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Effect of Monetary-Fiscal Policies Interaction on Price and Output Growth in Nigeria

¹Yakubu Musa, Barfour K. Asare and Shehu U. Gulumbe

This paper investigates the effectiveness of monetary-fiscal policies interaction on price and output growth in Nigeria. The dynamic correlations of variables have been captured by the analyses of impulse response and variance decomposition. From innovation analyses, the results suggest that the policy variables money supply and government revenue have more positive impact on price and economic growth in Nigeria specifically in the long run, thus some time with lag. Although monetary and fiscal policy variables have a dominant effect on economic activity, it is clear from this study that economic activity is dominated by its own dynamics in most of the periods. The estimates presented in this paper suggest that both monetary and fiscal policy exert greater impact on real GDP and inflation in Nigeria. Overall, it is evident that the impact of policy is solely depending on the policy variable selected, although some policy variables are considered to be more beneficial to the social and economic development.

Keywords: Cointegration, Impulse Response, Variance Decomposition, VEC Model

JEL Classification: E31, E5, E6, F43

1.0 Introduction

The motivation of this study is derived from various studies on the Nigerian economy that have found diverse and, at times, contradictory empirical evidence on which direction should policymakers take and magnitude of the effects of some variables on inflation and aggregate output. These findings have, at times, led to conflicting discussions on the direction of economic policy, which creates difficulties for policy makers in choosing an appropriate policy mix that will enable faster growth of output in the economy and lower inflation. Harmony between monetary and fiscal policy variables is necessary so they do not contradict one another.

Fiscal and monetary policies are the tools through which an economy is regulated by the government or the respective central bank. The objectives of

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monetary and fiscal policies in Nigeria are wide-ranging. These include increase in Gross Domestic Product (GDP) growth rate, reduction in the rates of inflation and unemployment, improvement in the balance of payments, accumulation of financial savings and external reserves as well as stability in Naira exchange rate (CBN, 2009). Generally, both fiscal and monetary policies aim at achieving relative macroeconomic stability.

The purpose of this paper is to empirically use impulse response function and forecast error variance decomposition to analyse the impact of monetary-fiscal policy interactions on prices and Real GDP in Nigeria, using Cointegrated VAR methodology. The study is similar to that of Habibur (2005) for Bangladesh.

2.0 Empirical Literature

The relative impact of fiscal and monetary policy has been studied extensively in many literatures. Friedman and Meiselman (1963), Ansari (1996), Reynolds, A. (2000), Chari et al. (1991), Schmitt-Grohe and Uribe (2001), Shapiro and Watson (1988), Blanchard and Quah (1989), Clarida and Gali (1994), Chari and Kehoe (1998), Chowdhury (1988), Weeks (1999) Chowdhury *et al.* (1986), Feldstein (2002) and Cardia (1991) have examined the impact of fiscal and monetary policies on various aggregates.

However, the bulk of theoretical and empirical research has not reached a conclusion concerning the relative power of fiscal and monetary policy to affect economic growth. Some researchers find support for the monetarist view, which suggests that monetary policy generally has a greater impact on economic growth and dominates fiscal policy in terms of its impact on investment and growth [Ajayi (1974), Elliot (1975), Batten and Hafer (1983)], while others argue that fiscal policy stimulant are crucial for economic growth [Chowdhury et al (1986), Olaloye and Ikhide (1995)]. However Cardia (1991) found that monetary policy and fiscal policy play only a small role in varying investment, consumption, and output.

Montiel (1989) applied a five-variable VAR model (money, wages, exchange rate, income and prices) to examine sources of inflationary shocks in Argentina, Brazil and Israel. The findings indicate that exchange rate movements among other factors significantly explained inflation in the three countries. Other studies which have reached similar conclusions are Kamin (1996) for United states, Odedokun (1996) for Sub-Saharan Africa, Elbadawl

(1990) for Uganda, Nnanna (2002) for Nigeria and Lu and Zhang (2003) for China. Suleman, *et al* (2009) in their study of money supply, government expenditure, output and prices in Pakistan found that government expenditure and inflation are negatively related to economic growth in the long run while M2 positively, impact on economic growth.

