Optimal Fiscal and Monetary Policy Under Uncertainty in Nigeria: A Markov-Switching Dynamic Approach

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Abstract: *The effectiveness of the conduct of fiscal and monetary policy under uncertainty in Nigeria between 1980 and 2020 was examined using a Markov-switching dynamic regression model to estimate the uncertainty as portrayed by monetarists/ neo-Keynesians. The results reveal an ineffective conduct of fiscal and monetary policy under uncertainty in Nigeria as it is shown that the uncertainty about the impact of fiscal and monetary policy in the future surpasses the existing uncertainty as indicated by the higher probability values. The study recommends a dominance of monetary policy rather than fiscal policy if the policy thrust of the government is to reduce policy uncertainty in the economy both at current and future periods.*

Keywords: *Monetary policy; fiscal policy; markov switching; regime; uncertainty.*

JEL Classifications: *E52; H3*

1. Introduction

The empirical work of Benigno and Woodford (2014) and Rudebusch (2019) gave birth to the merger between the New Keynesian paradigm of optimal monetary policy and the neoclassical paradigm of optimal fiscal policy. The policy merger examined the joint

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determination of optimal fiscal and monetary policy under uncertainty. How should fiscal and monetary policy be set under uncertainty? Thus, a government can either increase taxes or better still employ the use of inflation to reduce the real value of the domesticated government debt.

The interest in the analysis of macroeconomic policy under uncertainty cannot be over-emphasized and this is premised on what is not known; thus, an uncertainty is dealt with on the basis of what is known. The extant literature on an optimal macroeconomic policy is of the view that uncertainty surrounding the impact of policy thrust of government tends to gather greater momentum in recent time and this has attracted considerable attention. Similarly, monetary authority of an economy undoubtedly faces serious challenges and this may occur during the course of dealing with uncertainty as regards the state of the economy (Kozicki & Vardy, 2017; Soderstrom, 2019). Macroeconomic models, as described by Clemens and Soretz, (2014), are used to ascertain the policy action and are also mere abstractions from reality. They appear incomplete and are surrounded by uncertainty as well.

The divergent nature of the economy does not only anchor on the state and the fundamental shocks that are surrounded by uncertainty, parameters which define the fundamental economic relationships also do. The empirical works of Ramsey (1928), Barro and Grossman (1979) and Lucas and Nancy (1983) corroborated the neoclassical school and affirm that optimal fiscal policy places more premium on the assertion that welfare may be unutilized if taxation is distorted. Also, if the government smoothens taxes across different periods over time, then different realizations of uncertainty are possible.

The prominent source of uncertainty was viewed from opposite direction by Neo-Keynesian theorists as transition period from state of equilibrium to another as a result of shock was emphatically described as disequilibrium effects (George-Marios, Hellwig & Pavan, 2013, George-Marios, 2017). It was also emphasized that New Keynesian literature is of the view that fiscal policy has the tendency to assist in relatively stabilizing output by offsetting cyclical variation in monopolistic distortions but tends to lay little or no emphasis on the essential monetary policy (Chari, Lawrence & Patrick, 2014).

One prominent feature of related studies in literature such as Svensson (2017), Kiley and Roberts (2017), Kim and Ruge-Murcia (2016), and Chari et al (2014) is that optimal policy is only derivable in environments that conform to the rules. Indeed, an optimal economic policy in an economy is characterized by a single or better still an insignificant number of abnormalities from a seamless neoclassical paradigm. The optimal macroeconomic policy is a choice standard which gives an arrangement of monetary changes over a multi-period arranging skyline. Consequently, as indicated by Lars and Noah (2018), the policy is therefore disintegrated into two parts; a long run policy which is based on the probability distribution of future occurrence and a short run policy which relies upon the actualisation of random variables.

Past empirical investigations on the impact of uncertainty on policy have been solely concerned about the countercyclical reaction (Wenlang & Willi, 2015), maybe in light of the fact that Keynesian hypothesis accentuates short run policy instead of long run objectives while monetarists regularly accept that the independent 'normal' growth of output is indeed an optimal long run growth The short run countercyclical policy simply hinges on how system rapidly adjusts to long run path (Correia, Juan & Pedro, 2012; Soderstrom, 2019).

