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Emmanuel T. Adamgbe
Central Bank of Nigeria, etadamgbe@cbn.gov.ng

Peter D. Golit
Central Bank of Nigeria, pdgolit@cbn.gov.ng

Izuchukwu I. Okafor
Central Bank of Nigeria, iiokafor@cbn.gov.ng

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Emmanuel T. Adamgbe, Peter D. Golit and Izuchukwu I. Okafor*

Abstract

In Nigeria, anecdotal evidence suggests that the fiscal operations of government, especially disbursements from the Federation Account to the three-tiers of government, had over the years created liquidity challenges requiring aggressive monetary management. Against this background, this paper addresses two questions: (i) Does government spending have significant spillover effects on inflation in Nigeria? (ii) Does government spending induce a concomitant response by the CBN? In addition, unlike the sparse literature in Nigeria on these two issues, which essentially relies on constant parameter models, we use a time-varying parameter vector autoregressive (TVP-VAR) model with stochastic volatility. Applying this framework allows us not only to identify the general relationship between the variables of interest; it also permits us to understand the dynamics of these variables over time in line with the underlying macroeconomic structure of the economy. The posterior estimates of the means show that the response of inflation to a government spending shock was relatively stable for the period prior to 1990 over the estimation sample. A tendency to elevate prices became pronounced between 1990 and 2011. Concomitantly, short-term interest rate (prime lending rate) had shown greater variability in terms of its response to government expenditure shocks in the period 1990 to 2011 as in the case of inflation.

Keywords: Government spending shocks; Bayesian inference; Markov chain Monte Carlo; Time-varying parameter; Monetary policy; Stochastic volatility

JEL Codes: C11, C15, C32, E52

Authors' E-mail: etadamgbe@cbn.gov.ng; pdgolit@cbn.gov.ng; and iiokafor@cbn.gov.ng

I. Introduction

Fiscal dominance in most developing economies has been viewed as an anathema to the effectiveness of monetary policy. It is said to create liquidity surfeit that seemingly undermines consistency in the implementation of monetary policy. The problem gets aggravated if the central bank monetizes the government deficit fuelling inflation, a key objective of monetary policy. Bond financing arguably a better option for financing government spending, may result in the inflow of portfolio capital that is subject

* *Emmanuel Adamgbe, Peter Golit and Izuchukwu Okafor are staff of the Research Department in the Central Bank of Nigeria. The usual disclaimer applies.*

to reversal if macroeconomic conditions become adverse. At the domestic front, there is an apparent crowding-out effect on the core private sector credit.

In the light of these developments, the central bank deploys a variety of policy measures available to it to contain adverse effect of anticipatory spending shocks. Some of these measures include adjustments of the policy rate, conduct of open market operations (OMO), cash reserve requirements, standing facilities and repurchase transactions. However, monetary policy could be overstretched against the backdrop of providing adequate liquidity, financial market efficiency and avoiding macroeconomic distortions.

In Nigeria, anecdotal evidence shows that government spending had over the years created liquidity challenges requiring aggressive monetary management. Against this background, this paper addresses two questions: (i) Does government spending have significant spillover effects on inflation in Nigeria? (ii) Does government spending result in a concomitant response in the monetary policy instrument? The empirical literature produces inconclusive evidence on how the objectives of monetary policy are undermined by fiscal policy. Also, the time varying response of monetary policy anchors is still sparse and evolving. Nnanna (2001, P. 11) brings out the time dimension by noting that while monetary policy in Nigeria was relatively successful under an indirect rather than direct monetary policy regime, the effectiveness of monetary policy has been undermined by the effects of fiscal dominance. Batini (2004) is more specific in suggesting that in the 1980s and 1990s, monetary policy was often constrained by fiscal indiscipline that encouraged a loose monetary policy stance leading to high inflation and significant exchange rate misalignment. Folawewo and Osinubi (2006) suggested, central bank independence could be eroded, if it accommodates fiscal policy through the monetization of fiscal deficits, thereby causing volatility in the inflation and exchange rates. In addition, unlike the sparse literature in Nigeria on these two issues, which essentially relies on constant parameter models, we use a time-varying parameter vector autoregressive (TVP-VAR) model with stochastic volatility.

TVP-VARs are quite common in the analysis of macroeconomic issues and allow us to capture the time-varying nature of the underlying structure in the economy in a more flexible and robust manner (Nakajima, 2011). Therefore, this paper makes the first attempt, to analyze for Nigeria, the time-varying spillover effects of government spending shocks on inflation and monetary policy using the TVP-VAR approach. While we have a fair understanding of the major structural changes and shifts in monetary policy regimes in the economy over the period of the analysis, their possible effects on the variables under consideration are evaluated in the TVP-VAR model.

The rest of the paper is organized as follows: Section 2 discusses the literature, while section 3 presents the data and methodology of the TVP-VAR technique. Section 4 analyses the results of a shock of government spending on inflation and the monetary policy interest setting behavior. Finally, section 5 concludes the paper.

II. Literature Review

Studies on the relationship between government spending and monetary policy abound, with mixed results. While some studies argued that government spending does not necessarily undermine monetary policy, others agreed to the contrary.

Several studies show the apparent connect between government spending and monetary growth. Karpetis and Varelas (2006) developed a simple dynamic New Keynesian type model using the multiplier – accelerator principle to examine the quantitative impact of changes in the level of government expenditures and the growth rate of nominal money supply on the level of several macroeconomic magnitudes. They found that the equilibrium values of actual and expected inflation are proved to be affected by government expenditures and the growth rate of nominal money supply.

