***	*I*(1)
mpr	-3.3346(0)[-2.9369]**	-	*I*(0)
int	-2.3074(0)[-3.6056]	-6.8439(0)[-3.6105]***	*I*(1)
lr	-3.5639(0)[-2.9369]**	-	*I*(0)
dma	-1.4900(0)[-3.6056]	-6.0883(0)[-3.6105]***	*I*(1)
ge	-1.8646(1)[-3.6105]	-10.1222(0)[-3.6105]***	*I*(0)
inf	-4.1023(1)[-3.5298]**	-	*I*(0)

Note: *** significant at 1%; ** significant at 5%; Calculated at trend and intercept and lag lengths selected automatically using the Schwarz Info Criterion. agdp - agriculture output to GDP; mpr - monetary policy rate; int - interest rate; lr – liquidity ratio; dma - deposit money bank credit to agriculture; ge – government expenditure; inf - inflation rate.
Source: Author's computation (2022).

The Johansen cointegration test was utilized to investigate the long-run relationship between monetary policy and agricultural performance. The VAR lag order selection criterion test and the lag exclusion Wald tests were employed to ascertain the most suitable lag length for estimating the three Johansen co-integration models. The Schwarz Information Criterion (SIC) of the VAR model system for the Johansen co-integration model indicates that a lag length of 1 is the optimal, suitable, and highly significant lag. The Johansen cointegration analysis findings are presented in Table 4. The test is employed due to its suitability for variables that exhibit stationarity at first difference.

Table 4: Johansen cointegration test of monetary policy and agriculture performance

Lags interval (in first differences): 1 to 2 **Series:** *agdp mpr int lr dma ge inf*

Trend assumption: *Linear deterministic trend*

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Hypothesized No. of CE(s)	Max-Eigen Statistic	Probability
r = 0*	0.850828	236.4673	150.5585	r = 0*	72.30095	50.59985
r ≤ 1*	0.722349	164.1663	117.7082	r ≤ 1*	48.69289	44.49720
r ≤ 2*	0.651983	115.4735	88.80380	r ≤ 2*	40.10912	38.33101
r ≤ 3*	0.566897	75.36434	63.87610	r ≤ 3	31.79763	32.11832
r ≤ 4*	0.470756	43.56671	42.91525	r ≤ 4	24.17965	25.82321
r ≤ 5	0.326397	19.38706	25.87211	r ≤ 5	15.01434	19.38704
r ≤ 6	0.108698	4.372720	12.51798	r ≤ 6	4.372720	12.51798

Note: * denotes rejection of the hypothesis at the 0.05 level. industrial growth (iy), investment (k), labour force (l), rule of law (rlw), government effectiveness (gef), control of corruption (ccn), regulatory quality (rqv), foreign direct investment (fdi), and trade intensity (ti).

Source: Author's computation (2022).

The co-integrating equation for the series is presented in Table 4. The analysis of various indicators including agriculture output to GDP (agdp), monetary policy rate (mpr), interest rate (int), liquidity ratio (lr), deposit money bank credit to agriculture (dma), government expenditure (ge), and inflation rate (inf) indicated that, at the McKinson-Haug-Michelis 5% significance level, the alternative hypotheses "r=4" and "r=2" of the Trace and Max-Eigen statistics, respectively, were not rejected. This signifies that the series, when assessed in the designated sequence, satisfy three and five cointegrating vector equations, respectively. It implies that

monetary policy and agricultural performance in Nigeria are interconnected in the long run.

4.3 Empirical Results

The section reports the findings of the impulse response function (IRF) and variance decomposition analysis (VDA) to examine the response of agricultural performance to shocks in monetary policy in Nigeria. For the estimation result, responses of shocks in monetary policy to agriculture performance were reported in this section. For this shock analyses, the considered economic variables are classified into relevant shocks as shown on Table 5.

Table 5: Classification of shocks

Shocks	Variables
Monetary Policy shocks	Monetary Policy Rate shocks Interest Rate shocks Liquidity Ratio shocks Deposit Money Bank Credit to Agriculture shocks
Fiscal Policy shock	Government Expenditure shocks
Unstable Price shocks	Inflation rate shocks

Source: Author's classification (2022).

