

## **Monetary Policy Shocks and Agricultural Output Growth in Nigeria**

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**Abstract:** *This paper investigated the transmission channel of monetary policy shocks to agricultural output growth over the period 1970 – 2012. Data were drawn from the Central Bank of Nigeria Statistical Bulletin, 2013. The study estimated a VAR model and showed that producers are able to effectively transfer increases in cost of production to the final consumer through increased prices; and that though monetary policy shocks, interest rate and consumer prices have dominant impacts on agricultural output growth in Nigeria, but that monetary policy shocks transmitted through the interest rate channel are more effective. It was therefore recommended that monetary policy efforts to revitalize the agricultural sector should focus more on the use of differential interest rates amongst other policy tools.*

**Keywords:** *Agriculture, Monetary Policy Shock, Nigeria*

**JEL Classification – E52**

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### **I. Introduction**

Nigeria is a country blessed with vast human and natural resources. It covers a land expanse of 923,773km<sup>2</sup> inhabited by a population projected at 166.2 million people in 2012, which represents 2.35 percent of world population (accessed at <http://tradingeconomics.com>). The country has varied vegetation that is suitable for agriculture. This underscores why in the early years of independence her economy was largely driven by agriculture.

Although recent records show gleams of hope, the productive base of the Nigerian economy has remained comatose about five decades since independence. The economy is largely mono-cultural and externally-oriented. In 2010 Over 65 percent of real gross output and 80 percent of government revenue was accounted for by agriculture and mining and quarrying (including crude oil and gas). Also, 90 percent of foreign exchange earnings and 75 percent of employment was accounted for by primary production in the same year. The issue however is that, secondary activities, comprising manufacturing and building and construction, which traditionally have greater potential for broadening the productive base of the economy and generating sustainable foreign exchange earnings and government revenues accounted for a meager 4.14 percent and 2.0 percent of gross output respectively. Services or tertiary activities which depend on wealth generated by the productive sectors for their operations accounted for 30 percent of gross output. Significantly, service activities have been expanding their influence in the economy over the last decade accounting for over 35 percent of the growth of the real gross domestic product (GDP) (CBN, 2010).

Over the last five years there have been changes in the structure of the economy. The entry of the telecommunications sector changed the landscape of the Nigerian economy. The sector has witnessed tremendous and sustained real GDP growth. The sector's share of GDP and contribution to GDP growth increased from a meager 1 percent and 3 percent, respectively in 2005 to over 3 percent of GDP share and over 14 percent of GDP growth respectively, in 2010. This represents an annual average growth rate of about 34 percent in the last five years. Similarly, wholesale and retail trade sector accelerated by more than 10 percent per annum, accounting for over 32 percent of GDP growth and 16 percent of GDP during the period 2006-2010. By contrast, the oil and gas sector shrank in importance during the same period as its share of GDP declined from about 25 percent in 2005 to about 16 percent in 2010. With an average annual real growth rate of -3 percent, the sector's contribution to GDP growth was negative between 2005 and 2009. It however had a positive growth rate in 2010 as normalcy returned to the Niger Delta region. Manufacturing sector's contribution to real GDP growth which declined from over 5 percent in 2005 to about 3.96 percent in 2009, edged up to 4.14 % in 2010. Agricultural activities comprising crop production, forestry, livestock and fishery recorded an average annual growth rate of about 5.74 percent and remain the dominant sector of the economy with 41 percent share of the real GDP during 2006-2010. The sector's activities are largely informal and dominated by use of simple technologies. Consequently, productivity is low as growth has been largely induced by expanding hectares cultivated (CBN Annual Report, 2010).

Furthermore, recent statistics showed that at 2.6 percentage points, the services sub-sector had the largest contribution to GDP growth. This was followed by wholesale and retail trade with 1.9 percentage points;

and agriculture with 1.6 percentage points; building and construction and industry contributed a meager 0.3 and 0.2 percentage points, respectively in 2012. Also, the growth of sectoral GDP showed that the industrial sector is lagging behind. It recorded negative growth of -3.4 in 2008 and increased dramatically to 5.6 in 2010 but this was not sustained as the growth rate declined to 1.2 percent in 2012 compared to the agricultural sector which grew at the rate of 6.3 per cent in 2008 and an average of 5.7 percent between 2009 and 2011 and declined to 4.0 percent in 2012 (CBN Annual Report, 2012).