While Jiranyakul (2007) acknowledges the government spending-money nexus, this was found to be consistent only for the quasi measure of money. Investigating causality and cointegration, using Thai-data for the year 1993 to 2004, he finds no co-integration among public spending, economic growth and money supply, but a unidirectional causality among economic growth, public spending and Quasi-money supply (M2). However, using 1973 – 2004 data for Saudi Arabia, Albatel (2007) employs granger causality test and finds a bi-directional causality between broad money supply (M2), government expenditure and economic growth.

Effects of government spending on key macroeconomic indicators have also been highlighted in the literature. Hall (2009) and Woodford (2011) deployed the New Keynesian paradigm to understand the effects of government spending in general, and to evaluate in what sense current conditions are special relative to historical experience. The findings indicate that an unexpected increase in government consumption will induce a large output expansion if monetary policy is accommodative. Unexpected increases in government spending would normally create inflation. If the monetary authority reacts strongly to inflation, the real rate will increase, increasing private savings. If, instead, an unexpected government expenditure expansion is accompanied by a (temporarily) weak response of the nominal rate to inflation, the real rate may fall, stimulating both

consumption and investment expenditure. In the unlikely case where the real rate is unchanged after a spending shock – this requires a one-to-one adjustment of the nominal rate to changes in inflation - the output multiplier is 1, and private spending will be unaffected by the shock.

Coenen et al. (2010) also confirms that, in normal conditions, expenditure increases induce modest aggregate demand effects. The short run effects could be magnified if spending increases come with provisions for future spending cuts (but not future tax increases); if monetary policy is accommodative; if pricing frictions are important; or if price markups are strongly countercyclical. Clearly the findings from Hall (2009) and Coenen, et al. (2010) suggest that prevailing domestic conditions are critical to government spending, either creating problems for monetary policy or otherwise. These findings corroborate the work of Mohanty (2012) which submits that in a Ricardian world, fiscal deficits and debt have no consequences for interest rates, as the private sector saves the full extent of discounted tax liability implied by a rise in the fiscal deficit. In a non-Ricardian world, however, changes in fiscal deficits can lead to changes in interest rates.

Ravn, Schmitt-Grohé and Uribe (2012), analyses the effects of unanticipated changes in government spending using the SVAR methodology proposed in Blanchard and Perotti (2002). Based on data from a panel of four industrialized countries, they find that an increase in government spending produces an expansion in output, an expansion in consumption, a depreciation of the real exchange rate, and a deterioration of the trade balance. Perhaps with preference for price stability and limited policy instrument, a country would worry about external balance and real exchange rate depreciation if the non-tradable sector is dominant. Such is the case for an oil producing developing country like Nigeria.

Corsetti, Meier and Müller (2012) tried to capture the dynamic response of key macroeconomic variables to a government spending shock. They specifically considered the responses of eight variables of interest: output and its components (private consumption, private fixed investment, and the trade balance), the real effective exchange rate, CPI inflation, the short-term nominal interest rate, and, of course, government spending itself. Using a panel of OECD countries, they identified fiscal shocks as residuals from an estimated spending rule and traced their macroeconomic impact under different conditions regarding the exchange rate regime, public indebtedness, and health of the financial system. They found that real exchange rate responded to a spending shock and varied systematically with the exchange rate regime. This underscores the importance of interactions between fiscal and monetary policy which they

proposed as an interesting avenue for future research, especially in an open economy context.

Kollmann (2010) considered a two-country model with incomplete financial markets and flexible prices, and showed that an increase in public spending in one country can depreciate its real exchange rate, provided that labor supply is highly elastic. As noted by López et al. (2011), for 54 emerging and developed countries, when the fiscal deficit expands by 1%, long-term interest rates rise between 10 and 12 basis points.

In Nigeria, Adeyeye and Fakiyesi (1980), using annual time-series data, spanning 1960-1977, estimated the hypothesis that the main factor responsible for instability of prices and inflationary tendencies in Nigeria had been government expenditure. Their result established some significant positive relationship between inflation rate and growth in bank credit, growth of money supply and growth in government expenditure. This result not-withstanding, it is difficult to substantiate the argument consistently overtime and require further investigation deploying a more recent technique that establishes the historical dimension of the relationship between government spending and the objectives of monetary policy.

