Monetary and Fiscal Policy Interactions in Nigeria: An Application of a State-Space Model with Markov-Switching

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This paper uses quarterly data to explore the monetary and fiscal policy interactions in Nigeria between 1970 and 2008. As a preliminary exercise, the paper examines the nature of fiscal policies in Nigeria using a vector autoregression (VAR) model. The simulated generalized impulse response graphs generated from the VAR estimation provides evidence of a non-Ricardian fiscal policy in Nigeria. Further, the paper analyzes the interactions between monetary and fiscal policies by applying a State-space model with Markov-switching to estimate the time-varying parameters of the relationship. The evidence indicates that monetary and fiscal policies in Nigeria have interacted in a counteractive manner for most of the sample period (1980-1994). At other periods, we do not observe any systematic pattern of interaction between the two policy variables, although, between 1998 and 2008, some form of accommodativeness can be inferred. Overall, the results suggest that the two policy regimes (counteractive and accommodative) have been weak strategic substitutes during the post 1970 (Civil War) period. For the policy maker, our results imply the existence of fiscal dominance in the interactions between monetary and fiscal policies in Nigeria, implying that inflation, predominantly results from fiscal problems, and not from lack of monetary control.

Keywords: Monetary-fiscal policy interaction; State-space models; Markov-switching, Fiscal Theory of the Price Level (FTPL).

JEL Classification: E31, E63, H5

1. Introduction

Monetary and fiscal policies are the two most important tools for managing the macroeconomy in other to achieve high employment rates, price stability and overall economic growth. An important issue that has exercised the minds of macroeconomist is the understanding of how the dependence, independence and interdependencies between monetary and fiscal policies could lead the economy closer or further away from set goals and targets.

In a poorly co-coordinated macroeconomic environment, fiscal policies might affect the chances of success of monetary policies in various ways, such as: its eroding impact on the general confidence and efficacy of monetary policy, through its short-run effects on aggregate demand, and by modifying the long-term conditions for economic growth and low inflation. On the other hand, monetary policies may be accommodative or counteractive to fiscal policies, depending on the prevailing political and economic paradigms.

After the prosecution of the Nigerian Civil war in 1970, diverse monetary and fiscal policies measures were employed to reconstruct the economy and to put it on a sustainable growth trajectory. These efforts may have been bolstered or undermined by the nature of the interactions between monetary and fiscal policies in Nigeria. This paper hypothesizes that the interactions between monetary and fiscal policies in Nigeria, have been characterized by regime-shifts, which can be demarcated into two phases of accommodative and counteractive policies.

The objective of the paper is therefore, to examine the hypothesis of regime-shifts in the interactions between monetary and fiscal policies in Nigeria during the Post Civil War era (1970-2008). To that end, we employ a state-space (Ss) model with Markov-switching (Ms) properties to examine this behaviour. This exercise is justified because to the best of my knowledge, it does not only pioneer the application of the Ss-Ms model for the analysis of policy interactions in Nigeria, it inherently provides insights about the validity or otherwise of the fiscal theory of the price level in Nigeria.

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The rest of the paper is organized as follows. In Section 2, the paper discusses the issues in the literature and theory of monetary-fiscal policy interactions. Section 3 examines the preliminary evidence on the fiscal theory of price level determination in Nigeria. Section 4 specifies the State-space model with Markov-switching properties. The Kalman algorithm for the one-step ahead forecast is also described. Section 5 presents the results and the synthesis from the results, while Section 6 contains the conclusion.

2. Issues on Monetary-Fiscal Policy Interactions

Numerous studies have examined the interactions between monetary and fiscal policies (see for example Semmler and Zhang, 2003; Fialho and Portugal, 2009; Sargent, 1999 and Leith and Wren-Lewis, 2000). Most of these studies have focused on three basic issues (theoretical and empirical) on the interactions between monetary and fiscal policies. These issues include: the fiscal theory of price level determination, strategic interaction, and time-varying regime changes in policy interactions. The major issue that has been prominent in most of these studies is the issue of the "fiscal theory of price level determination" (FTPL). The FTPL has been studied by Leeper (1991), Sims (1994, 1997 and 2001), Woodford (1994, 1995 and 2000), Semmler and Zhang (2003), among others. These studies seek to analyze the "non-Ricardian" fiscal policy, which specifies the time paths of government's debt, expenditure and taxes, without considering the government's intertemporal solvency, such that, in equilibrium, the price level has to adjust to ensure solvency (Semmler and Zhang, 2003).