The above developments have been in the presence of government efforts to diversify her revenue base, export basket and foreign exchange earners. Thus both monetary and fiscal policies have been manipulated in recent years to reflect this position. Besides growing at a high rate money supply growth exceeded its target for most of the period between 1991 and 2012. Target money supply growth exceeded actual realization only in 1996, 2004, 2009, 2010 and 2012 (CBN Annual Report, 2012). This should mean availability of more credit facilities not only to the industrial and services sector but also to the agricultural sector, thus encouraging mechanized and large scale agricultural activities. It is sad to note that the agricultural sector in Nigeria which can give the economy a face-lift particularly, in the area of employment generation and food production if given adequate attention has suffered years of neglect and low productivity due to lack of funds for investment in the sector. It is therefore imperative to investigate how monetary policy shocks are transmitted into the agricultural sector and how effective they are in stimulating agricultural output expansion.

## **II. Literature Review**

### **2.1 Empirical Literature**

Ehinomen & Charles (2012) assessed the effectiveness of the monetary policies in promoting agricultural development in Nigeria over the period 1970 to 2010. Using the Ordinary Least Square (OLS) technique they showed that although CBN's monetary policies play crucial role in influencing the level of agricultural productivity in the country, it has not recorded significant progress in terms of providing enabling environment for better performance in the agricultural sector.

Nenbee & Madume (2011) investigated the impact of monetary policy on Nigeria's macroeconomic stability between 1970 and 2009. They viewed macroeconomic stability in terms of price stability. Employing the Co-integration and Error Correction Modeling (ECM) techniques their study revealed that only 47 percent of the total variations in the model are caused by the monetary policy variables-Money Supply (MOS), Minimum Rediscount Rate (MRR) and Treasury Bills (TRB) in the long-run. The coefficient of the ECM is rightly signed and impacts on inflation in Nigeria while the current and past (lag 2) MOS is wrongly signed as well as not impacting inflation. Again, Past (lag 2) MRR impacts on inflation while current and past (lag 1) TRB do not. The policy implication arising from the findings is that the monetary policy tools showed a mix result in terms of their impact on inflation in Nigeria.

Hassan (2012) evaluated the long-run neutrality of money supply on agricultural prices; the effect of money supply on agricultural prices; and effect of key macroeconomic indicators on agricultural prices in Nigeria. Using the least square estimation technique they showed that money supply had significant impact on agricultural prices and that agricultural prices do not react more sensitively than aggregate price to changes in money supply. Money supply and exchange rate also accounts for 86.2% of variations in agricultural prices.

Danjuma, *et al* (2012) examined the impact of monetary policy on inflation in Nigeria by examining the impact of monetary policy instruments in Nigeria during the period 1980– 2010. The framework for analysis involved the estimation of inflation function derived from the monetary theory of inflation. The study employed, granger causality, stationarity test and correlogram to minimize the possibility of estimating spurious relations, while retaining long-run information. It turned out that liquidity ratio and interest rate were the leading monetary policy instruments that were employed in combating inflation in Nigeria while cash reserve ratio, broad money supply and exchange rate were impotent and ineffective monetary policy instruments.

Chuku, (2009) used a structural vector autoregression (SVAR) model to trace the effects of monetary policy shocks on output and prices in Nigeria. The assumption that the Central Bank cannot observe unexpected changes in output and prices within the same period was made, thus placing a recursive restriction on the disturbances of the SVAR. Three alternative policy instruments of broad money (M2), Minimum Rediscount Rate (MRR) and the real effective exchange rate (REER) were used. They concluded that the manipulation of the quantity of money (M2) in the economy is the most influential instrument for monetary policy implementation.

