



RESPONSES OF RICE OUTPUT TO MONETARY POLICY SHOCK IN NIGERIA FROM 1981-2020

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ABSTRACT

The research looked at how monetary policy shocks affects rice output in Nigeria. The study made use of time series data spanning the year 1981 to 2020 obtained from the Central Bank of Nigeria (CBN) and National Bureau of Statistics (NBS). The shocks were detected using the Vector Auto-Regressive model (VAR). The study revealed that unit shocks in interest rates, inflation, and exchange rates all harmed rice output with rice output responding more to a unit shock in interest rate. Monetary policy shocks have both positive and negative effects on rice output at different periods. This study concluded, however, that the timing of monetary policy instruments change has serious implications for rice output, and that rice output can bring about positive change in Nigeria's agricultural output if monetary policy instruments are well managed. The study recommended that the monetary authority should ensure that various policies are implemented to ensure that the interest rate to the agricultural sector is within a single digit, accessible, affordable, and sustainable to ensure greater productivity in the sector, as it accounted for the greatest shock in comparison to other monetary variables, the monetary authority should pursue an exchange rate policy that encourages investment in the Nigerian economy's real sector while maintaining market stability.

Keywords: Monetary policy, rice output, impulse response VAR, Shocks, Nigeria.

INTRODUCTION

One of the macroeconomic policy's key goals is to accelerate growth centres that will enable the provision of products and services that will promote residents' well-being (CBN, 2014) as cited by Ogundipe *et al.* (2017). The real sector of the economy makes it possible to produce goods and services. Job creation will result in higher income, consumption, and investment. One of the macroeconomic tools is monetary policy (the other being fiscal policy) has been used to stimulate economies to attain macroeconomic goals.

Price stability, exchange rate stability, and maintaining equilibrium are some of the objectives. Others are a balance of payments, job creation, output promotion, and long-term sustainable growth. The monetary authority's deliberate endeavour might be defined as monetary policy to manage the money supply and credit conditions to achieve certain broad economic objectives which might be mutually exclusive (Falade and Folorunso, 2015) as cited by Ogundipe *et al.* (2017). In other words, monetary policy deals with the actions taken to regulate the supply of money, cost, and availability of credit in the economy by the monetary authorities or the Central Bank (Ogundipe *et al.*, 2017).

Agriculture was the most important sector of Nigeria's economy until the discovery of oil in the late 1950s and early 1960s when it accounted for over 65 percent of the country's GDP and provided the majority of the country's foreign exchange revenues through the export of agricultural products (Okah, 2015) Nigerian agriculture's food sub-sector boasts a diverse range of staple crops made feasible by the agro-ecological production method. Cereals, tubers, legumes, and vegetables are the main food crops. These are goods that are extremely important for household food security expenditures and income.



Rice, wheat, and maize are three of the world's most significant food crops, accounting for more than half of all calories consumed globally (Makama *et al.*, 2017). As a result, more than half of the world's population consumes rice. Global milled rice production increased from 409.2 million tons in 1999 to 496.4 million tons in 2014, according to available data. Nigeria boosted its rice production from 4.82 million tonnes in 2013 to 6.73 million tonnes in 2014 (Makama *et al.*, 2017).

Rice demand has risen considerably in Nigeria as a result of expanding population, rising income levels, urbanization, and changes in family work arrangements (Makama *et al.*, 2017). Nigeria is one of six countries that account for around 46% of worldwide malnutrition. Rice, on the other hand, is essential for feeding enormous populations in Asia, parts of Latin America and the Caribbean, and, increasingly, Africa. As a result, more than half of the world's population depends on it for food security. Rice is viewed as a "strategic" commodity in many countries, both developed and developing, and is subject to a range of government controls and interventions as a result of these considerations (FAO, 2017).

In Nigeria, the government's participation in economic activity has yielded mixed results in terms of economic performance. Because the economy has expanded in actual output in some years while decreasing in others, the overall impression of the country's development efforts is bad. Nigeria's monetary and fiscal policies aim to boost GDP, and growth rate, reduce inflation and unemployment, improve the balance of payments, build financial savings and foreign reserves, and maintain a stable Naira exchange rate. Until recently, the policy instruments used to achieve these aims were woefully inadequate, with Nigeria relying too heavily on fiscal policy rather than monetary policy to achieve its objectives (Ogah *et al.*, 2021).