The introduction of the non-Ricardian fiscal policy into a standard New-Keynesian monetary sticky price model alters the stability conditions associated with the central bank's interest rate policy[2]. The process through which this occurs is simple. First, fiscal policies affect the equilibrium price-level. An increase in the price level reduces the real value of the net assets of the private sector or, equivalently, the net government liability. The reduction of private sector wealth reduces private-sector demand for goods and services through direct wealth effect. As a result, there will be only one price level that results in aggregate demand that equals aggregate supply. Changes in expectations regarding future government budget also have similar wealth effects that require an off-setting change in the price level in order to maintain equilibrium.

Under this non-Ricardian fiscal policy, one thus arrives at a theory of price-level determination in which fiscal policy plays the crucial role, because the effects of price-level changes on aggregate demand depends on the size of the government budget and also due to the off-setting wealth effects of expected future government debt (Semmler and Zhang, 2003).

Following Woodford (1995), the fiscal theory of price level determination can be presented thus: Let P_t denote the price level at time t, W_t the nominal value of beginning-of-period wealth, g_t government expenditure in period t, T_t the nominal value of net taxes paid in period t, R_t^b the gross nominal return on bonds held from period t, to $t+1$ and R_t^m the gross nominal return on the monetary base. Other variables are defined thus:

$$\tau_t = T_t/P_t \ (real\ tax)$$
$$\Delta_t = (R_t^b - R_t^m)/R_t^b \ ('price' of\ holding\ money)$$
$$r_t = \left(\frac{P_t}{P_{t+1}}\right) - 1 \ (real\ rate\ of\ return\ on\ bonds)$$
$$m_t = M_t/P_t \ (real\ balances)$$

Under this circumstances the equilibrium condition that determines the price level P_t at time t, given the predetermined nominal value of net government liabilities W_t, and the expectations at date t, regarding the current and future values of real quantities and relative prices can be expressed as:

[2] Benhabib et al. (2001) demonstrate the conditions under which interest rate feedback rules that are used to set the nominal interest rate as an increasing function of the inflation rate induces aggregate instability. They find that these conditions are partly affected by the monetary-fiscal policy regime emphasized in the fiscal theory of the price level.

$$\frac{W_t}{P_t} = \sum_{s=t}^{\infty} \frac{(\tau_s - g_s) + \Delta_s \mathrm{m}_s}{\prod_{j=t}^{s-1}(1 + r_j^b)} \qquad (1)$$

Woodford (1995) explains the mechanisms by which the price level adjusts to satisfy the equilibrium condition in Equation (1) under assumptions of long-run price flexibility[3]. The mechanism is such that an increase in the nominal value of outstanding government liabilities or size of real government budget deficit expected at some future date is inconsistent with equilibrium at the existing price level. Either change causes households to believe that their budget set has expanded, and so, they demand additional consumption immediately. The consequence will be an excess demand for goods, and price level will therefore increase, to the extent that the capital loss to the value of private-sector assets restores household's estimates of their wealth to ones that just allow them to purchase the quantity of goods that the economy can supply. Woodford (1995) emphasized that in the special case of the "Ricardian" policy regime, the fiscal mechanism described above, fails to play any role in the price level determination.

An examination of the monetary-fiscal policy interactions within the FTPL framework is essential for a country like Nigeria, where government's fiscal deficits as a ratio of GDP have largely been significant, averaging around -3.89 and government's debt as a proportion of GDP has fluctuated between 9 and 41% from 1970 to 2008[4]. These significant ratios, intuitively suggests that fiscal policies may have a significant influence on the price level in Nigeria. Overall, the principle of the fiscal theory of the price level (FTPL) implies that unless specific measures are taken to implement a coordinated fiscal policy, the objective of price stability may not be achieved even with a committed, independent and "non-discretionary" monetary policy regime.

Despite its popularity and general acceptability, the FTPL has come under intense criticisms on the theoretical and empirical formulations. Buiter (2001), Semmler and Zhang (2003), and Canzoneri et al. (2000) provide some detailed criticism on the FTPL. Another prominent issue in the literature on the monetary-fiscal policy relations is the analysis of the "strategic-interactions" between monetary and fiscal policies. Some examples of studies that explore the strategic interactions between monetary and fiscal policies include Cantenaro (2000), van Anarle et al. (2002) and Wyplosz (1999). The work by van Anarle et al. (2002) was particularly interesting because they considered the interactions between monetary and fiscal authorities in a differential game framework. They derived explicit solutions for the dynamics of fiscal deficit, inflation and government debt in a cooperative and Nash open-loop equilibrium framework. From their results, they identified three alternative policy interactions: (1) non-cooperative monetary and fiscal policies, (2) partial-cooperation and (3) full-cooperation; both in the symmetric and asymmetric settings.