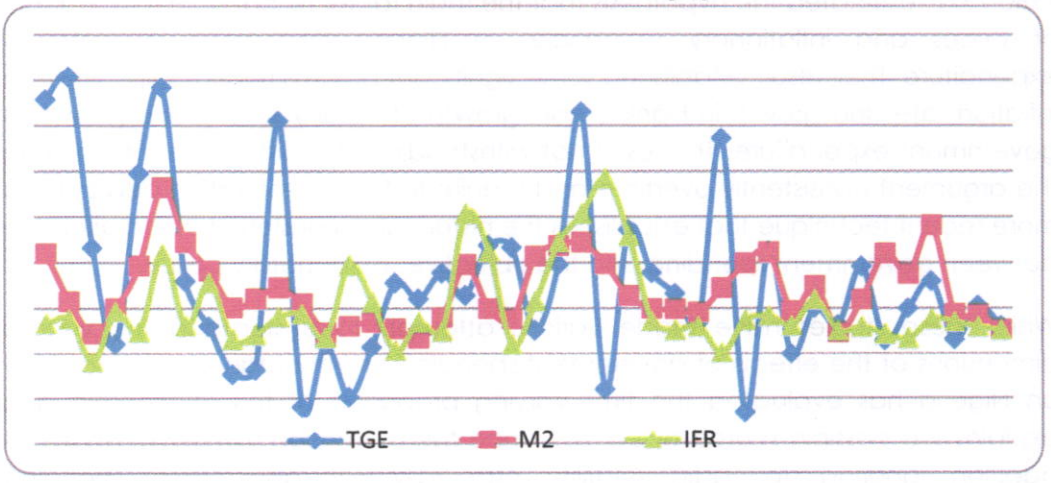
While these studies have made various attempts to understand the various dimensions of the effects of government spending on monetary policy, no study on Nigeria has evaluated the time-varying properties of this relationship and explains the possible source of conflict once the estimation sample changes. In addition, ignoring stochastic volatility, especially with government spending being pro-cyclical over the years could introduce an important source of distortion of the relationship between government spending and monetary policy over time.

III. Trends in Government Spending and Monetary Aggregates

Nigeria witnessed considerable increase in government spending for most part of the period spanning 1970 to 2011. Overall, cyclicality of government expenditure correlated strongly with the rate of change of broad money supply and the rate of inflation. Thus, periods of sharp increases and episodes of marked declines in government expenditure resulted in a similar response from broad money growth and rate of change of the price level. From 111.1% in 1970, the rate of growth in government spending rose to 121.6% in 1971 owing to the boom in the international crude oil market and the resultant increase in foreign exchange earnings. The rapid monetization of foreign exchange earnings resulted in massive injections that caused money supply to increase about 23.1 per cent with inflation rate also rising in the wake of inflationary pressures due to the non-sterilisation of the large inflow.

By 1980, the growth rate of government spending had moderated to 102.1%. The huge expenditures, however, led to a substantial growth in monetary aggregates as the broad money supply which had weakened to 8.6% in 1972 from the 23.1% recorded in 1971 peaked at an all-time high of 72.9% in 1975. The double digits growth in broad money supply persisted throughout the second half of the 1970s, before moderating to 29.1% in 1980. The ensuing inflationary pressures led to expansion in the rate of inflation from 13.1% in 1970 to 43.5% in 1975 before it eventually subsided to 16.1% in 1980.

Figure 1: Growth in Fed. Govt. Expenditure, TGE (%), Broad Money Supply, M2 & Inflation Rate, IFR (%)



The consequent drop in the growth of broad money supply in 1978 and 1979 caused a significant plunge in the rate of inflation which declined to single digit rates at 6.2% and 8.3% in 1978 and 1979, respectively (see figure 1 above).

By 1994, oil prices had reached their lowest levels since 1973. Government spending slowed and kept broad money supply on a deceleration path although inflation remained elevated due to the demand pressures that characterize the declining economic fortunes.

Following the return to civil rule in 1999, government expenditure recorded a higher negative growth rate in 2000 due to the active legislative scrutiny of spending plans to curtail wasteful expenditures. By 2002, the highly expansionary fiscal policy was financed mainly from a drawdown of government deposits in the banking system and the issuance of short-term debt. IMF Article IV 2002 reports that for "the first 8 months of 2001, federal government deposits with CBN fell by N373billion (58.4 per cent of end-2001 reserve money)", while "federal government overdraft facility from the CBN stood at N50 billion (7 per cent of

reserve money)". These developments entailed huge liquidity injections making it difficult to implement monetary policy.

The stance of monetary policy was accommodative with the prevailing expansionary fiscal stance as the broad money went up by 17.5 per cent in the first 9 months of 2001 higher than the targeted growth of 11.5 per cent. Bank credit to the federal government similarly rose 10 times higher than it was in the previous year as banking system holdings of Treasury securities increased as the CBN battled to mop up excess liquidity.

The pro-cyclicality of government spending continued in 2003, while the monetary policy stance remained expansionary. Although, the federal government started the implementation of fiscal consolidation strategies, the huge expenditure from the local and state governments due to oil windfall created problems for monetary policy. Bouts of inflationary pressures, higher than target reserve money and broad money meant the objectives of monetary policy were far from being attainable. Thus, money overhang and negative short-term interest rates prevailed by end-2003 and early 2004 and made the CBN intensified its OMO activities.

In 2004, government expenditure lulled following adherence to fiscal rule. The tight fiscal stance was accompanied concomitantly with a tight monetary policy stance. Strikingly, since the past 2 decades, monetary policy targets were realized owing to this fiscal regime. Additional reforms such as the CBN's withdrawal in purchases from the primary market of government securities and a shift to a more market based interest rate determination reinforced the efficacy of monetary policy. This development subdued pressures on the exchange rate and reduced inflation. However, the inability of the CBN to sterilize excess reserves that were being accumulated resulted in an increase in the broad money in the first quarter of 2005 by 25 per cent.

Fiscal consolidation continued into 2007 with the CBN meeting its inflation target. The continued implementation of the rule, liquidity mop up and appreciation of the naira were key drivers. The large liquidity injections arising from high oil receipts have challenged the implementation of monetary policy.