4.3.1 Impulse Response Analysis of Agricultural Performance to Monetary Policy Changes

The contemporaneous response of agricultural performance to Cholesky one squared variances shocks exerted on itself, monetary policy rate, lending interest rate, liquidity ratio, deposit money bank credit to agriculture (*as exogenous monetary policy shocks*), government expenditure and inflation rate (*as other exogenous shocks*). This section presents findings that show the mechanism through which life expectancy responds to one-standard deviation of monetary policy shocks because of innovation distortion.

Figure 1 presents the IRF plots of average agricultural performance to monetary policy shocks in Nigeria. The IRF analysis reveals that average agricultural performance positively responds to monetary policy rate at the initial period to the fifth period, and thereafter slopes downward to the seventh period while steep for the remaining periods. Also, a one standard deviation shock to lending interest rate causes significant

increases in average agricultural performance from the first to fourth period, which later affects performance of the agriculture sector negatively for the remaining periods. As regards liquidity ratio, an increase was observed between period 1 through 3 after which it consistently declines again till period 6, and later showed an increasing response of average agricultural performance for the remaining periods in Nigeria. In the first to second period, average agricultural performance responds negatively to one standard deviation shocks exerted on deposit money bank credit to agriculture in Nigeria. Afterwards, it rises steeply through the fifth period, moves upward to the seventh periods while maintaining a steep movement for the remaining periods.

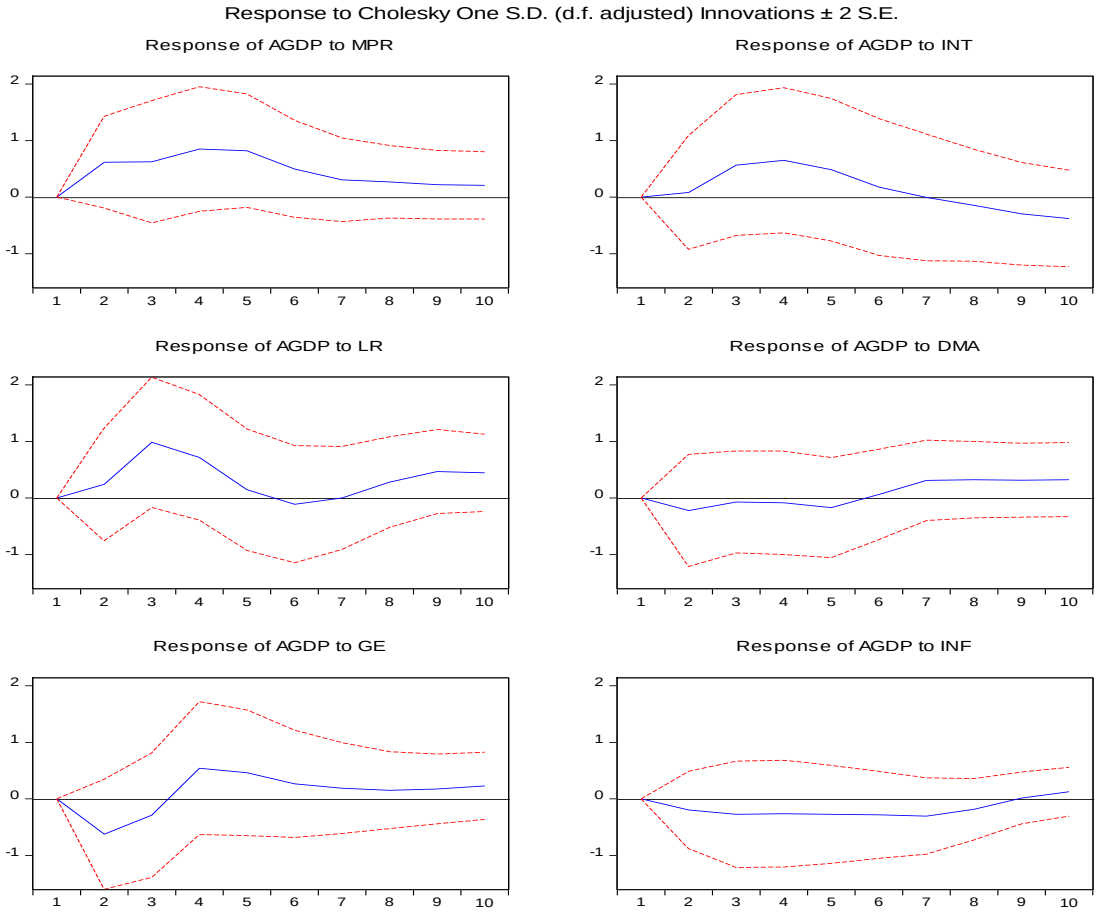

Figure 1: Impulse response graph of agricultural performance to monetary policy shocks
Source: Author's computation (2022).