Although the work by van Anarle et al. (2002) and most other works on monetary –fiscal policy interactions are theoretical, recent studies on this relationship have been empirical. For example, Fialho and Portugal (2009) studies the interactions between monetary and fiscal policies in Brazil using a Markov-switching vector autoregression model. By applying the fiscal theory of the price level, they propose that there is a relationship between public debts (a measure for fiscal policy) and Selic (their measure for monetary policy). They also assume the existence of two regimes and possibility for switching between the two. From their results, they conclude that the nature of macroeconomic coordination between monetary and fiscal policies in Brazil follows a "substitution- approach", throughout the period of the study, with a dominant monetary regime, in opposition to the non-Ricardian policies of the fiscal theory of the price level.

Another fascinating empirical study is the one by Canzoneri et al. (2000) who studies the fiscal regime of the U.S with VAR models, arguing that Ricardian regimes are as empirically plausible as non-Ricardian regimes, and provide interpretations of certain aspects of monetary and fiscal policy interactions. Melitz (1997) uses pooled data for 15 member states of the European Union (EU) to undertake some estimation, and find that coordinated macroeconomic policies are in practice in the region. Specifically, they conclude that "easy-fiscal" policy leads to "tight-monetary" policy and "easy-monetary" policy, to "tight-fiscal" policy.

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[3] This assumption may not always be plausible because within the Keynesian framework, prices may be sticky in the short-run.

[4] Computed by author with data sourced from CBN Statistical Bulletin, Anniversary Edition.

In a very influential paper, Muscatelli et al. (2002) estimated VAR models with both constant and time varying parameters for G7 countries and found that monetary and fiscal policies where used as strategic complements, and that the strategic interdependence between monetary and fiscal policies can be captured using Bayesian VAR models. The finding and recommendation by Muscatelli et al. (2002) influence the study by Semmler and Zhang (2003) that use both a VAR and a State-space model with Markov-switching to analyze the interactions between monetary and fiscal policies in the Euro-Area. Their results reveal that there exist some regime changes in the monetary and fiscal policy interactions in France and Germany.

The approach that is adopted in this work is substantially influenced by the recommendations that emerged from the findings of Muscatelli et al. (2002). That is, the interdependence between monetary and fiscal policies can be adequately captured in a Bayesian VAR model with Markov-switching characteristics. The approach we adopt also draws from the "State-space" refinement introduced by Semmler and Zhang (2003). Thus, this paper analyzes the monetary-fiscal policy interactions in Nigeria, using a State-space Markov-switching VAR model.

3. Preliminary Evidence from Nigeria

Before analyzing the hypothesized regime switching nature of the interactions between monetary and fiscal policies in Nigeria, we first undertake some preliminary empirical research on the nature of fiscal policies in Nigeria, using a simple VAR framework. The rationale behind our preliminary investigation is to test whether the fiscal regime in Nigeria has followed the "Ricardian" or "non-Ricardian" approach, to enable us ascertain whether the assumptions for the fiscal theory of price level determination are valid or invalid for Nigeria. The approach we adopt is in the spirit of Canzoneri et al. (2000) and Semmler and Zhang (2003). Thus, we exaime the interaction between two fiscal variables: fiscal balance and government liabilities. Government liabilities are measured by the Federal Government's domestic debt outstanding, and the fiscal balance is the overall surplus or deficit of government finances. We scale the two variables by dividing with nominal GDP. All the data sets are compiled from the CBN Statistical Bulletin, Special Anniversary Edition and are converted to quarterly frequencies by means of the cubic spline technique (see Lisman and Sandee, 1964 and Denton, 1971 for a description of this frequency conversion technique). Figure 1 plots the scatter between fiscal balance to GDP and government liability to GDP in Nigeria.

The Figure indicates that there exist a negative correlation between fiscal balances and government liability in Nigeria, with the correlation coefficient being -0.672. This suggests that net borrowing does not decrease when the fiscal balance decreases. Rather, it increases when the fiscal balance decreases. This observed relationship suggests the existence of "non-Ricardian" fiscal policy in Nigeria.

Further, we undertake VAR estimation for the two variables. The VAR model with order (*k*) is presented thus:

$$\boldsymbol{Y}_t = \boldsymbol{C_0} + \sum_{\boldsymbol{i=1}}^{k} \Phi_{\boldsymbol{i}} \boldsymbol{Y}_{t-i} + \boldsymbol{\epsilon}_t \quad (3.1).$$