Edoumiekumo, *et al* (2013) examined the responsiveness of real sector output to monetary policy shocks in Nigeria. Applying a VAR model and covering the period 1970 to 2011 the study revealed that credit to the private sector and investment had direct instantaneous impacts on real sector development (GDP). Although monetary policy rate and interest rate had no instantaneous and direct impact on real sector development they indirectly do so through the credit and investment channels. They concluded monetary

policy rate and bank lending rates are the most important monetary policy tools that can make or mar the Nigerian real sector and that a sound monetary policy in Nigeria is one that encourages credit to the private sector and capital accumulation.

Apere and Karimo (2014) examined the effectiveness of monetary policy on economic growth and inflation in Nigeria over the period 1970 to 2011. Estimation results from a VAR(1) model showed that in the short run it is output and inflation that drives monetary growth, while output growth is affected by inflation only. Results from the impulse response and variance decomposition showed that monetary policy variables may not have an instantaneous impact on output, but are key determinants of output growth in the long-run. Furthermore, in the short-run the level of production is more important in controlling inflation, but it is monetary policy variables that matter in the long-run. They therefore asserted that there is need to differentiate between short and long run monetary policy targets.

### 2.2 Monetary Policy Transition Mechanism

There are different transmission channels through which monetary policy affects economic activities. These channels have been broadly examined under the monetarist and Keynesian schools of thought. The monetarist postulates that change in the money supply leads directly to a change in the real magnitude of money. Friedman and Schwartz (1963) contended that an expansive open market operations by the Central Bank, increases stock of money, which also leads to increase in commercial banks reserves and ability to create credit and hence increase money supply through the multiplier effect. In order to reduce the quantity of money in their portfolios, the bank and non-bank organisations purchase securities with characteristics of the type sold by the Central Bank, thus stimulating activities in the real sector. This view is supported by Tobin (1978) who focused on assets portfolio choice and revealed that monetary policy triggers asset switching between equity, bonds, commercial paper and bank deposits. According to Tobin, tight monetary policy affects liquidity and banks ability to lend thus restricting loan to prime borrowers and business firms to the exclusion of mortgages and consumption spending thereby contracting effective demand and investment.

The Keynesians on the other hand posit that change in money stock facilitates activities in the financial market affecting interest rate, investment, output and employment. Modigliani, (1963) supports this view but introduced the concept of capital rationing and said willingness of banks to lend affects monetary policy transmission. In their analysis of use of bank and non bank funds in response to tight monetary policy Oliner and Rudebush (1995) observe that there is no significant change in the use of either but rather larger firms crowd out small firms in such times and in like manner Gertler and Gilchrist (1991) supports the view that small businesses experience decline in loan facilities during tight monetary policy and they are affected more adversely by changes in bank related aggregates like broad money supply. Further investigation by (Borio, 1995) who investigated the structure of credit to non government borrowers in fourteen industrialised countries observe that it has been influenced by factors such as interest rates, collateral requirement and willingness to lend.

## III. Methodology And Data

### 3.1 Data and Sources

This study used time series secondary data. The relevant data were collected from the Central Bank of Nigeria Statistical Bulletin, 2013 edition. Data collected include broad money (M2), Monetary Policy Rate (MPR), Consumer Price Index (CPI) and index of agricultural production (AGX), and spans 1970 to 2012.

### 3.2 Model Specification

For the purpose of analyzing and forecasting macroeconomic activities, and tracing the effects of policy shocks on the economy simple, small-scale VARs with sound theoretical foundation have proved to be as good as or better than large-scale structural equation systems. VAR models in addition to forecasting have been used to serve two primary functions: (i) testing causality (weak exogeneity) and; (ii) studying the effects of policy shocks through impulse response characterization and forecast error variance decomposition. This study therefore estimated a vector autoregressive (VAR) model to trace the effect of monetary policy shocks on agricultural output growth in Nigeria. The generalized VAR model is specified as:

$$y_t = \mu + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_k y_{t-k} + \epsilon_t \quad (1)$$