Both monetary and fiscal policies are important in achieving the fundamental government goal of improving citizen wellbeing. According to Abata *et al.* (2012), a more integrated and monetized economy, as well as a regular information network system, are essential before the monetary policy may yield the desired results, as maintained by classical economists. The author, on the other hand, bemoaned the lack of fundamental flexibility in the Nigerian economy (in terms of interest rates, treasury certificates, and so on) that could have facilitated a much more efficient use of the monetary policy. Based on empirical evidence, he thus denounces the classical preference for monetary policy over fiscal policy and predicts that it will only work for developed economies. They recommend that in a developing economy like Nigeria, a combination of both strategies should be used to improve economic performance.

Works like example Ogundipe *et al.* (2017) focused on monetary policy and manufacturing sector output in Nigeria using a structural VAR approach, Hammed, (2020) carried out his study on monetary policy shock and manufacturing output in Nigeria from 1981-2018, Adegioriola *et al.* (2022) did their studies on monetary policy instruments and performance of the real sectors in Nigeria, Ogah *et al.* (2021) analyzed the impact of monetary and fiscal policy on rice productivity in Nigeria from 1981-2018. However, none of these works focuses on the impulse response of rice output to monetary policy shock thus creating the need for this research work. The interest here is to look at how rice output from 1981-2020 responds to unit shock in the monetary policy of the government.

To fill a gap in the literature, the study uses a structural vector autoregressive technique to examine the influence of monetary policy shocks on rice output in Nigeria from 1981 to 2020, taking into account the various monetary transmission mechanism channels. This study is divided into five sections to achieve this goal: introduction, an overview of related literature, methodology, results and discussion, and conclusion. The work explored some empirical



perspectives on growth rate as opined by Neoclassical Economists, as well as how monetary policy tools played out in the Nigerian agriculture sector with particular attention to rice output.

The quantity theory of money, the Keynesian theory of money, the monetary transmission mechanism theory, the theory of production, and the endogenous growth theory are some of the associated theories of monetary policy and production that exist in the literature. This research is based on the monetary transmission mechanism hypothesis, which describes the channels via which monetary policy affects the economy's real sector. It explains how 'policy-induced changes in the money stock or the short-term nominal interest rate have an impact on real variables like aggregate output and employment'.

According to Romer (2010), the Keynesian school of thought economic growth theory, proposed that government expenditure can help an economy's sectoral growth (particularly agricultural expansion). As a result of the multiplier effects on aggregate demand, a rise in government spending is projected to lead to an increase in employment, profitability, and investment. As a result, government spending raises aggregate demand, resulting in higher output depending on expenditure multipliers. Public spending, according to Keynes, is an exogenous component that can be used as a policy tool to boost GDP (agricultural growth in particular).

Ogah *et al.* (2021) examined the effect of monetary and fiscal policy instruments on rice productivity in Nigeria from 1981-2016 using the Johansen Cointegration technique, the result indicates that there exists a long-run relationship between monetary and fiscal policy and rice productivity.

Mansor and Ruzita, (2005) examined how industrial output in Malaysia responded dynamically to exchange rate and monetary policy shocks. Their findings backed up the idea that interest rate and exchange rate shocks had a larger impact on manufacturing production than on aggregate output or output from other industries. Alam and Waheed (2006) investigated Pakistan's monetary transmission channels across seven economic sectors (agricultural, mining and quarrying, manufacturing, construction, wholesale and retail commerce, banking and insurance, and home ownership). Manufacturing, wholesale and retail trade, and banking and insurance sectors all decreased faster in reaction to interest rate shocks, according to the study's findings, although agricultural, mining and other sectors remained stable. The study discovered that the manufacturing, wholesale and retail commerce, and banking and insurance sectors all dropped faster in reaction to interest rate shocks, whereas agriculture, mining and quarrying, construction, and home ownership were shown to be unaffected by interest rate fluctuations.