Where $\boldsymbol{Y}_t = (Y_{1t}, Y_{2t,})'$ is a *2*1* vector of endogenous variables, i.e., fiscal balance to GDP ratio (*FSB*), and government liability to GDP ratio (*GL*), while $\boldsymbol{Y}_{t-i}$ is the corresponding lag term for order *i*. $\Phi_{\boldsymbol{i}}$, is an *n* n* matrix of autoregressive coefficients, for *i = 1, 2, ...k*. $\boldsymbol{C_0} = (C_1, C_2)'$ is the *C* intercept vector of the VAR model. $\boldsymbol{\epsilon}_t = (\epsilon_{1t}, \epsilon_{2t,})'$ is an *n*1* vector of white noise processes. *K* is the number of lagged terms. VAR estimations are very sensitive to lag structure of variables. Using a sufficient lag length may help to reflect the long-term impact of variables on others. However, including longer lag lengths will lead to multicollinerarity problems and will increase the degrees of freedom (DOF). Empirical simulations show that for any $K \geq 11$, the model will become divergent with at least one autoregressive root that is greater than one. According to sequential modified Likelihood Ratio test statistic (LR), lag orders between 1 and 3 are recommended for models of this nature (Wooldridge, 2006). Here, we use lag order 2, determined by the Hannan-Quinn information criterion.

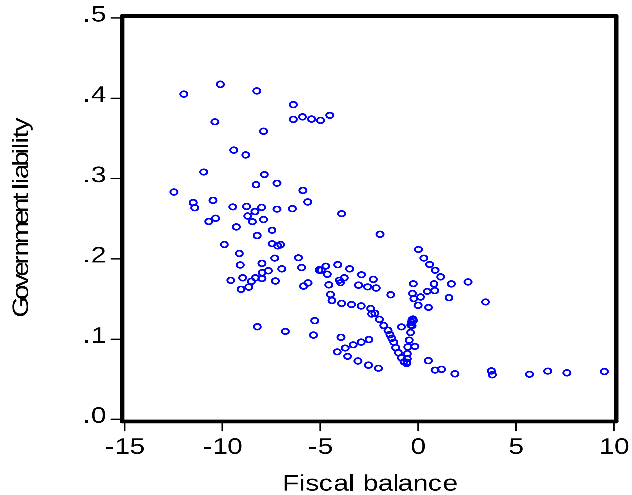

Figure 1 Scatter of government liability/GDP and fiscal balance/GDP.

Before undertaking the VAR estimation, we test for stationarity of the variables, using the ADF unit root test[5]. The results indicate that the variables are stationary at their first-differences. Hence, we use the first differences of the fiscal balance and government liability series in the VAR estimation. With two lags of the variables (determined by the Hannan-Quinn information criterion), the results obtained from the estimation are thus:

$$\Delta FSB = \underset{(0.599)}{0.098} + \underset{(27.89)}{1.601}\Delta FSB_{t-1} - \underset{(-12.46)}{0.717}\Delta FSB_{t-2} - \underset{(-1.58)}{8.495}\Delta GL_{t-1} + \underset{(1.027)}{5.389}\Delta GL_{t-2}$$

$$\Delta GL = \underset{(3.660)}{0.004} - \underset{(-0.470)}{2.09 * 10^{-4}}\Delta FSB_{t-1} - \underset{(-0.385)}{1.72 * 10^{-4}}\Delta FSB_{t-2} + \underset{(44.19)}{1.831}\Delta GL_{t-1} - \underset{(-21.37)}{0.866}\Delta GL_{t-2}$$

$$R^2 = 0.96 \qquad Log\ Likelihood = -186.79$$

Where ΔFSB and ΔGL denotes the first difference of fiscal balance/GDP and government liability/GDP respectively, and the values in parenthesis are the *t*-values. The results from the VAR estimation lend credence to the negative relationship observed in the scatter diagram plotted in Figure 1. Following this estimation, we simulate the impulse responses for the two variables, and present then in Figure 2. The impulse response graphs indicate that one-standard deviation innovation in ΔFSB causes a negative response in ΔGL (see Figure 2, Panel C), and similarly, one S.D innovation in ΔGL also induces negative some kind of negative response in ΔFSB (see Panel B). This relationship provides preliminary evidence of the existence of the non-Ricardian fiscal regime in Nigeria.

4. Model Specification

We draw from Muscatelli et al. (2002) and Semmler and Zhang (2003) by specifying a State-Space (SS) model with Markov-Switching (MS) characteristics. The reason for applying this model is to enable us test the hypothesis of regime changes (accommodative and counteractive) and the nature of the interactions (i.e., substitutes or complements) between monetary and fiscal policies in Nigeria, and if yes, to find out how they may have interacted, i.e., as substitutes or complements. The peculiar advantage of the SS-MS model is in the fact that it allows us to take into account multiple structural breaks in a given time series, and to explain non-linearities in the data. Though powerful, the SS-MS model is restrictive, because it only permits the existence of two time-regimes (Maddala and Kim, 1998). This limitation does not undermine the objective of our work, since we hypothesize that monetary-fiscal policies in Nigeria can be categorized into accommodative or counteractive regimes.