Where  $y_t$  is a column vector of four (4) variables, that is  $y_t = [M2, MPR, CPI, AGX]'$  modeled in terms of its past values.  $A_i$  are  $k \times k$  matrix of coefficients to be estimated,  $\mu$  is a  $k \times 1$  vector of constants and  $\epsilon_t$  is a vector of white noise processes with the following properties

$$E(\epsilon_t) = 0 \text{ for all } t \quad E(\epsilon_t \epsilon_s') = \begin{cases} \Omega & s=t \\ 0 & s \neq t \end{cases}$$

where the covariance matrix,  $\Omega$  is assumed to be positive definite. Thus the  $\epsilon$ 's are serially uncorrelated but may be contemporaneously correlated. The lag length,  $k$  is determined empirically using the Akaike information criterion. The model with the lower Akaike value is selected. Therefore estimation was done by

iteration starting with the maximum lag length identified using the information criteria until the optimum model is arrived at—that is until the model becomes stable (no modulus or eigenvalue lies outside the unit circle). M2 is broad money supply, MPR is monetary policy rate, CPI is consumer price index and AGX is index of agricultural production.

Although the study used the Granger Causality test to establish instantaneous (short-run) relationship between the variables the study identified shocks that affects agricultural output growth through the use of the impulse response function and the forecast error variance decomposition (see Greene, 2002 and Johnston & Dinardo 1996).

#### **IV. Results And Discussion**

To estimate the model, some tests were carried out which included: (i) Lag length selection; and (ii) VAR stability tests (iii) VAR LM test for serial correlation (iv) VAR Granger Causality/Block Exogeneity Wald Tests (v) the impulse response function and ; (vi) Forecast Error Variance Decomposition. The results are presented and discussed here in that order. The optimum lag length was determined using lag order selection criteria for which results are present on table 1. Since most of the criteria – FPE, SC and HQ showed lag one to be the optimum lag length the VAR(1) model was estimated. For policy purposes, the VAR model has to be dynamically stable and so after estimation the Roots of Characteristic Polynomial were examined for stability and the results presented on table 2. The results revealed that no root lies outside the unit circle as all modulus were less than unity, therefore the VAR(1) model is dynamically stable and useful for policy analysis. The VAR LM test for serial correlation is necessary to make valid inferences after estimation. The results for this test are presented on table 3 and they showed that the model does not suffer serial correlation up to lag(12). The granger causality test results are presented on table 4. The results revealed a uni-directional causality running from interest rate to consumer prices. This is indication that producers are able to effectively transfer increases in cost of production to the final consumer through increased prices, thus inflation in Nigeria is mainly a monetary issue. The impulse response graphs are presented in figure 1. The graphs revealed that the impact of money supply shocks on innovations in the agricultural sector though negative in the first and second forecast periods became positive between the second and third periods and did not die out in the long run. While the impact of interest rate and consumer prices shocks on innovations in the agricultural sector were minimal (zero) in the first forecast period they increased gradually from thence and did not die out in the long-run. The impact of shocks in the agricultural sector on own innovations was very high in the first forecast horizon but declined rapidly and seemed to die out in the long run. The implication is that monetary policy shocks, interest rate – a measure of cost of borrowing and consumer prices have dominant impacts on performance of the Nigerian agricultural sector. AGX forecast error variance decomposition which measures the percentage of the forecast error variance of AGX that is explained by own and innovations in other variables over the forecast horizon are presented on table 5. The results revealed that in the first forecast horizon 96 percent of the forecast variance is explained by own innovation while innovations in money supply explained 3.5 percent, interest rate and CPI together explained a meager 0.29 percent. However in the long – run, own innovations declined rapidly and explained 56.49 percent in the tenth horizon. While innovations in M2, INTR and CPI together explained 43.51 percent it was INTR that explained most of the variance in AGX in the long – run (23.19 percent). M2 and CPI explained 10.72 and 9.60 percents respectively. This is an indication that interest rate is the most effective monetary policy tool that causes changes in the performance of the agricultural sector in Nigeria. in other words monetary policy shocks is transmitted through the interest rate channel to agricultural production.