Using a Structural Vector Autoregression (SVAR) technique and quarterly data from 1986 to 2008, Chuku (2009) examined the effects of monetary policy changes on output and prices in Nigeria. The study discovered that monetary policy shocks or money supply innovations have a rather minor influence on output and inflation. Sulaiman and Migiro (2014) use time-series data from 1981 to 2012 to examine the relationship between monetary policy and economic growth in Nigeria, using Granger causality and the Johansen test for cointegration. Cash reserve ratio, monetary policy rate, exchange rate, money supply, and interest rate were utilized as monetary variables, while the gross domestic product was employed as a proxy for Nigerian economic development. The study discovered a long-run association between monetary variables and economic growth in Nigeria using the Johansen test for cointegration.

Between 1970 and 2015, Eko *et al.* (2017) used the Vector Error Correction Model and the Granger causality test to examine the influence of monetary policy shocks on Nigerian industrial output. The dependent variable was the contribution of manufacturing and solid minerals to GDP, whereas explanatory variables were the monetary policy rate, exchange rate, and bank lending to the industrial



sector. The manufacturing sub-sector had a positive impact on the monetary policy rate, commercial bank credit to the industrial sector, and exchange rates, according to the findings, while the contribution of the solid minerals sub-sector to GDP responded positively to shocks in commercial bank credit to the industrial sector and exchange rates after the first year. The causality test revealed a one-way relationship between the monetary policy rate and exchange rate and manufacturing sector contribution to GDP on the one hand, and a commercial bank loan to the industrial sector and exchange rate to solid mineral sector contribution to GDP on the other.

In summary, works on the effects of monetary policy on economic growth specifically in Nigeria using the structural vector autoregressive approach as well as taking into consideration all the monetary transmission mechanism channels without referencing to impulse and shock of the policies on the rice output.

MATERIALS AND METHODS

The Study Area

The study area is Nigeria. Nigeria is a West African country lying between longitudes 3⁰E and 15⁰E and latitudes 4⁰ and 14⁰N. The capital of the country in Abuja, which is geographically located in the North Central part of the country. Nigeria, which is the most populous country in Africa, has an estimated population of over 170 million (Udah and Nwachukwu, 2015). It is situated in the Gulf of Guinea and it is bordered by Benin Republic to the West, Republic of Cameroon and Chad to the East and Niger Republic to the North. The lower course of the Niger River flow southward part of the country in the Gulf of Guinea, with Swamps and Mangrove Forest bordering the Southern part (Oyinbo and Rekwot, 2013). The country has a total area of 923,768 square kilometers with land occupying 910,768 square kilometers and water occupying 13,000 square kilometers (Oyinbo and Rekwot, 2013).

Nigeria has a tropical climate with two distinct seasons; the dry and the wet seasons. It comprises the following ecological Zones: Mangrove Swamp, Rainforest, Guinea Savannah, Sudan Savannah and Sahel Savannah. Its terrain is divided into the South low lands merging into Central hills and Plateau, mountains in the south and plains in the North. There are arable crops which occupy 33.02% of the total land cover; permanent crops occupy 3.14%, while others occupy 63.84% (Udah and Nwachukwu, 2015). Above 70% of Nigeria's population is engaged in agriculture (NBS, 2016). The major agricultural crops produced in the country include cocoa, cotton, palm-oil, maize, rice, sorghum, millet, groundnut, cassava, yam and rubber. The major livestock reared are cattle, sheep, goat, pig, and poultry.

Method of Data Collection

Secondary data consisting of annual time series covering a period of 39 years (1981 – 2020) were used for this study. Variable of interest includes rice output, interest rate, exchange rate and inflation. which were obtained from the Central Bank of Nigeria (CBN) and National Bureau of Statistics (NBS).

Analytical Techniques

This study employed a yearly series of selected variables from 1981 to 2020. The choice of this period is to focus on the era of market based monetary regime in Nigeria as well as to capture some key activities in the agricultural sector in the 1980s with particular reference to rice. The econometric approach used in this study is the Structural Vector Autoregression (SVAR) approach as this is best suited in capturing the dynamic response of estimated variables to various shocks that occur within an economy as well as have proper theoretical base. The SVAR methodology was employed in this study to estimate and analyze the effect of monetary policy on rice output in the Nigerian economy. As noted by Ogundipe *et al.* (2017), the use of SVAR in the analysis of monetary policy effects have produced relatively better and robust

results. In addition, the SVAR is theoretically suitable and offers the benefit of identifying monetary policy as well as other shocks.