Rodriguez and Diaz (1995) estimated a six-variable VAR – output growth, real wage growth, exchange rate depreciation, inflation, monetary growth, and the Solow residuals – in an attempt to decompose the movements of Peruvian output. They observed that output growth could mainly be explained by “own” shocks but was negatively affected by increases in exchange rate. Rogers and Wang (1995) obtained similar results for Mexico. In a five-variable VAR model – output, government spending, inflation, the real exchange rate, and money growth – most variations in the Mexican output resulted from “own” shocks. They however noted that exchange rate depreciations led to a decline in output. Since coordination among the stabilization policies can be fruitful in the progress of an economy that is facing dual challenges of growth and price stability, one of the objectives of the underlying study is to examine Nigeria’s economy by investigating the policy responses to, and their effects on, all the endogenous variables.

Despite their demonstrated efficacy in other economies as policies that exert influence on economic activities, both policies have not been sufficiently or adequately used in Nigeria (Ajisafe & Folorunso, 2002). However, few studies have applied the VAR approach on studies of Inflation and output growth in Africa countries, including Nigeria (Ajisafe & Folorunso, 2002).

In Nigeria, there have been very few empirical studies regarding the relative efficacy of the stabilization tools. Okpara (1988) in his study on money supply, government expenditure and prices in Nigeria, found a very poor and insignificant relationship between government expenditure and prices. Olubusoye and Oyaromade (2008) analyzing the source of fluctuations in inflation in Nigeria using the frame work of error correction mechanism found that the lagged consumer price index (CPI) among other variables propagate the dynamics of inflationary process in Nigeria. The level of output was found to be insignificant but the lagged value of money supply was found to be negative and significant only at the 10% level in the parsimonious error correction model.

Omoke and Ugwuanyi (2010) in their longrun study of money, price and output in Nigeria found no cointegrating vector but however found that money supply granger causes both output and inflation suggesting that monetary stability can contribute towards price stability. Also, Olukayode (2009) in his study of government expenditure and economic growth found that private and public investments have insignificant effects on economic growth during the review period 1977-2006. Ajisafe & Folorunso, (2002), in their analysis, showed that monetary rather than fiscal policy exerts a great impact on economic activity in Nigeria using cointegration and error correction modeling techniques. The emphasis on fiscal action of the government has led to greater distortion in the Nigerian economy.

3.0 Material and Methods

3.1 Description of Data

The data set used for this analysis is the annual series of the selected relevant macroeconomic variables from 1970 to 2010. The data for money supply (broad money M2), exchange rate and monetary policy rate will be used as monetary policy variables. Data for government revenues both oil and non-oil revenues, government expenditure (capital & recurrent) will be used as fiscal policy variables. Data for gross domestic product (both Agriculture and industrial), and Inflation rate (proxy by consumer price index) will be used as non-policy or growth variables. The data were obtained from Central Bank of Nigeria Statistical Bulletin 2009 and 2010.

3.2 Model Specification

The General basic model of VAR (p) has the following form

$$y_t = \mu + \psi D_t + A_1 y_{t-1} + \dots + A_p y_{t-p} + u_t \quad (1)$$

where y_t is the set of K time series variables $y_t = (y_{1t}, \dots, y_{Kt})'$, A_i 's are $(K \times K)$ coefficient matrices, μ is vector of deterministic terms, D_t is a vector of nonstochastic variables such as economic intervention and seasonal dummies and $u_t = (u_{1t}, \dots, u_{Kt})'$ is an unobservable error term. Although the model (1) is general enough to accommodate variables with stochastic trends, it is not the

most suitable type of model if interest centers on the cointegration relations. The vector error correction model (VECM) form is:

$$\Delta y_t = \psi D_t + \Gamma_1 \Delta y_{t-1} + \dots + \Gamma_{p-1} \Delta y_{t-p+1} + \alpha u_{t-1} + u_t \tag{2}$$

where $\alpha = (\alpha_1, \alpha_2, \dots, \alpha_k)$

In the VEC model, (attention focuses on the $(k \times 1)$ matrix of cointegrating vectors β) u_{t-1} which quantify the “long-run” relationships between variables in the system, and the $(k \times 1)$ matrix of error-correction adjustment coefficients α , which load deviations from the equilibrium (*i.e.* αu_{t-1}) to Δy_t for correction. The Γ_j ($j = 1, \dots, p - 1$) coefficients in (2) estimate the short-run effects of shocks on Δy_t and therefore allow the short-run and long-run responses to differ. The term αu_{t-1} is the only one that includes I(1) variables. Hence, αu_{t-1} must also be I(0). Thus, it contains the cointegrating relations.