The impulse response of average agricultural performance to shocks in government expenditure showed that a one standard deviation shock to government expenditure causes significant decrease in average agricultural performance for the 1st and 2nd periods after which it sharply rose through the 3rd and 4th periods. But, between 4th and 8th it declined drastically, and it sustained a steady state through the remaining periods. Also, for the response of agricultural performance to inflation rate shocks, a one standard deviation shock given to average inflation will start with decreasing inflation rate in the first period to 2nd period while remaining steep through the 3rd to 7th periods and then have an increasing slope for periods 8, 9 and 10. This implied that inflation will have negative impact on average agricultural productivity in Nigeria.

4.3.2 Variance Shocks Decomposition Analysis of Agricultural Performance Changes to Monetary Policy Shocks

This section is complementary to the previous section 4.3.1 which analyses the impulse response function of agricultural performance to one standard deviation innovation of monetary policy shocks. While, the impulse reaction functions traced the effects of a shock to one endogenous variable on the other variables in the VAR, Variance Decomposition separates the variation in an endogenous variable into the component shocks of the VAR. Thus, the variance decomposition provides information about the relative importance of each random innovation in affecting the variables in the VAR system. Table 6 show the variance regression (VAR) model and variance decomposition analysis (VDA) of agricultural performance and monetary policy shocks in Nigeria.

Also, it determines the proportion of the forecast error variance of average agricultural performance accounted for by innovations to its individual shocks, monetary policy rate shocks, lending interest rate shocks, liquidity ratio shocks, deposit money bank credit to agriculture shocks, government expenditure shock, and inflation rate shock in the unrestricted VAR model system.

The result of variance decomposition of average agricultural performance to individual innovation shocks in the VAR is presented in Table 6. Table 6 presents separate variance decomposition for each endogenous variable. The second column labeled "S.E", contains the forecast error of the variable at the given forecast horizon. The source of this forecast

error was the variation in the current and future values of the innovations to each endogenous variable in the VAR. The other columns for each of the monetary policy indices and other macroeconomic variables give the percentage of the forecast variance due to each innovation, with each row adding up to 100. Also, the forecast period of 10 years is selected but split into short-run and long-run where 1 to 5 years is considered short-run while 6 through 10 years is the future or long-run.

Table 6: Variance decomposition analysis for average life expectancy

Periods	S.E.	AGDP	MPR	INT	LR	DMA	GE	INF
1	2.592274	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	3.445698	92.23419	3.196249	0.059951	0.495393	0.410661	3.281914	0.321639
3	3.842223	81.27094	5.229924	2.224464	6.951433	0.364038	3.194026	0.765178
4	4.114983	71.66708	8.833897	4.441764	9.101274	0.360223	4.529382	1.066377
5	4.263774	66.75279	11.93033	5.434286	8.594001	0.492505	5.392504	1.403593
6	4.315805	65.15298	12.97731	5.474375	8.453232	0.502102	5.642481	1.797518
7	4.359481	64.16513	13.21544	5.365374	8.284712	1.005580	5.720999	2.242772
8	4.408721	63.23875	13.29828	5.352582	8.509750	1.517584	5.715129	2.367925
9	4.465748	61.74501	13.20265	5.654231	9.392147	1.973865	5.722901	2.309190
10	4.528400	60.07246	13.05171	6.191047	10.10242	2.432789	5.825033	2.324552

Cholesky Ordering: agdp mpr int lr dma ge inf

Source: Author's computation (2022).

In the first year, 100% forecast error is explained by the variable itself in which other variables have exogenous impact as they do not influence average agricultural performance in the short-run. This fact is also established in the vector autoregresion estimate where average agricultural performance at lag 1 accounted for highest t-statistics value. Similarly in the second period, except liquidity ratio that has a strong influence in predicting average agricultural performance in the 3rd period, its own shock still has greater influence. For the remaining periods, shocks from within has greater influence on the response of agricultural performance. In the long-run, 60.07% forecast error is explained by the variable itself indicating a moderate influence into the future, this result is confirmed in the VAR estimates in which the variables moderately influenced by agricultural performance. Looking at monetary policy, its influence rises year by year with a strong influence. Similarly, the influences of lending interest rate and deposit money banks

credit to agriculture increase in a yearly basis although their influence is weak as well as their likelihood of predicting average life expectancy in the future. For liquidity ratio, its influence is strong but the influence rises for periods 2, 3 and 4, falls through periods 5, 6, and 7, and later gains momentum for the remaining periods.