Data for this study were analyzed using inferential statistics like Vector Auto Regression (VAR), used to capture the objectives of the study. In order to obtain more meaningful insight, logarithmic transformation of these variables was adopted. The unit root test of all variables was carried out. The Augmented Dickey Fuller (ADF) method was used to test for the presence of unit root in each variable (an indication for non-stationarity). This was because the use of data characterized by unit roots might lead to serious errors in statistical inference.

Following Oyinbo and Rekwot (2013) the Augmented Dickey Fuller (ADF) model with the constant term and trend can be specified as follows:

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \beta Y_{t-1} + \sum_{i=1}^p \delta_i \Delta Y_{t-i} + \varepsilon_1 \quad \dots (1)$$

where;

Y is the value of the variable of rice output, inflation, interest rate and exchange rate, α_0 is the constant, α_1 is the coefficient of the trend series, p is the lag order of the autoregressive process, Y_{t-i} is the lag value of order one of Y_{t-i} and ε_1 is the error term. For the Vector Auto Regression, the impulse response of rice output to the monetary policy is specify as follows:

Given that;

$$LnRiceOut_t = \alpha_0 + \alpha_1 Lninfl_t + \alpha_2 Lnintr_t + \alpha_3 LnExcgrt_t + e \quad \dots (2)$$

where;

LnRiceout = Rice output, in time t;

LnInflt = Inflation rate in time t;

Lnintr = Interest rate in time t;

LnExcgrt = Exchange rate in time t;

α_0 = constant

α_1 to α_4 are coefficients

e = Error term.

Equation 2 is called a structural VAR as it is assumed to be determined by some underlying economic theory. Thus, the structural model of this study is described by the following dynamic system of simultaneous equation 3,4 and 6:

$$LnRiceout_t = \alpha_0 + \sum_{i=1}^k \beta_i LnRiceout_{t-i} + \sum_{i=1}^k \theta_{1i} LnInflt_{t-j} + \sum_{i=1}^k Q_{mi} Lnintr_{t-m} + \sum_{i=1}^k Q_{ni} LnExcgrt_{t-n} + \mu_{1t} \quad \dots (3)$$

$$LnInflt_t = \sigma + \sum_{i=1}^k \beta_i LnRiceout_{t-i} + \sum_{i=1}^k \theta_{1i} LnInflt_{t-j} + \sum_{i=1}^k Q_{mi} Lnintr_{t-m} + \sum_{i=1}^k Q_{ni} LnExcgrt_{t-n} + \mu_{2t} \quad \dots (4)$$

$$Lnintr_t = \alpha + \sum_{i=1}^k \beta_i LnRiceout_{t-i} + \sum_{i=1}^k \theta_{1i} LnInflt_{t-j} + \sum_{i=1}^k Q_{mi} Lnintr_{t-m} + \sum_{i=1}^k Q_{ni} LnExcgrt_{t-n} + \mu_{3t} \quad \dots (5)$$

$$LnExcgrt_t = \lambda + \sum_{i=1}^k \beta_i LnRiceout_{t-i} + \sum_{i=1}^k \theta_{1i} LnInflt_{t-j} + \sum_{i=1}^k Q_{mi} Lnintr_{t-m} + \sum_{i=1}^k Q_{ni} LnExcgrt_{t-n} + \mu_{4t} \quad \dots (6)$$

where;



α_0 , σ , α , λ , are constants, while β_i , Q_m , θ_1 and ω_n are coefficients of the variables while other variables are as defined before.

The variables used in the equation were measured as: rice output was measured in tones, inflation was measured in percentage, interest rate was also measured in percentage and exchange rate was measured in naira that is value of naira to one dollar. It is expected that a unit shock in any of these variables will lead to a corresponding change in rice output.