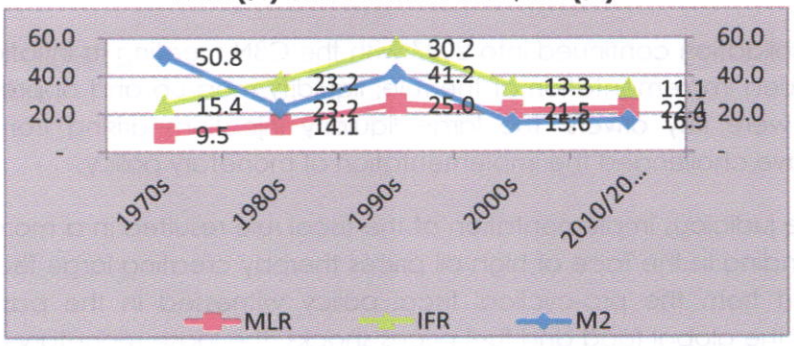
In 2009, the judicious implementation of the fiscal rule resulted in a more efficient public spending in the face of high oil prices thereby creating large fiscal buffers that depart from the pro-cyclical fiscal policy witnessed in the past. Largely caused by the global food and fuel prices shocks, the loose monetary conditions associated with stimulus plans to cushion the impact of food and fuel price hikes exacerbated the rate of inflation. The shut-down of access to borrowing reduced

the expenditure appetite of spending units at all tiers of government and moderated inflationary pressures.

Having weathered the storm of the financial and economic crises, the era of pro-cyclical fiscal policy re-emerged as government spending rose by 10 per cent in 2009 and 37 per cent in 2010. This was not unconnected with the increase in the wages of federal workers and the inability of the federal government to maintain the oil-based fiscal rule. An obvious aftermath effect of this development was the collapse of the sterilization of oil revenues which was implemented between 2005 and 2008, hence, eroding the fiscal buffers and sustaining inflation rate at double digit level. Monetary expansion was significant with the broad money growth at levels higher than 40 per cent. Consequently, short-term interest rates turned negative in real terms and pressures on the exchange rate continued to build-up. This led to CBN intervention in the foreign exchange market to stabilise the exchange rate.

The average movements depicted in figure 2 below suggest co-movements among the growth in monetary aggregates, the maximum lending rate and the rate of inflation under a largely liberalized economy (1980s to 2010/2011). From 23.2% in the 1980s, the growth in broad money supply (M2) averaged 41.2% in the 1990s, with the maximum lending rate and the rate of inflation rising from their average levels of 14.1 and 23.2%, respectively in the 1980s to 25.0 and 30.2% in the 1990s. In the 2000s, the broad money supply (M2) and the rate of inflation (IFR) both declined despite the marginal increase in the lending rate suggesting that inflation is a monetary phenomenon as government spending seemed to undermine the achievement of the primary goal of monetary policy specifically in the 1990s to 2000s under a largely liberalized financial system.

Figure 2: Average Growth in Broad Money Supply, M2; Maximum Lending Rate, MLR (%) and Inflation Rate, IFR (%)



However, the 1970s did not reflect the above pattern in view of the prevailing policy stance of the government under the largely controlled monetary regime where direct monetary control caused interest rates and inflation to vary somewhat differently with the average changes in broad money supply. It is instructive to note that the growth in lending rates and inflation both improved following a contraction in monetary aggregates in the 1980s. The varying pattern in the 1980s captured the non-responsiveness of prices to monetary growth in a regulated economy or regime of controlled prices. The outcomes of this trend analysis, thus, demonstrate that any government spending that influences money supply would affect the objectives of monetary policy in Nigeria. This is however, inconclusive and merely anecdotal which require further empirical investigation to evaluate the time-varying properties of the relationship between government spending and monetary policy objectives.

IV. Methodology

IV.1 Data

This paper utilises annual data for the period 1970 – 2011. The choice of annual data reflects the difficulty in obtaining fairly even fiscal data on a quarterly basis. The variables used in this paper are inflation, government expenditure, money supply, interest rate and the monetary policy rate. The choice of inflation is in view of its realization as the ultimate goal of monetary policy, as the success or failure of monetary policy is signaled by the prevailing rate of inflation. Government expenditure is the indicator variable for government spending and is thus, included in the model to capture the influence of public outlay on monetary policy. In the literature Kirchner, et al (2010) opines that government spending shocks are shown to be uncertain and inconclusive, while its inclusion also confers the advantage of capturing the spending multipliers in a fiscal policy setting. The Monetary Policy rate is chosen in recognition of its role as the dominant operating instrument in the conduct of monetary policy in Nigeria while Money Supply is the main intermediate target.

IV.2 The Model

The methodology adopted for this paper is the time-varying parameter VAR (TVP-VAR) model with stochastic volatility enunciated by Primiceri (2005). While the concept of stochastic volatility dates back to Black (1976), recent works in financial and macroeconomic analysis have relied on this idea (Shephard, 2005; cogley and Sargent, 2005; Nakajima, 2011). Nakajima (2011, pp. 108) for instance, observed that "in many cases, a data-generating process of economic variables seems to have drifting coefficients and shocks of stochastic volatility".

The TVP-VAR model is evidently a robust tool for the analysis of macroeconomic issues and reflects the time-varying characteristics of the underlying economic structure quite flexibly. This is because it allows for a deeper understanding of both temporary and permanent changes of the model parameters given that the specification benefits from a first-order random walk process. In addition, by capturing volatility in the disturbances, the estimated time-varying coefficients have the property of unbiasedness as opposed to the assumption of constant volatility in the disturbances.