Table 7: Percentage of agricuture performance variation due to monetary policy shocks

Overall % Share of Macroeconomic Variables Shocks			
Agriculture Performance Shocks	**Monetary Policy Shocks**	**Fiscal Policy Shocks**	**Price Stability Shocks**
69.59%	23.79%	5.00%	1.62%
Overall % Share of Monetary Policy Shocks			
Monetary Policy Rate Shocks	**Interest Rate Shocks**	**Deposit Bank Money Credit to Agriculture Shocks**	**Liquidity Ratio**
44.35%	18.78%	4.23%	32.64%

Source: Author's computation (2022).

For clarity and simplicity, the variation in agricultural performance due to various shocks within and outside is decomposed into different monetary policy variables, fiscal policy indices and price stability indicators. Thus, the results of the percentage share of agricultural performance changes accounted for by the considered shocks from various monetary policy variables, fiscal policy indices and price stability indicators are presented in Table 7.

The table showed that agricultural performance shocks (shocks from itself) accounted for 60.59% of the total variation in agricultural performance in Nigeria respectively. Afterwards, monetary policy variables account for 23.79% of the total variation in agricultural performance, subsequently followed by shocks in fiscal policy (5.0%), and shocks in price stability (1.62%) respectively. Concerning the 23.79% shocks in monetary policy indicators, shocks in monetary policy rate accounted for 44.35% of the total variation in agricultural performance, followed by shocks in liquidity ratio (32.64%), lending interest rate (18.78%), and deposit money bank credit to agriculture (4.32%) respectively.

5. Conclusion

This study examines the response of agriculture performance to shocks in monetary policy instruments within the periods 1981-2021, using the impulse response and variance decomposition estimators. The result of the impulse response estimator showed that the average agricultural performance positively responds to monetary policy rate at the initial period to the fifth period, and thereafter slopes downward to the seventh period while steep for the remaining periods. Also, a one standard deviation shock to lending interest rate causes significant increases in average agricultural performance from the first to fourth period, which later affect performance of the agriculture sector negatively for the remaining periods. As regards liquidity ratio, an increase was observed between period 1 through 3 after which it consistently declines again till period 6, and later showed an increasing response of average agricultural performance for the remaining periods in Nigeria. In the first to second period, average agricultural performance responds negatively to one standard deviation shocks exerted on deposit money bank credit to agriculture in Nigeria. Afterwards, it rises steeply through the fifth period, moves upward to the seventh periods while maintaining a steep movement for the remaining periods.

As for the variance decomposition estimator, the findings showed that agricultural performance reacts more positively to monetary policy instruments such as monetary policy rate, lending interest rate, deposit money bank credit to agriculture and liquidity ratio. Statistically, monetary policy variables account for 23.79% of the total variation in agricultural performance. In the order of shocks, shocks in monetary policy rate accounted for 44.35%, followed by liquidity ratio (32.64%), lending interest rate (18.78%), and deposit money bank credit to agriculture (4.32%). This negates the results of past studies that Nigeria's agricultural food output is due to changes in exchange rate and government expenditure movements (Olarinde and Abdullahi, 2014).

Since the concluded that the effectiveness of monetary policy in the agricultural sector is mirrored from the monetary aggregates and credit channels, the apex bank should place more emphasis expansionary monetary policy framework with a view to increasing monetary aggregates to boost output in the agricultural sector. Also, the study found that deposit money bank credit to agriculture significantly affects

agricultural performance; it becomes imperative that delay and stringent conditions in assessing commercial bank credit and facility should be eliminated. Programmes aimed at availing affordable credit to farmers should be prioritized to cushion the agriculture sector against adverse monetary policy shocks in the short to medium term, specifically interest rates, to ensure continuous production. Lastly, government should increase the budgetary allocation to agricultural sector in a consistent manner due of the primary and vital importance it plays in the national economy, hoping that with proper monitoring of fund, it would contribute more significantly to the economy of the country.

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