RESULTS AND DISCUSSION

Unit Root Test for Stationarity

Table 1 presents test of stationarity using Augmented Dickey-Fuller test (ADF) for inflation rate, interest rate and exchange rate. The ADF test result indicates that all variables were stationary at level, that is, they co-integrated at level. It is noted that, all variables (lnInflation rate, lnInterest rate and lnExchange rate) were stationary at 10% level of significance. This level was achieved to avoid spurious result. The outcome implies that the level forms of these variables either performed random work or have numerous means of covariances, or both. According to studies such as (Olanipekun and Benjamain, 2015; Ogah *et al.*, 2021), first differencing only accounts for short run connections among series. This could be addressed by locating cointegration between the series. Furthermore, (Idowu, 2013) stated that the integration order is best decided by taking the first or second difference of the variables, and that the autoregressive function, rather than the ADF test, accomplishes the differencing.

Table 1: Augmented Dickey-Fuller Unit Root Test Result

Variables	Level z(t)	Critical Value	Remarks
lnInflation rate	-2.605	-2.966	Stationary
lnInterest rate	-1.343	-2.966	Stationary
Exchange rate	-2.502	-2.966	Stationary
Critical Values			
1%	-3.668		
5%	-2.966		
10%	-2.616		

Source: Authors' Computation 2022 Using STATA 15

Table 2 further shows that the eigenvalues are located within the unit circle, indicating that the VAR meets the stability condition. It was straightforward to deduce from both tests (ADF and Eigenvalue stability condition test) that all series (lnInflation rate, lnInterest rate, and lnExchange rate) were approved and supported VAR since they met the stability criteria (Ogundipe, 2017). (Idowu, 2013) said that an equal number of rejections satisfy VECM whereas an unequal number of rejections support VAR.

Table 2: Eigenvalue Stability Condition

Eigenvalue	Modulus
0.3479058+.4443562i	0.56435
0.3479058-.4443562i	0.56435
-0.2986747+.1453438i	0.332162
-0.2986747-.1453438i	0.332162
0.0011625	0.001162

Source: Authors' Computation 2022 Using STATA 15



Table 3 shows that the $\text{prob} > \chi^2$ is not statistically significant at 5% at lags 1 and 2, therefore we do not reject the null hypothesis of no autocorrelation. As a result, we infer that the residuals have no autocorrelation. This agrees with a previous study (Idowu, 2015), which indicated that there is no serial correlation of the residuals to further substantiate this.

Table 3: Lagrange-multiplier (LM) test for autocorrelation (Lagrange-multiplier Test)

Lag	χ^2	Df	$\text{prob} > \chi^2$
1	12.9757	16	0.67453
2	21.4482	16	0.16192

Note: H_0 means no autocorrelation at lag order

Source: Authors' Computation 2022 Using STATA 15

The Jarque-Bera normality test was used to summarize the difference between critical and anticipated values. The Jarque-Bera normality test verified the normality of the variables used, as shown in Table 4. The alternative hypothesis (H_1) was accepted because the p-value was less than 5% confidence level. As a result, this is consistent with (Guy et al, 2004), who said that the jarque-bera test applied to the whole data rejects the null hypothesis at any statistical significance, owing to the two outlier results.

Table 4: Jarque-Bera Test of Normality

Equation	χ^2	df	Prob > χ^2
D lnriceout	1.705	2	0.42636
D lnexchge	131.347	2	0.00000
D lninterest	379.302	2	0.00000
D lninflationrate	0.451	2	0.79817
All	512.804	8	0.00000

Source: Authors' Computation 2022 Using STATA 15

Impulse Response of Rice Output to a Shock in Exchange Rate

The impulse response functions show the dynamics of responses of rice output variable in the model to structural change and shock in exchange rate over the period studied. Figure 1 depicts the response of rice output to the structural exchange rate impulse. Following a one standard deviation structural shock in exchange rate, rice output grew from the first to the second period, and it continued to climb from the third to the eight periods. From period three to period eight, there was a consistent growth in rice output at a contractionary exchange rate, which is consistent with economic theory. This conclusion is consistent with Ogundipe *et al.* (2017) findings, which found an increase in the first and second periods of manufacturing production response to a monetary policy shock in Nigeria from 1981 to 2015. According to Adegoriola *et al.* (2022), a 1% shock in monetary policy reduces industrial production by 0.002 percent at the time of the shock in Nigeria from 1981 to 2018.