#### **V. Conclusion And Recommendation**

The basic conclusions that can be drawn from this study are that: (i) in the short-run it is interest rate shocks that cause inflation, that is, producers are able to effectively transfer increases in cost of production to the final consumer through increased prices; (ii) though monetary policy shocks, interest rate – a measure of cost of borrowing and consumer prices have dominant impacts on agricultural output growth in Nigeria, interest rate is the most effective monetary policy tool that causes changes in the agricultural output growth in Nigeria. That is monetary policy shocks transmitted through the interest rate channel are more effective.

The study recommend as follow:

1. To revitalize the agricultural sector monetary policy should focus on soft loans to the agricultural sector or adopt credit rationing. In this case the interest rate on funds borrowed for agricultural purposes should be less compare to other sectors.
2. Mechanisms should be put in place to ensure that those who borrow at the rate prescribed for the agricultural sector are actually involved in agriculture.
3. Funds allocated for agricultural purposes should be monitored thoroughly to ensure that they are not diverted to other use(s).

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### Tables

**Table 1: Lag Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-67.98737	NA	0.000576	3.891209	4.065362	3.952606
1	92.41063	277.4452	2.36e-07*	-3.914088	-3.043322*	-3.607102*
2	103.9894	17.52460	3.10e-07	-3.675102	-2.107722	-3.122527
3	126.3590	29.02009*	2.39e-07	-4.019407	-1.755414	-3.221243
4	144.5405	19.65566	2.53e-07	-4.137325	-1.176719	-3.093573
5	161.4223	14.60049	3.30e-07	-4.184991*	-0.527772	-2.895650

Notes:

\* 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: Author’s Computation

**Table 2: Roots of Characteristic Polynomial**

Root	Modulus
0.945252	0.945252
0.901582	0.901582
0.731392 - 0.048035i	0.732967
0.731392 + 0.048035i	0.732967

Source: Author’s computation

**Table 3: VAR LM Test for serial correlation**

Lags	LM-Stat	Prob
1	19.19471	0.2587
2	21.37061	0.1647
3	16.43056	0.4233
4	20.29677	0.2072
5	20.89935	0.1824
6	11.78805	0.7584

7	6.663846	0.9792
8	7.631600	0.9591
9	9.701819	0.8817
10	6.031304	0.9878
11	13.61129	0.6276
12	10.41992	0.8438

Probs from chi-square with 16 df.

Source: Author's Computation

**Table 4: Granger Causality**

Hypothesized relation	Wald Statistic	Decision
LOG(M2) does not granger cause LOG(CPI)	0.6544	Do not reject
LOG(CPI) does not granger cause LOG(M2)	0.5002	Do not reject
LOG(CPI) does not granger cause LOG(INTR)	0.1161	Do not reject
LOG(INTR) does not granger cause LOG(CPI)	13.9352***	Reject
LOG(CPI) does not granger cause LOG(AGX)	1.9495	Do not reject
LOG(AGX) does not granger cause LOG(CPI)	0.1595	Do not reject

Source: Author's computation

**Table 5: Forecast Error Variance Decomposition of LOG(AGX)**

Period	S.E.	Variance Decomposition of LOG(AGX):			
		LOG(M2)	LOG(INTR)	LOG(CPI)	LOG(AGX)
1	0.074464	3.514453	0.163346	0.138871	96.18333
2	0.099814	2.086313	2.543039	0.477131	94.89352
3	0.117421	1.736994	5.723346	1.040973	91.49869
4	0.131474	2.379707	8.978152	1.829495	86.81265
5	0.143493	3.696214	12.00521	2.822038	81.47654
6	0.154165	5.333054	14.72544	3.986299	75.95520
7	0.163848	7.003224	17.15708	5.284657	70.55504
8	0.172753	8.515763	19.34847	6.678134	65.45763
9	0.181023	9.767256	21.34756	8.128677	60.75651
10	0.188765	10.71999	23.19116	9.600624	56.48822

Cholesky Ordering: LOG(M2) LOG(INTR) LOG(CPI) LOG(AGX)

Source: Author's Computation

**Figure 1: Responsiveness of LOG(AGX) to Cholesky One Standard Deviation Innovations**