Also, the use of Markov Chain Monte Carlo methods provides a Bayesian inference to estimating the TVP-VAR model allows for a robust tracking of the likelihood function. In terms of the time series characteristics, in the Bayesian VAR literature, it is common to work with macroeconomic variables in levels, without worrying about unit root or cointegration issues. In the TVP-VAR framework, unit root and cointegration are less important given the inclusion of an intercept in each equation which evolves according to a random walk process. This can account for any unit root non-stationarities in each dependent variable not otherwise explained by the lagged dependent variables which appear in each equation of the TVP-VAR. However, as a sensitivity and counterfactual analysis, the TVP-VAR is fitted on the growth rates of the included variables.

Consequently, following Primiceri (2005) and Nakajima (2011), we estimate a time-varying parameter VAR model with stochastic volatility of the form:

$$y_t = \beta_{1t} y_{t-1} + ... + \beta_{st} y_{t-s} + \upsilon_t, \qquad \upsilon_t \sim N(0, \Omega), \tag{3}$$

For $t = s+1, ..., n$, where, $\upsilon_t = A_t^{-1}\Sigma\varepsilon_t$, y_t is a (n x1) vector of observed variables, $\beta_{1,t} \cdots \beta_{st}$ are $(n \bullet n)$ matrices of time-varying coefficients, and Ω is a $(n \bullet n)$ time-varying covariance matrix. The triangular reduction scheme Ω is given by the decomposition, $A_t^{-1}\Sigma_t\Sigma_t A_t^{'-1}$, where A_t is a lower triangular matrix given by,

$$A_t = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ \alpha_{21,t} & 1 & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ \alpha_{n1,t} & \cdots & \alpha_{nn-1,t} & 1 \end{bmatrix}$$

, and, Σ_t, the diagonal matrix defined by

$$\Sigma_t = \begin{bmatrix} \sigma_{1,t} & 0 & \cdots & 0 \\ 0 & \sigma_{2,t} & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & 0 & 0 & \sigma_{n,t} \end{bmatrix}$$

As in Primiceri (2005), Nakajima (2011), $\alpha_t = \left(\alpha_{21},\ \alpha_{31},\ \cdots,\ \alpha_{n,n-1}\right)'$ is a stacked row vector of the lower-triangular elements in A_t; and, $h_t = \left(h_{1t}, \cdots, h_{nt}\right)'$, where $h_{jt} = log\sigma_{jt}^2$. The time-varying parameters are assumed to follow a random walk process as follows:

$$\beta_{t+1} = \beta_t + \eta_t,\ \alpha_{t+1} = \alpha_t + \lambda_t,\ h_{t+1} = h_t + \mu_t$$

$$\begin{pmatrix} \upsilon_t \\ \eta_t \\ \lambda_t \\ \mu_t \end{pmatrix} \sim N\left(0,\ \begin{pmatrix} I & 0 & 0 & 0 \\ 0 & \Sigma_\beta & 0 & 0 \\ 0 & 0 & \Sigma_\alpha & 0 \\ 0 & 0 & 0 & \Sigma_h \end{pmatrix}\right),$$

for $t = s+1,...,$ n, where $\beta_{s+1} \sim N\left(\eta_{\beta o},\ \Sigma_{\beta o}\right)$, $\alpha_{s+1} \sim N\left(\lambda_{\alpha o},\ \Sigma_{\alpha o}\right)$, $h_{s+1} \sim N\left(\mu_{ho},\ \Sigma_{ho}\right)$.

This way, the MCMC is applied to evaluate the joint posterior distributions of the parameters of interest under certain prior probability densities. Following Nakajima (2011), we assume the following priors for the i-th diagonal elements:

$$\left(\Sigma_\beta\right)_i^{-2} \sim Gamma\left(40,\ 0.02\right), \qquad \left(\Sigma_\alpha\right)_i^{-2} \sim Gamma\left(4,\ 0.02\right),$$

$$\left(\Sigma_h\right)_i^{-2} \sim Gamma\left(4,\ 0.02\right)$$

For the initial set of the time-varying parameter, flat priors are set such that: $\eta_{\beta o} = \lambda_{\beta o} = \mu_{ho} = 0$ and $\Sigma_{\beta o} = \Sigma_{\alpha o} = \Sigma_{ho} = 10 \times I$.

This framework allows us to identify the general relationship between government spending and monetary policy indicators. In addition, the approach also helps our understanding of the dynamics of these variables over time in line with the underlying macroeconomic structure and developments in the economy.

IV.2.1 Estimation Diagnostics

To compute the posterior estimates, we generate 40,000. While 30,000 were retained (M), 10,000 draws were discarded (N). To assess the robustness of the estimation under MCMC sampling algorithm, we calculate the convergence diagnostic (CD) proposed by Geweke (1992) to check for possible sampling bias in the posterior estimates of the distribution characteristic being investigated. The CD applies standard time-series techniques which rely on a single chain and proofs to be a robust test to evaluate the convergence properties of the mean of a given function of a sampled variable. The chain is split into 2 "windows": the first 0.1 and the last 0.5 proportions in the MCMC iterations in order to test for differences in the means of the 2 "windows". For the entire chain to be stationary, the 2 means should statistically be the same. The convergence diagnostic measured by the standard Z-scores which is computed by taking the differential of the 2 means, dividing it by the asymptotic standard error of this differential. As n tends to infinity (∞), the sampling distribution of Z tends to N (0; 1) if the chain has converged. Thus, once the values of Z falls in the extreme tails of N (0; 1), the chain, is yet converge.