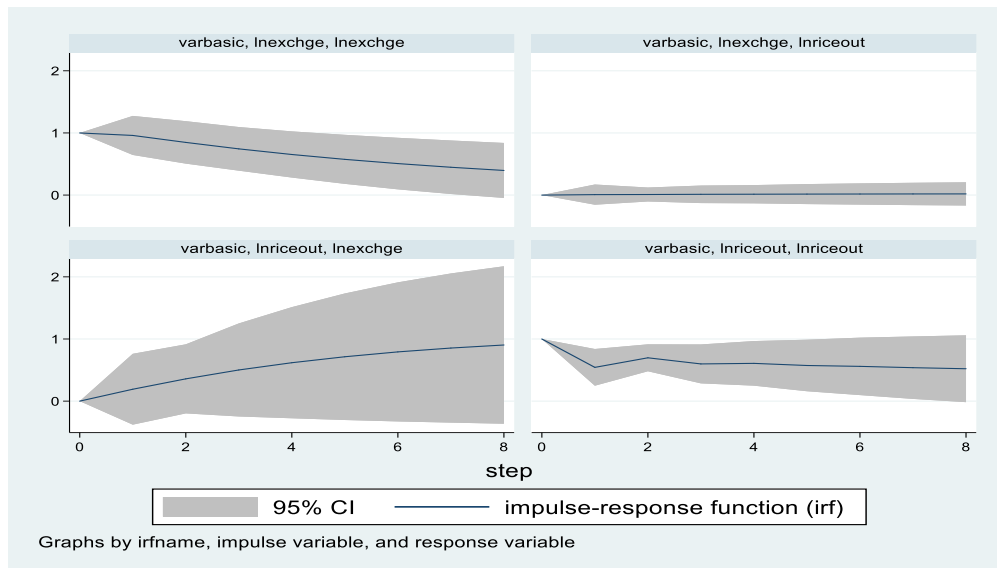


Figure 1: *Response of rice output to a shock in exchange rate using structural and orthogonalized IRF.*

Source: Authors' Computation 2022 Using STATA 15

Impulse Response of Rice Output to a Shock in Inflation Rate

Figure 2 indicates the response of rice output to a unit shock in inflation rate, from the figure, rice output decreases at from first period to second period, increase at decreasing rate from third period to fourth period and maintain constant from fifth to eight period as a result of unit shock in inflation rate. This is a clear message that rice output respond significantly to unit shock in inflation. Cristi *et al.* 2012) have noted that industrial output responds to a shock in inflation rate in Romania.

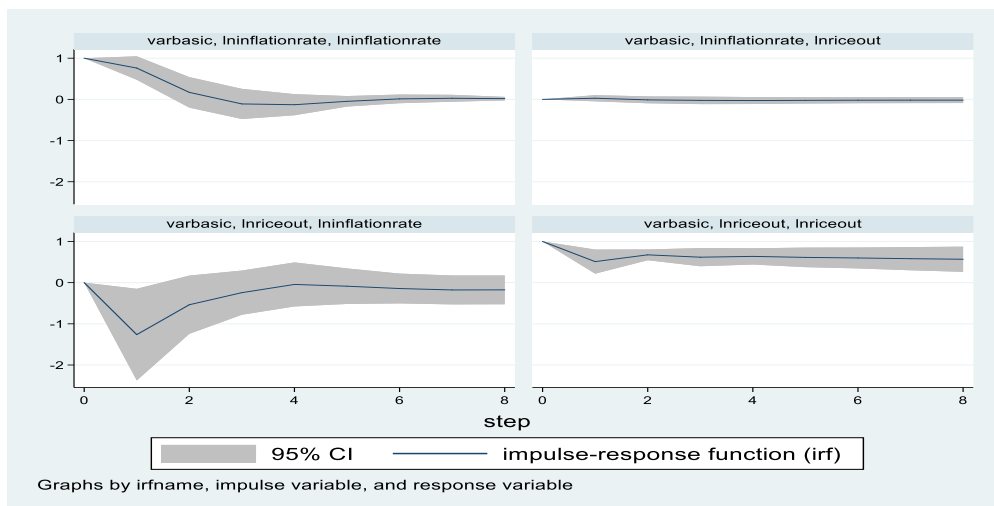


Figure 2: *Response of rice output to a shock in inflation rate using structural and orthogonalized IRF.*