[5] See Appendix for the results

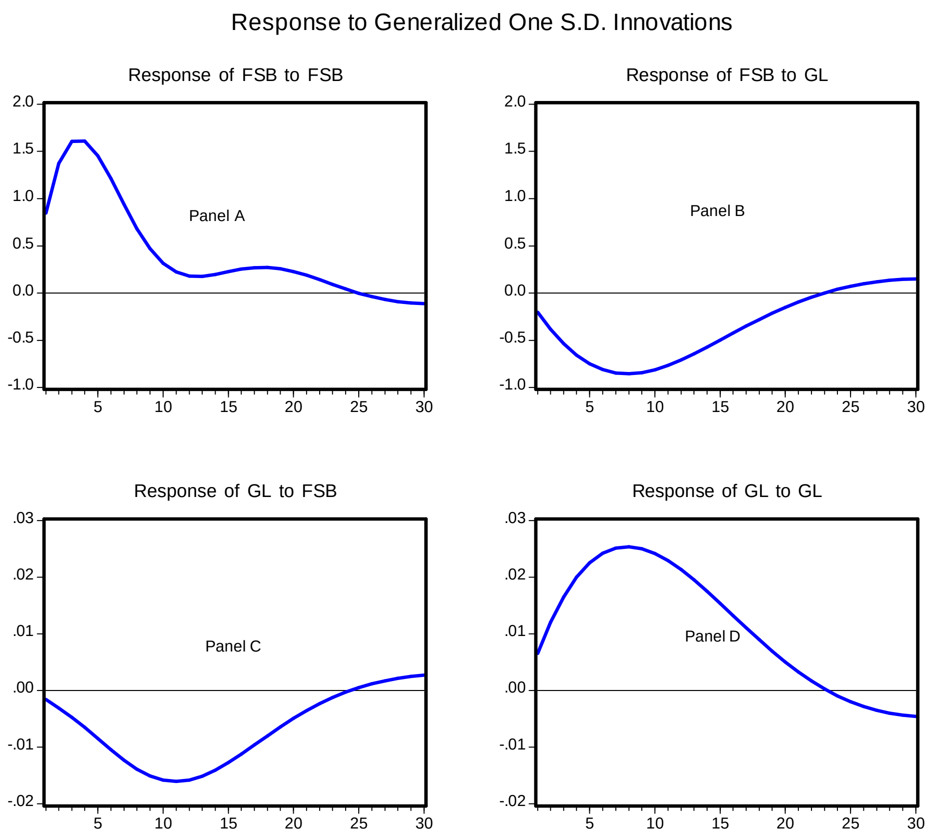

Figure 2 Generalized impulse responses of ΔFSB to ΔGL and vice versa

The procedure we follow is to set up a VAR model with the fiscal and monetary variables as endogenous variables, and then estimate the time-varying parameters in a State-Space model with Markov-Switching. We use the minimum rediscount rate (denoted by ***MRR***) as our measure of the central bank's monetary policy, and the budget balance to GDP ratio (denoted by ***FSB***) as our measure for fiscal policy. Thus, we estimate the following simple equation:

$$FSB_t = a_{1t} + \alpha_{2t} FSB_{t-1} + \alpha_{3t} MRR_{t-1} + \varepsilon_t \qquad (2)$$

Where ε_t is a shock with normal distribution and zero mean. We assume that the coefficients a_i are time-varying, and the variance of the shock ε_t is not constant, but rather, has Markov-Switching properties. Hence we define X_t and ϕ_t as

$$X_t = (1\ FSB_{t-1}\ MRR_{t-1}) \qquad (3)$$

$$\phi_t = (a_{1t}\ a_{2t}\ a_{3t})' \qquad (4)$$

Equation (2) can be rearranged as

$$FSB_t = X_t \phi_t + \varepsilon_t \qquad (5)$$

Following Kim (1993), Kim and Nelson (1999) and Maddala and Kim (1998), we assume that ε_t has two states of variance with Markov-switching properties, hence:

$$\varepsilon_t \backsim N\left(0\ \sigma^2_{\varepsilon,SS_t}\right) \qquad (6)$$

with

$$\sigma^2_{\varepsilon,SS_t} = \sigma^2_{\varepsilon,0} + \left(\sigma^2_{\varepsilon,1} - \sigma^2_{\varepsilon,0}\right) SS_{t,}\ \sigma^2_{\varepsilon,1} > \sigma^2_{\varepsilon,0} \qquad (7)$$

and

$$Pr[SS_t = 1|SS_{t-1} = 1] = p$$
$$Pr[SS_t = 0|SS_{t-1} = 0] = q$$

Where SS_t = 0 or 1, indicates the state of the variance of ε_t and Pr stands for probability. The time-varying vector ϕ_t is assumed to have the following path.