The CD is complemented by an examination of the inefficiency factors, which are also due to Geweke (1992) and are obtained as the inverse of the efficiency factors. It should be noted that efficiency and well mixing of the Markov Chain are required properties of the MCMC sampling approach. While mixing is measured by the autocorrelation time, the efficiency factor is estimated by dividing the variance of the posterior by the variance of the sample mean generated from the MCMC sampling procedures.

IV.2.2 Dynamic Impulse Response Functions

Thereafter, to understand the dynamic relationship between government spending and monetary policy, the impulse responses are drawn from the estimated TVP-VAR system. Unlike constant parameter VAR estimates where the impulse responses are generated for a pair of variables, the impulse responses from a TVP-VAR model which uses the time-varying parameters include an extra aspect, calculated at all points in time.

V. Analysis of Results

V.1 Model Diagnostics

Table 1 gives the estimates for posterior means, standard deviations, the 95 percent credible intervals[1], the convergence diagnostics (CD) of Geweke (1992), and inefficiency factors, which are computed using the MCMC sample. From the result, we do not reject the null hypothesis of the convergence to the posterior distribution for the parameters using the 5 percent level of significance, indicating that the iteration process is adequate for the TVP-VAR and the inefficiency factors are low suggesting an efficient sampling for the parameters.

Table 1: TVP Regression Model with Stochastic Volatility

Parameter	Mean	Stdev	95%U	95%L	Geweke	Inef.
$(\Sigma_\beta)_1$	0.0137	0.0253	0.0041	0.0361	0.244	117.6
$(\Sigma_\beta)_2$	0.0135	0.0102	0.0041	0.0423	0.398	84.42
$(\Sigma_\alpha)_1$	0.0055	0.0016	0.0034	0.0095	0.967	12.86
$(\Sigma_\alpha)_2$	0.0056	0.0016	0.0034	0.0094	0.437	15.46
$(\Sigma_h)1$	0.0055	0.0016	0.0033	0.0095	0.502	12.6
$(\Sigma_h)_2$	0.0055	0.0016	0.0034	0.0095	0.736	10.25

V.2 Stochastic Volatility of Government Spending and other indicators in the TVP-VAR Model

The stochastic volatility of government spending and the other variables show the variance of a shock to government expenditure and these variables over the estimation sample had been largely stable. This is not unconnected with the fact that the pattern of behavior of these variables had largely been the same; high expenditure, strong monetary expansion, high interest rates and a tightening monetary policy stance which kept the policy rate at the same level for a long time before an adjustment.

V.3 Simultaneous Relationship of Government Spending and other indicators in the TVP-VAR Model

In terms of analyzing the simultaneous relationship, defined by the lower triangular matrix, the posterior mean estimates are plotted. For this paper, it gives the size of simultaneous impact of growth in money supply, inflation and interest rate as a result of a unit of government expenditure shock. The result as shown in figure 3

[1]According to Nakajima (2011) in Bayesian inference, "credible intervals" are used to describe the extent of parameter uncertainty, as opposed to "confidence intervals" that is very commonly used in the literature. Under the MCMC analysis, it is conventional to report the 2.5 percent and 97.5 percent quantiles of posterior draws as it is evident in the above results.

indicate that the simultaneous relation of growth in money supply to a shock in government expenditure (g→m) is positive at 0.15 percentage points, and remain constant over the estimation period. In other words, fiscal expansion increases the supply of money directly and through money creation by financial institutions.

Government spending comes at a cost and given the budget constraint and borrowing requirements, there is an observed increase in the lending rate (prime) as a result of an expenditure shock (g→r). This was about 0.01 percentage point in the early 1970, varying steadily over time to about 0.05 percentage point in early 2000 with a gradual decline thereafter to about 0.03 percentage point. This development coincided with the high interest rates in the early 1990's, with some improvements following financial liberalization that started around 1993. While pockets of distress in the banking sector witnessed between 2001 and 2006 accentuated the high interest rate situation, especially as the distressed banks increased their patronage of the interbank market. The slightly lower effect in the 1970s was due largely to the administration of interest rates and financial repression that characterized the financial sector.

In addition to the positive effect on interest rate, inflation remained positive to a shock to government spending (g→p), standing at about 0.2 percentage point between 1970 and 1985, but became dampened in the later years. In addition, a careful look at the simultaneous relation between monetary expansion (influenced by a government shock) and headline inflation (m→p) show that headline inflation rises by as much as 0.6 percentage point.