Source: Authors' Computation 2022 Using STATA 15

Impulse Response of Rice Output to a Shock in Interest Rate

Figure 3 indicates the response of rice output to a unit shock in interest rate, from the figure, rice output increase at first period which is positive, decrease in second period and again

decreases further in third period which is negative. From fourth to eight periods there was a decrease which is constant. Rice output respond significantly to unit shock in interest rate over the period of study. The clear indication here is that rice output was affected by changes in interest rate. As noted by Adegioriola *et al.* (2022), agricultural output in Nigeria responds to changes in interest rate from positive to negative from periods one to five. Hammed *et al.* (2020) also found out that a 1% shock in interest rate decreases manufacturing output at a time of shock by 0.002% in Nigeria from 1981-2018.

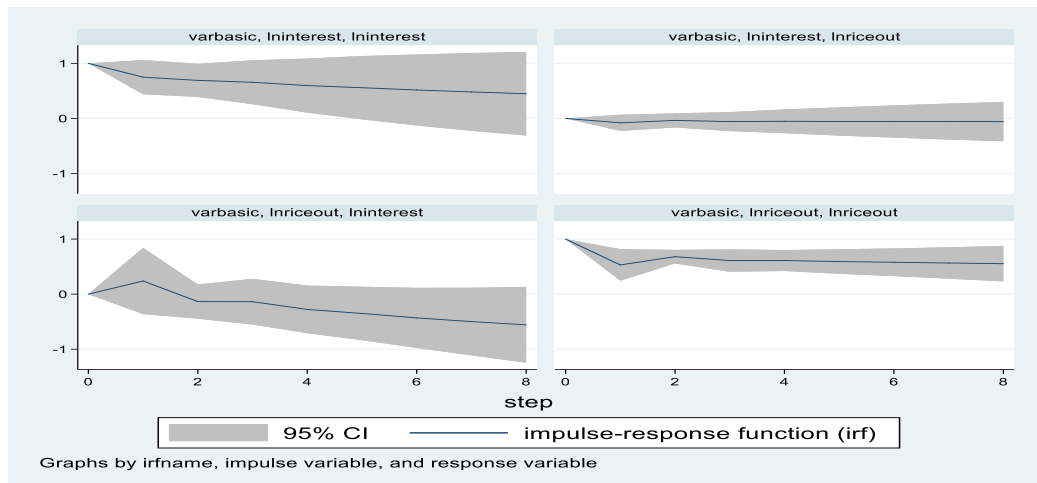


Figure 3: *Response of rice output to a shock in interest rate using structural and orthogonalized IRF.*

Source: Authors' Computation (2022) Using STATA 15

CONCLUSION AND RECOMMENDATIONS

From the results obtained, monetary policy instruments (interest rate, exchange rate and inflation rate) in Nigeria plays a key role for the growth of rice output and can boost agricultural production. It is clearly seen that the interest rate unit shock during the period of study adversely affected rice output, this is followed by unit shock in inflation and exchange rate in that order. Nigerian government rice output during the period of study was affected by the changes in the monetary policy of the government. Such shocks could lead to decrease in rice output and being a staple food crop, this could affect the diet of many Nigerians. The shocks in the monetary policy have positive and negative impacts on the rice output depending on the periods. The timing of the monetary policy instruments has serious implications on the rice output. The study recommended:

1. The adoption of friendly policies to curtail rising inflation and interest rate.
2. The monetary authority should pursue an exchange rate policy that encourages investment in the Nigerian economy's real sector while maintaining market stability.
3. The monetary authority should ensure that various policies are implemented to ensure that the interest rate to the agricultural sector is within a single digit, accessible, affordable, and sustainable in order to ensure greater productivity in the sector, as it accounted for the greatest shock in comparison to other monetary variables.

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