$$\phi_t = \bar{\Phi}_{SS_t} + F\phi_{t-1} + \eta_t, \ \ \eta_t \backsim N\left(0\ \sigma^2_{\eta,SS_t}\right) \quad (8)$$

Where $\bar{\Phi}_{SS_t}$ denotes the drift of ϕ_t under different states. F is a diagonal matrix with constant elements. η_t is a vector of shocks of normal distribution with zero mean and Markov-switching variance. σ^2_{η,SS_t} is assumed to be a diagonal matrix. If we assume that $E(\varepsilon_t, \eta_t) = 0$, then the State-space model with Markov-switching transition probabilities can be expressed thus:

$$FSB_t = X_t\phi_t + \varepsilon_t, \ \ \varepsilon_t \backsim N\left(0\ \sigma^2_{\varepsilon,SS_t}\right) \quad (9)$$
$$\phi_t = \bar{\Phi}_{SS_t} + F\phi_{t-1} + \eta_t, \ \ \eta_t \backsim N\left(0\ \sigma^2_{\eta,SS_t}\right) \quad (10)$$

Equation (9) is called the "Signal" or "Observation" equation, while Equation (10) is referred to as the "State" or "Transition" equation[6].

The estimation of the SS-MS VAR model is done by the maximum likelihood ratio method. The maximization of the likelihood of an MsVAR model results in an iterative process to obtain estimates of autoregressive parameters and of the transition probabilities controlled by the unobserved states of a Markov Chain.

The Ss-MsVAR model is estimated using the Kalman filter, which is a recursive algorithm for sequentially updating the one-step ahead estimates of the state mean and variances, given new information (see Harvey, 1989 and Hamilton and Susmel, 1994 for more details). In a State-space model with Markov-switching, the goal is to form a forecast of ϕ_t based not only on Y_{t-1} (where Y_{t-1} denotes the vector of observations available as at time *t-1*), but also conditional on the random variable SS_t, taking on the value *j* and on SS_{t-1}, taking on the value *i*. Where *i* and *j* equal 0 or 1 respectively. Hence,

$$\phi^{(i,j)}_{t|t-1} = E[\phi_t|Y_{t-1}, SS_t = j, SS_{t-1} = i] \quad (11)$$

While the corresponding mean square error of the forecast is

$$P^{(i,j)}_{t|t-1} = E\left[(\phi_t - \phi_{t|t-1})(\phi_t - \phi_{t|t-1})'\middle|Y_{t-1}, SS_t = j, SS_{t-1} = i\right] \quad (12)$$

Based on the conditions that $SS_{t-1} = i$ and $SS_t = j$ (*i, j = 0, 1*), the Kalman filter algorithm for our model is as follows:

$$\phi^{(i,j)}_{t|t-1} = \bar{\Phi}_j + F\phi^{i}_{t-1|t-1,} \quad (13)$$
$$P^{(i,j)}_{t|t-1} = FP^{i}_{t-1|t-1}F' + \sigma^2_{\eta,j} \quad (14)$$
$$\xi^{(i,j)}_{t|t-1} = FSB_t - X_t\phi^{(i,j)}_{t|t-1} \quad (15)$$
$$\upsilon^{(i,j)}_{t|t-1} = X_tP^{(i,j)}_{t|t-1}X_t' + \sigma^2_{\varepsilon,j} \quad (16)$$
$$\phi^{(i,j)}_{t|t} = \phi^{(i,j)}_{t|t-1} + P^{(i,j)}_{t|t-1}X_t'[\upsilon^{(i,j)}_{t|t-1}]^{-1}\xi^{(i,j)}_{t|t-1} \quad (17)$$
$$P^{(i,j)}_{t|t} = \left(I - P^{(i,j)}_{t|t-1}X_t'\left[\upsilon^{(i,j)}_{t|t-1}\right]^{-1}X_t\right)P^{(i,j)}_{t|t-1} \quad (18)$$

If we observe the sequence of data up to point *T*, then, the process of using this information to form expectations for any time period up to time *T* is known as "fixed-interval smoothing". Additional details on the smoothing procedure can be found in Maddala and Kim (1998) and Eviews 5.1 User's guide.

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[6] The complete set of specifications for the Signal and State equations as implemented in Eviews is presented in the Appendix.