Sims’s seminal work introduces unrestricted vector autoregression (VAR) that allows feedback and dynamic interrelationship across all the variables in the system and appears to be highly competitive with the large-scale macro-econometric models in forecasting and policy analysis (Sims, 1980). To provide an empirical insight into the effectiveness of monetary and fiscal policy on prices and economic growth in Nigeria, we estimate seven-variable VAR models by using GDP, CPI, MSP, EXG, MPR, REV and EXPT; and use the impulse response function on the results to analyze the effect of the two policy variables to economic variables. For brevity, only the results of the impulse response are presented.

Our basic model of VAR (p) has the following form

$$y_t = \mu + A_1 y_{t-1} + \dots + A_p y_{t-p} + u_t \tag{3}$$

where $y_t = (\text{GDP}_t, \text{CPI}_t, \text{MSP}_t, \text{EXG}_t, \text{MPR}_t, \text{REV}_t, \text{EXPT}_t)'$ is the set of 7 time series variables, A_i 's are (7×7) coefficient matrices, μ is vector of

deterministic terms and $u_t = (u_{1t}, \dots, u_{7t})'$ is an unobservable error term. The corresponding vector error correction model (VECM) for equation (3) is:

$$\Delta y_t = \Gamma_1 \Delta y_{t-1} + \dots + \Gamma_{p-1} \Delta y_{t-p+1} + \alpha u_{t-1} + u_t \quad (4)$$

where $\alpha = (\alpha_1, \alpha_2, \dots, \alpha_7)$

3.4 Impulse Response Functions for VEC Model

Impulse Response Functions (IRFs) are one of the useful tools of the VAR/VECM approach for examining the interaction between the variables in this study. They reflect how individual variables respond to shocks from other variables in the system. When graphically presented, the IRFs give a visual representation of the behaviour of variables in response to shocks. The responses are for a particular variable to a one-time shock in each of the variables in the system. As noted by Odusola and Akinlo (2001), the interpretation of the impulse response functions takes into consideration the first differencing of the variables as well as the vector error correction estimates. The response forecast period is ten years to enable us capture both the long term and short term responses.

4.0 Results and Discussion

4.1 Unit Root Tests

Table 1: ADF Test at First difference

Variables	With constant			With constant & trend		
	t-statistic	5% C.V	Prob.*	t-statistic	5% C.V	Prob.*
LGDP	-5.829827	-2.938987	0	-6.130762	-3.529758	0
LCPI	-3.650003	-2.941145	0.0092	-3.691008	-3.533083	0.0352
LMSP	-4.27302	-2.938987	0.0017	-4.161437	-3.529758	0.0113
EXG	-5.787631	-2.938987	0	-6.070563	-3.529758	0.0001
MRR	-6.586201	-2.941145	0	-7.039576	-3.533083	0
LREV	-6.989153	-2.938987	0	-6.909853	-3.529758	0
LEXPT	-7.825812	-2.938987	0	-7.765785	-3.529758	0

Lag length for ADF tests are decided based on Akaike information criteria (AIC)

* MacKinnon (1996) one-sided p-values

Before using the data in the estimation of VAR/VECM, we need to know time series properties of all the variables. Accordingly, a series of unit root test, such as Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are

used to determine the order of integration for each series. The ADF unit root tests used Akaike information criterion for lag order selection and PP unit root tests lag length are decided based on Akaike’s information criterion and AR spectral – GLS detrended spectra. The null hypothesis of non-stationary is rejected if the t-statistic is less than the critical t-value. After differencing the variables once using the ADF test and PP test, all the variables were confirmed to be stationary (Tables 1 & 2).