The inflation numbers mimics this development and more so that monetary policy rate (then minimum rediscount rate) responded positively to the anticipated liquidity surfeit in the economy (g→i). The monetary policy rate (then minimum rediscount rate) remained positive, varying over time in the estimation sample to reflect prevailing liquidity conditions. Similarly, a shock to the lending rate, say a hike, receives a response of as much as 0.75 percentage points of the monetary policy rate (r→i) in terms of their simultaneous relation and remains positive throughout the sample horizon. The effect was rather miniscule with a much aggressive tightening at the turn of financial liberalization initiatives in 1986. Consequently, the simultaneous effect rose gradually from 0.01 percentage point in 1970 to 0.06 percentage point around 2003 and largely at that level over the sample period. Indeed the response in terms of its simultaneous relationship, improved inflationary conditions in particular, the period 1996 – 2011, with average inflation rate standing at 13.35 per cent within a band of approximately (□) 6 standard deviations. It is also evident that the period of high monetary expansion accompanied by permanent shocks to market interest rates saw a

delayed deceleration of the high inflation numbers in most of the years reflecting the prevailing liquidity conditions.

An overview of the inflation numbers show that beginning from 1995 when headline inflation was highest at 75%, the inflation path has continued to decelerate generally following the aggressive monetary policy strategy. Since 1996, headline inflation statistics fluctuate around 15 per cent, occasionally hitting single-digit. Inflation volatility remained high in the 1990s. High spikes were witnessed around 1992 to 1995, due largely to election spending in the wake of the June 12, 1993 elections. Nigeria experienced episodes of high, moderate and low inflation in the last couple of decades. In the last few decades, Nigeria was saddled by some key economic challenges – volatile naira exchange rate, weak growth, huge external debt, weak commodity prices and falling external reserves. But these factors were strongly correlated with the government fiscal space and are, obviously, shocks to government expenditure.

Thus, the poor inflation outcome can be associated with the inability to contain government expenditure shocks in addition to the deep structural factors which influenced the pattern of expenditure. With the economy still far off from full employment and if government spending do not improve the productive sectors to enhance absorptive capacity, monetary policy would struggle in keeping with its ultimate objective since monetary policy has a limit.

V.4 Time Varying Impulse Response Functions

V.4.1 Dynamic Response to government expenditure shocks

The posterior estimates of the means in figure 4 show that the response of inflation to a government shock was relatively stable for the period prior to 1990 over the estimation sample. A tendency to elevate prices became pronounced between 1990 and 2011. The 4-period ahead response shows that volatility in the shorter period exceeded those in the 8- and 12-period, respectively. These obviously suggest a negative long-run effect of fiscal expansion on the inflation rate. At a horizon of 4 periods, the response of the inflation rate was almost zero in 1973, but it rose to about 3.0 percentage points in 2011. The impact is however less at a horizon of 8 and 12 years, standing at approximately 1.0 percentage point in 2011. This is a reflection of a higher impact in short horizons.

Concomitantly, interest rate had shown similar variability in terms of its response to government expenditure shocks in the period 1990 to 2011 as in the case of inflation. The main reason for this behavior is due to the regime of control that characterized the administration of interest rates and credit ceilings to the so-called preferred sectors. The attendant financial repression kept interest rates at

less-than competitive levels concealing the plausible effect of government spending induced liquidity.

Money supply's response in 1970 to 1989 was huge reflecting the oil boom driven expenditure and reconstruction works following the civil war. The banking crisis of the late 1980s and early 1990s, however, slowed down the growth of money supply as the recession in those years reduce government revenue and possible fiscal profligacy, in particular, receipts from the exports of crude oil exports fell substantially. The subsequent borrowing led to the ballooning of the monetary aggregates, which only nosedived in the wake of the second-round effect of the global financial and economic crises in 2009.

VI. Conclusion

Applying a time-varying framework with stochastic volatility allowed us to identify the general relationship between government spending and monetary policy and also enabled us to understand the dynamics of these variables over time in line with the underlying macroeconomic structure of the economy. The posterior estimates of the means show that the response of inflation to a government spending shock was relatively stable for the period prior to 1990 over the estimation sample. A tendency to elevate prices became pronounced between 1990 and 2011. Concomitantly, interest rate had shown similar variability in terms of its response to government expenditure shocks in the period 1990 to 2011 as in the case of inflation. The above evidence suggests that except for the control regime that resulted in financial repression, there is a spillover effect of government expenditure shocks to monetary growth, inflation and interest rate.

It is evident that the poor inflation outcome over the years can be associated with the inability to contain government expenditure shocks in addition to the deep structural factors which have strong correlation with government fiscal space. With the economy still far off from full employment and if government spending do not improve the productive sectors to enhance absorptive capacity, monetary policy would struggle in keeping with its ultimate objective since monetary policy has a limit. Reducing government expenditure however is not the real answer to enhancing monetary policy, but a directed expenditure that would contain deep structural factors such as energy could greatly provide the antidote for monetary policy implementation challenges.