5. Empirical Results and Synthesis

The results from the State-space model with Markov-switching are presented in Tables 1, 2, 3 and Figure III. Table 1 presents qualified[7] evidence, which suggests that two different distinct regimes have characterized the interactions between monetary and fiscal policies in Nigeria. The point estimates of the regime dependent means, μ_1 for regime 1 and μ_2 for regime two are statistically different. The estimated mean in regime 1 is negative at -0.1286 and for regime 2, it is positive at 0.5591. These signs validate our hypothesis that within the sample period, the variables dichotomises into phases that exhibit declining and growing interactions. We label the growing phase as the period of accommodative monetary-fiscal policies (i.e. regime 2), and the declining phase as the period of counteractive monetary-fiscal policies (i.e. regime 1). Since the signs assumed by regime 1 and regime 2 are opposing (i.e. negative and positive), it implies that during the early stages of our sample period, both policies where counteractive and that latter on, they were accommodative. Muscatelli et al. (2002) refer to this kind of behaviour of monetary and fiscal policy as being strategic substitutes and complements, respectively.

The fact that we obtained a lower mean for regime (2), indicates that regime (1) (counteractive monetary-fiscal policy) has been the predominant phase during the sample period under review. Whereas, regime (2) can be interpreted as an adjustment strategy, originating from macroeconomic disturbances in the economy. This relationship is clearly depicted in the one-step ahead smoothed estimates of the signal series shown in Figure 3. From the figure, we observe that between 1998 and 2004, the smoothed estimates of fiscal policy were largely expansionary, with increasing government borrowings and liabilities. Whereas, during the same period, the smoothed estimates of monetary policy was contractionary. This kind of policy interaction may be unique to Nigeria's history, as the converse of this relationship is found by Fialho and Portugal (2009) for Brazil between 1995:6 and 1999:12.

Table 1 Parameter Estimates of the SS-MS Model

Parameters	Coefficients	z-statistics
μ_1	-0.1286	-0.2872
μ_2	0.5591	0.3134
ϕ_1	0.4666	0.0006
ϕ_2	-0.0404	-5.72E-05
ϕ_3	0.5452	$7.71 * 10^{-4}$
ϕ_4	0.0512	7.24E-05
ϕ_5	0.10957	$1.55 * 10^{-4}$
ϕ_6	-0.3801	$-5.37 * 10^{-4}$
ϕ_7	-0.9999	$-1. 41 * 10^{-3}$
ϕ_8	0.6047	$8.55 * 10^{-4}$
Log likelihood -491.74		

By analyzing regime (1) more closely, we observe that this regime is feasible in more turbulent moments in the history of the Nigerian economy. The period between 1980 and 1994, which was predominantly counteractive, coincides with the oil price crunch of the 1980's, and the period when Nigeria implemented the structural adjustment programme.

[7] The evidence is qualified because it does not provide a clear-cut demarcation

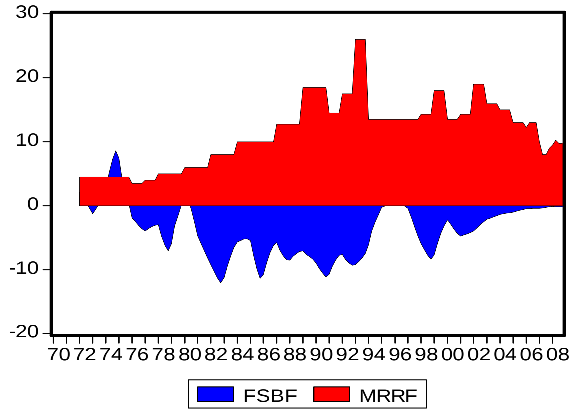

Figure 3 One-step ahead smoothed estimates of the signal series

Where FSBF and MRRF are the one-step ahead forecasts of fiscal balance and the minimum rediscount rate respectively. According to the time-varying transition probability coefficients presented in Table 2, not all the estimated coefficients in the data generating process (DGP) of the transition probabilities are significant.

Table 2 Estimates of Time-Varying Transition Probability Parameters

Parameters	Coefficients	RMSE[8]
α_1	-0.3608	0.3056
β_1	0.3504	0.6641
α_2	1.95505	0.4155
β_2	0.41488	0.2718

The parameters which govern the time-variation of the transition probabilities, namely, α_1 and α_2, have opposite signs. This is consistent with the intuition that an increase in the monetary measure (MRR) decreases the probability of remaining in a counteractive regime and increases the probability of switching regime. The parameters β_1 and β_2 determine the unconditional mean duration of staying in the accommodative or counteractive regimes of monetary and fiscal policy.

Table 3 Transition Probability Matrix

	Regime 1	**Regime 2**
Regime 1 (Accommodative)	0.8632	0.1368
Regime 2 (Counteractive)	0.2215	0.7785

The probability of transition from regime (1) to (2) and vice versa are displayed in Table 3. The Table shows that if the policy paradigm is in regime (1), at time *t*, then the probability that regime (1) will be maintained at time (*t+1*) is 0.8632, and the probability that the policy regime will shift from (1) to (2) at time (*t+1*) is 0.1368. For an initial state regime of (2), the probability of maintaining regime (2) in the next time period is 0.7785, and that of transiting to regime (1) is 0.2215. These probability values reinforce the results that we obtained from the time-varying coefficients displayed in Table 2.