Table 2: PP test at first difference

Variables	With constant			With constant & trend		
	t- statistic	5% C.V	Prob.*	t- statistic	5% C.V	Prob.*
LGDP	-5.830034	-2.938987	0	-15.10077	-3.529758	0
LCPI	-4.518484	-2.938987	0.0008	-4.415164	-3.529758	0.0059
LMSP	-4.3798	-2.938987	0.0012	-4.197327	-3.529758	0.0104
EXG	-5.791422	-2.938987	0	-6.071034	-3.529758	0.0001
MRR	-7.923522	-2.938987	0	-8.056571	-3.529758	0
LREV	-14.99314	-2.938987	0	-6.891959	-3.529758	0
LEXPT	-7.789539	-2.938987	0	-7.749461	-3.529758	0

PP unit root tests lag length are decided based on Akaike’s information criterion and AR spectral- GLS detrended spectra

* MacKinnon (1996) one-sided p-values

Table 3: Cointegration test (Linear deterministic trend)

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.701125	138.1911	125.6154	0.0068
At most 1	0.591261	91.08966	95.75366	0.1003
At most 2	0.475142	56.19721	69.81889	0.3701
At most 3	0.233437	31.05675	47.85613	0.6634
At most 4	0.213733	20.68907	29.79707	0.3773
At most 5	0.153078	11.31116	15.49471	0.1931
At most 6 *	0.116517	4.831426	3.841466	0.0279

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

4.2 Cointegration test

The unit root tests confirmed that the series are integrated (integrated of order one, I(1)) thus satisfying the initial assumption for co-integration analysis. Lag length were selected to be two using information criteria and satisfied the

mathematical stability condition. The results of the maximal eigenvalue and trace test statistics for the two models are presented in Tables 3 and 4.

The p-values at 5% and 10% level of significant indicate that the hypothesis of no cointegration among the variables can be rejected for Nigeria. Both Trace test and Maximum Eigenvalue test found one cointegrating relationships at 5% significant level. Since the variables are cointegrated, it is concluded that there exists a long-run equilibrium relationship between the variables.

Table 4: Cointegration test (Linear deterministic trend)

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.701125	47.10148	46.23142	0.0403
At most 1	0.591261	34.89245	40.07757	0.1711
At most 2	0.475142	25.14047	33.87687	0.3756
At most 3	0.233437	10.36767	27.58434	0.9791
At most 4	0.213733	9.377908	21.13162	0.8008
At most 5	0.153078	6.479739	14.26460	0.5524
At most 6 *	0.116517	4.831426	3.841466	0.0279

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

4.3 Persistence profile analysis

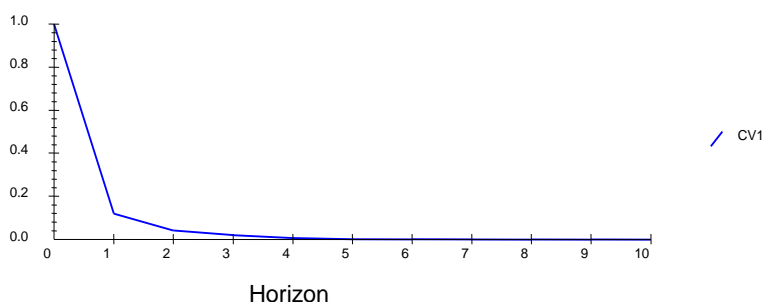


Figure 1: Persistence Profile of the effect of a system-wide shock to one cointegrating relationship (CV1)

Here, we conduct the persistence profile analysis introduced by Pesaran and Shin (1996) to analyze the speed of convergence to the equilibrium if the cointegrating relationship are exposed to a system-wide shock. The value of persistence profile is unity on impact, but it tends to be zero as the forecast time horizon tends to infinity. If the cointegrating relationship between monetary policy variables, fiscal policy variables, inflation rate and real GDP in Nigeria is stable and valid, the profile should approach zero in a short time horizon.

4.4 Impulse Response Functions for VEC Model

The results of impulse response function for shocks to monetary and fiscal policy variables are discussed below.