Figure 3: Posterior estimates of free parameters

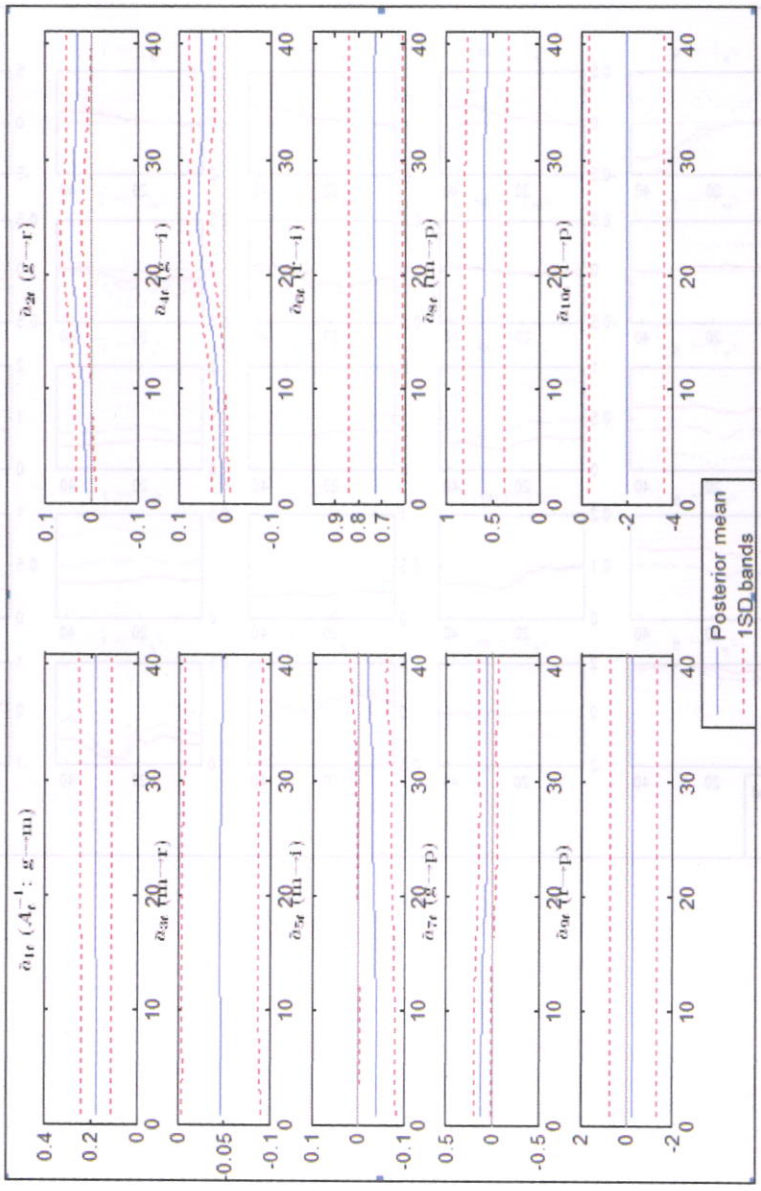
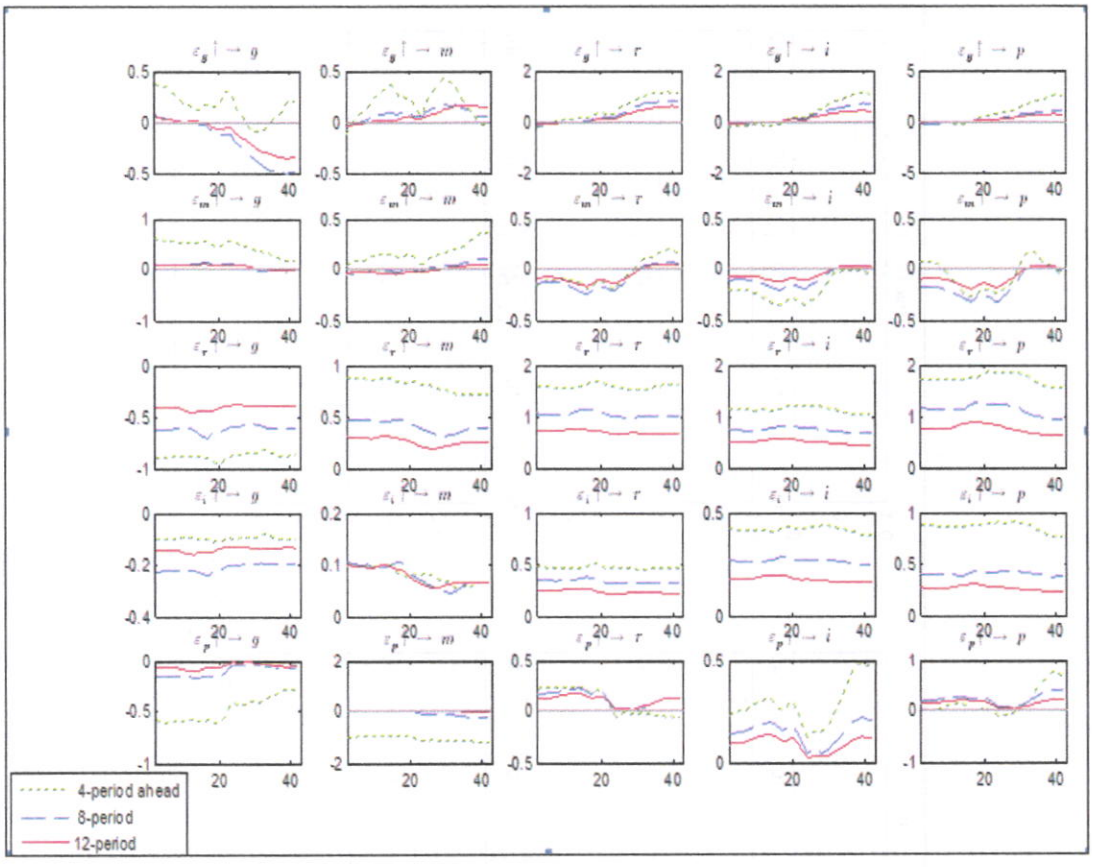


Figure 4: posterior means of time varying impulse functions – 4-, 8- and 12 - period ahead



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