[8] Where RMSE is the root mean square error.

Overall, we summit that the empirical evidence obtained here are qualified and should be interpreted with caution. This is because the point estimates of the regime dependent means μ_1 and μ_2 both have z-statistics that are not significant.

6. Conclusion

This paper uses quarterly data to explore the monetary and fiscal policy interactions in Nigeria between 1970 and 2008. The paper first examined the salient issues in the theory and literature of the interactions between monetary and fiscal policies. As a preliminary exercise, the paper examined the nature of fiscal policies in Nigeria using a VAR model. The simulated generalized impulse response graphs generated from the VAR estimation provides evidence of a non-Ricardian fiscal policy in Nigeria. These results suggest the validity of the fiscal theory of the price level determination, which postulates that changes in prices are driven by fiscal policies, and that the price level has to adjust to ensure equilibrium in private sector wealth, and government solvency (Woodford, 1995).

Further, the paper analyzes the interactions between monetary and fiscal policies by applying a State-space model with Markov-switching to estimate the time-varying parameters of the relationships. The evidence indicates that monetary and fiscal policies in Nigeria have interacted in a counteractive manner for most of the sample period (1980-1994). At other periods we do not observe any systematic pattern of interaction between the two policy variables, although between 1998 and 2008, some form of accommodativeness can be inferred (see Figure 3). Overall, the results suggest that the two policy regimes- counteractive and accommodative- were weak strategic substitutes during the post 1970 (Civil War) period. This is because the z-statistics of the coefficients of the regime means were not significant. With this kind of result, we identify a game were the fiscal authorities play first, while the monetary authorities are reactive, managing the monetary instrument based on fiscal activities.

For the policy maker, our results imply the existence of fiscal dominance in the interactions between monetary and fiscal policies in Nigeria. The evidence on the implementation of the non-Ricardian fiscal policy and the fiscal theory of the price level, implies that inflation, predominantly results from fiscal problems, and not from lack of monetary control. Based on the results obtained, government should pay attention to monetary activities before embarking on fiscal policies, especially with respect to government liabilities.

We submit that the empirical observations regarding the conclusions presented here are subject to criticisms, especially because of the insignificant z-statistics. However, it will be difficult to criticize the paper now, because to the best of my knowledge, the empirical literature on the interactions between monetary and fiscal policies in Nigeria, with regime switching factored in, is non-existent. This has made it difficult to compare results and conclusions.

The methodology used here can be improved by applying a special kind of Markov-Switching regression model with more than two regimes (see Maddala and Kim, 1998), and introducing another leg to the equation, which will analyze the sensitivity of fiscal policies to the exchange rate dynamics. Another suggestion is to apply a gradual switching State-Space model for two countries (Nigeria and a major trading partner, say China).

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APPENDIX

Detailed Specification of the State-Space Markov-switching model

```
@signal fsb = c(1)*c(1) + sv1*fsb(-1) + sv2*mrr(-1) + sv3*fsb(-1) + sv4*mrr(-1) + [var = exp(c(2))]
@signal mrr = c(3)*c(1) + sv5*fsb(-1) + sv6*mrr(-1) + sv7*fsb(-1) + sv8*mrr(-1) + [var = exp(c(4))]
@state sv1 = sv1(-1)
@state sv2 = sv2(-1)
@state sv3 = c(6) + sv3(-1) + [var = exp(c(5))]
@state sv4 = c(8) + sv4(-1) + [var = exp(c(7))]
@state sv5 = sv5(-1)
@state sv6 = sv6(-1)
@state sv7 = c(10) + sv7(-1) + [var = exp(c(9))]
@state sv8 = c(12) + sv8(-1) + [var = exp(c(11))]
```

Unit root test results

Variable	**ADF**		**KPSS**		**Conclusion**
	Level	1st Difference	Level	1st Difference	
FSB	-2.66[9]	-3.66[8]***	0.27[9] ***	0.06[1]	I(1)
GL	-2.15[12]	-3.26[11]***	0.26[10] ***	0.10[5]	I(1)
MRR	-2.05[0]	-12.14[0]***	1.10[10] ***	0.19[20]	I(1)

Notes: ***,** and * indicates significance at the 1%, 5%, 10% levels respectively. The values in bracket for the ADF test indicates the optimal lag length selected by the SIC within a maximum lag of 13. The values in bracket for the KPSS test indicate the bandwidth selection, using the Newey-West's Bartlett Kernel.