Shocks to Money Supply

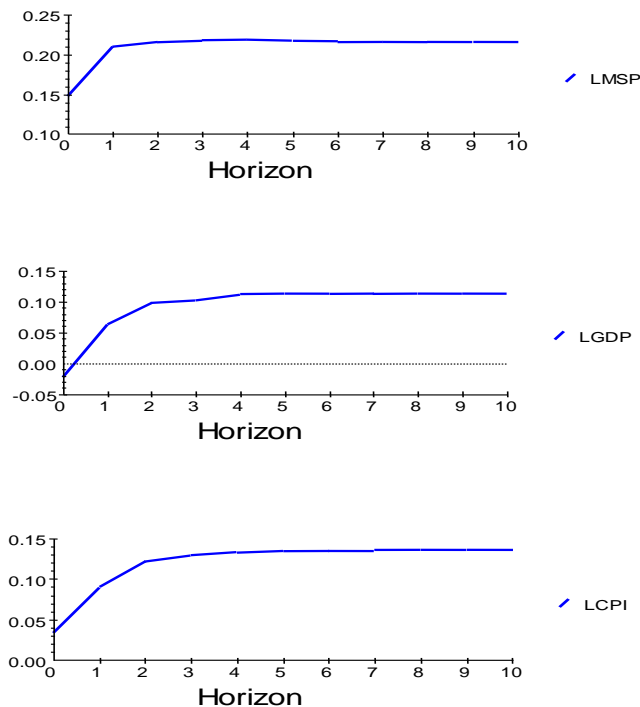


Figure 2: Impulse response of money supply shocks

From Figure 2, it can be observed that there is a large response of money supply to its own innovations. For instance, the figure shows that there is

immediate positive response of money supply to its own shock and with highest positive effect starting in the second year which continued in same path to the end of study period. The response of real GDP to money supply shock is quite negative at the initial stage but after the first half of the first year, the effect continues to increase even after the tenth year period. Meanwhile the responses of consumer price index to a standard deviation shock from money supply are positive and significant; more specifically in the long run.

Shocks to Exchange rate

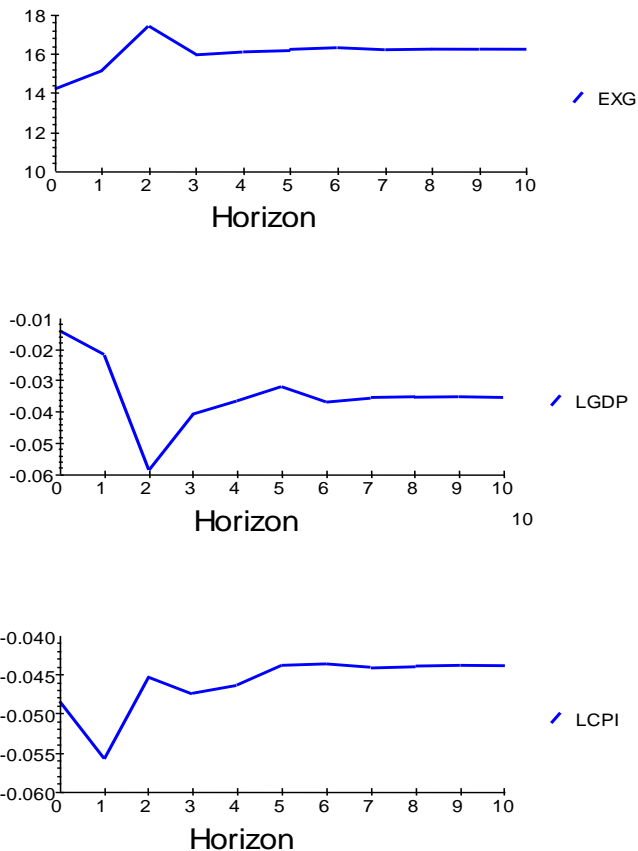


Figure 3: Impulse response of exchange rate shocks

Figure 3, shows the impulse response function of exchange rate shocks. The response of exchange rate due to its own shock is quite positive at initial stage but it climbed to a higher level in the second period before it declined in the third period and stabilizes to new positive level. The response of real GDP to

exchange rate innovations is negative but quite minimal (more specifically at initial periods) but it deepens in the second year before it stabilizes to a new negative level, which continues even after the tenth year period. Meanwhile, the response of prices to a standard deviation shock from exchange rate is negative with some noticeable fluctuation at the initial years although the negative response continues up to the end of forecast period but is quite minimal.

Shocks to Monetary policy rate²

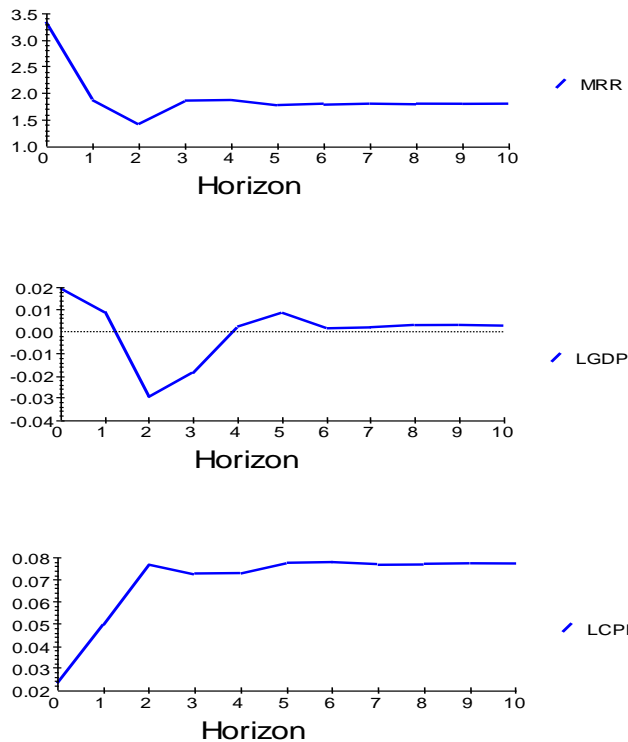


Figure 4: Impulse response of minimum rediscount rate shocks

The dynamic responses of all the variables in the system to the shock in Monetary policy rate are shown in Figure 4, the response of Monetary policy rate to its own shock is quite largely positive especially at the beginning of first year, but drops sharply to minimum positive level at second year with a small increase from the third year, and the positive effects continuous in the

² Monetary policy rate (MPR) was introduced in December, 2006. Before then, minimum rediscount rate (MRR) was used. So, for periods before December, 2006, MRR was used to proxy MPR.

same path to the end of forecast period. Real GDP responded positively to the monetary policy rate shock; although its dropped subsequently to negative in the second year but significantly increase thereafter to its positive effects although it seem the positive response approaches value zero in the later periods. We observe that an innovation in the Monetary policy rate, which corresponds to a concessionary monetary policy, has positive significant effect on prices, more specifically in the long run, with minimum positive response in the early periods.

Shocks to Government Revenue

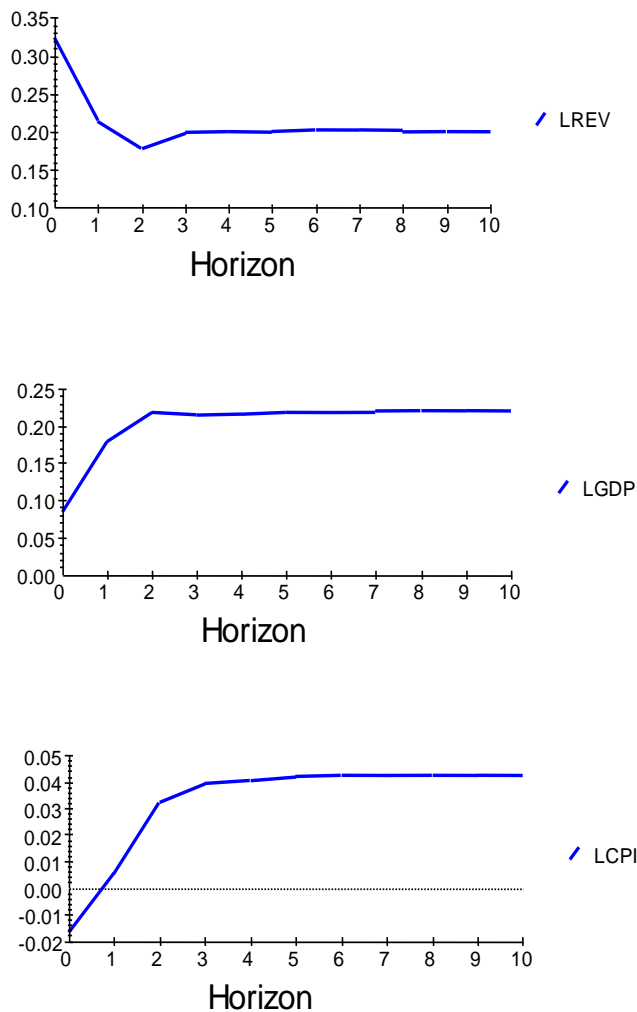


Figure 5: Impulse response of government revenues shock

Shocks to Government revenue, as shown in Figure 5, below, resulted in positive response by itself, but declined in the second year, and rose up again in the third period and it's remained in the same path to the end of the study period. Real GDP and consumer price index had similar positive responses to Government revenue shocks. The positive impact on revenues continues to be persistent. The response of inflation to Revenue shock initially is negative in the first year, but there are significant increases earlier in the second year toward a positive effect, over the long run inflation responded positively.

Shocks to Government Expenditure

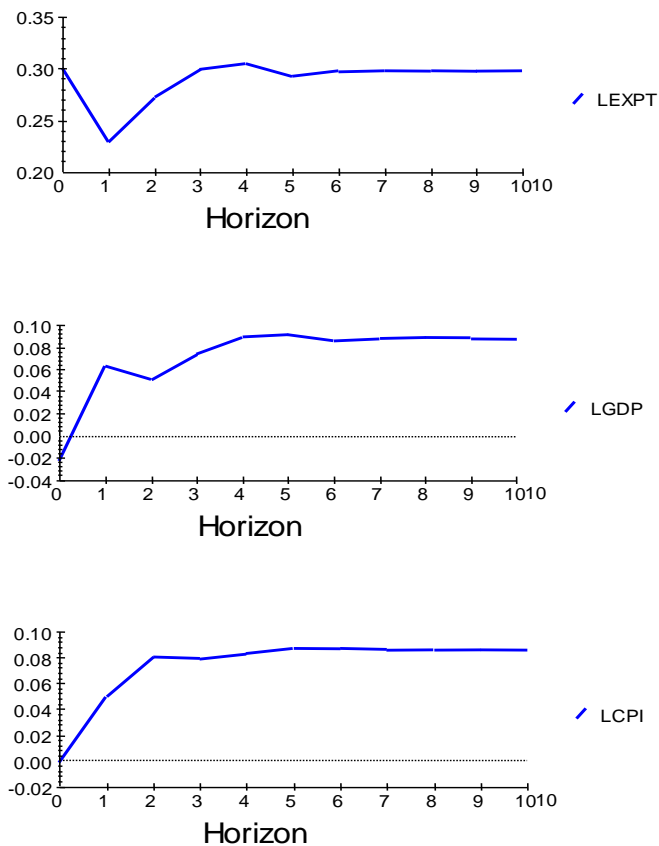


Figure 6: Impulse response of government expenditure shocks

Figure 6 reflects the impulse responses of a shock to government expenditure. There is significant positive response to the government expenditure itself from the first year to the end of ten years forecast period but with minimum

value at the end of first year. Real GDP responded briefly negatively to government expenditure shock in the first year which later toward the half of the same pick up to positive impact. Although, the real GDP responded positively but its response is high in the later periods. Inflation responded positively but with a relatively small magnitude.

4.5 VEC Model Forecast Error Variance Decomposition

The results of variance decomposition at VEC Model reveal the forecast error in each variable that can be attributed to innovations in other variables over ten year periods. In VEC Model, the forecast error variances of all the variables in the system are largely due to their own innovations, although over time the innovations of other variables show a tendency to increase gradually. Forecast error variance decompositions are presented in the Tables 7 and 8, which help identify the main channels of influence for individual variables. The number under each variable represents its percentage of variance that was attributable to the dependent variable over a 10 year period.

Variance of Gross domestic product

Table 5: Variance Decomposition of GDP

Period	S.E.	GDP	CPI	MSP	EXG	MRR	REV	EXPT
1	0.320063	83.94548	0	0.300003	0.107553	0.477539	11.1501	4.019329
2	0.468073	80.59338	0.01728	1.251237	0.221434	0.381788	15.43054	2.10434
3	0.595899	76.46285	0.099009	2.431264	0.824362	0.235613	18.17084	1.776058
4	0.696376	75.31301	0.167605	3.09286	0.862218	0.174685	18.99216	1.397456
5	0.78229	74.8567	0.189669	3.691847	0.85473	0.204873	19.05244	1.149744
6	0.859511	74.47776	0.221973	4.096243	0.820601	0.247233	19.13698	0.999208
7	0.930749	74.16116	0.248903	4.378391	0.822835	0.255854	19.22891	0.903943
8	0.996893	73.9391	0.266416	4.595314	0.8185	0.262	19.29173	0.82694
9	1.058913	73.76689	0.279123	4.768473	0.814025	0.269808	19.33442	0.767263
10	1.11748	73.62867	0.289963	4.904355	0.809816	0.275903	19.37095	0.72034

Cholesky Ordering: LMSP EXG MRR LREV LEXPT LGDP LCPI

According to Table 5, real GDP accounted for its contemporary variance from its own innovations with about 84 per cent in the first year, although it shows gradual decline from about 84% in the first year to about 74 % in the long term. There was some variation caused by government revenue and Money supply with about 11 and 1 per cent respectively in the early periods.

However, in later periods, government revenue and money supply increasingly contributed to variations of real GDP with about 19 and 5 percent in later periods, respectively. Although other variables made very little contribution to the variance of real GDP, the impact of revenue and money supply is more, especially in the later periods.

Variance of Consumer price Index

Variance decomposition of inflation is given also in Table 8. Variance of consumer price index was caused largely by its own innovations in the initial period with 58 percent. While the contributions of consumer price index, GDP and exchange rate reduced over time, all other variables in the system increased in their contributions. For instance, the contributions of money supply and monetary policy rate increased to 24 and 10 percent respectively in the long run, while that of exchange rate declined over time.

Table 6: Variance Decomposition of CPI:

Period	S.E.	GDP	CPI	MSP	EXG	MRR	REV	EXPT
1	0.320063	3.711275	58.13017	4.441665	9.569887	10.18643	13.89597	0.064603
2	0.468073	2.995588	46.4553	12.29317	8.066813	13.77134	15.29257	1.125211
3	0.595899	2.651315	41.44924	17.37257	6.243782	17.01023	13.92665	1.346219
4	0.696376	2.529178	40.14522	19.94486	5.614554	17.58365	12.93345	1.249079
5	0.78229	2.457839	39.26064	21.514	5.233003	17.78365	12.48958	1.261278
6	0.859511	2.410964	38.50805	22.54431	4.909136	18.09783	12.2397	1.290007
7	0.930749	2.383234	38.03942	23.22934	4.687424	18.31438	12.05363	1.292573
8	0.996893	2.363976	37.72738	23.72188	4.540026	18.43593	11.91911	1.29171
9	1.058913	2.348932	37.48245	24.09632	4.427105	18.53059	11.82075	1.293859
10	1.11748	2.337279	37.28984	24.38719	4.337632	18.60883	11.74391	1.295316

Cholesky Ordering: LMSP EXG MRR LREV LEXPT LGDP LCPI

5.0 Conclusion and policy implication

We evaluated the economic growth of Nigeria in a VEC model and the dynamic correlations of variables have been captured by the analyses of impulse response and variance decomposition. We observe that monetary and fiscal innovations are not all neutral in the short-term or long term; rather, these innovations depend on the policy instruments used. Money supply was seen to be a positive and significant function of both the consumer price index and the real gross domestic product.

That money supply was found to impact positively on economic growth corroborates with the findings of Suleman *et al.* (2009). The stock of money exerts a positive and significant influence on the growth of the economy and at the same time generates increase in prices, which are found to have significant reducing effect on the growth of the economy. One of the key findings is that fiscal policy matters for economic growth.

The results also show that Government revenue exerts a positive and significant influence on the growth of the economy and at the same time generates increase in prices. This is because the expenditure decision of the Nigeria government is significantly determined by the total government revenue. Although monetary and fiscal policy have a dominant effect on economic activity, it is clear from this study that economic activity is dominated by its own dynamics in most of the periods. Hence, we recommend that the coordination between the stabilization policy (fiscal and monetary policies) be sustained.

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