Following Lucas and Nancy, (1983), the empirical analysis of an optimal economic policy under uncertainty in Nigeria is examined and spans through three regimes. The first is the regime of extreme monetarist, the second is severe neo-Keynesian while the third is just a combination of the two previously mentioned regimes. It is quite apparent that when the focus of uncertainty is exclusively on the impact of strict monetarist policy, then the optimal monetary policy tends to move towards a constant money growth rate as uncertainty rises unabated. The assumption of the monetarist here is that even where there is a tendency for a shift as regards the uncertainty about the impact of policy in the future which tends to surpass the current uncertainty, it is therefore optimal to increase the current level of the money growth (Kim & Ruge-Murcia, 2016).

The varied emphases on uncertainty in literature are assumed to have emanated from a number of economic theories relating to policy adjustment as there is no consensus in literature in this regard. The persistent failure of policies of government especially in Nigeria to actualize the purpose for which they are formulated, despite numerous empirical efforts in this regard, attracts the attention of the researchers of this paper. The purpose of this paper is, therefore, to investigate the effectiveness of the conduct of fiscal and monetary policy under uncertainty in Nigeria. This paper uses Markov-Switching dynamic regression model to estimate uncertainty as portrayed by the monetarist or neo-Keynesian.

Following the introductory part presented in section 1, section 2 presents the relevant literature (both theoretical and empirical) review. Section 3 entails the methodology and estimation methods. Section 4 gives the data analysis and presentation of empirical results of optimal fiscal and monetary policy under uncertainty in Nigeria. Section 5 gives the recommendations and conclusion.

2. Literature review and hypothesis

In the extant literature, the exploit of the policymakers in the economy hinges on two distinctive approaches and they are the Bayesian and the Min-max (or robust control) frameworks. The former approach assumes that the policymakers must have had a prior belief or idea of the distribution of the parameters by minimizing the expected loss based on the parameter distribution. The second framework, Min-max approach, allows the policymakers to give up after considering all possibilities and conducts of the policy that had been hitherto worked reasonably well in the best possible case. Thus, typical empirical

studies which had adopted Bayesian framework include among others, Brainard (1967), Söderström (2019), and Kimura and Kurozumi (2007). The study, therefore, is anchored on the second framework, Min-max approach which gives the policymakers an avenue to conduct the policy that had been so far worked practically well in the best possible case. This approach has been effectively demonstrated in the empirical work of Giannoni (2002), which introduces uncertainty for the several structural parameters of the future-dependent model and dwells much on the second approach. It is concluded that in an ideal economy, the rule for the model tends towards a stronger response of the interest rate which is in sharp contrast to the case of an absence of uncertainty.

In fact, advanced nations of the world are not even exempted in this regard. For instance, the U.S. business cycle practically experienced an irritating array of real and nominal rigidities as identified in the extant empirical literature in explaining observed aggregate fluctuations (Schmitt-Grohé & Uribe, 2016). The result of the paper revealed that the attributed stable price in the US economy remains the ultimate goal of optimal monetary policy in one side and volatile optimal rate of inflation especially under the guise of an income tax regime This result is unique in the sense that the model has in it a number of frictions that would necessitate a volatile rate of inflation and as well as a conditional nominal public debt with the exception of lump-sum taxes, and sticky labor wages.

An empirical analysis of macroeconomic effects of fiscal policy within the framework of stochastic endogenous growth model was investigated by Clemens and Soretz (2014). The results reveal that the uncertainty emanating from technological disturbances significantly affects growth rate of the economy, and it is therefore attributed as precautionary motives of risk averse agents. Thus, due to externalities in human capital accumulation, the market allocation function becomes inefficient and thereby unequivocally necessitating the intervention by the government.

The impact of the interactions between fiscal and monetary policies on stock market behavior (ASI) shows a significant influence on stock market returns in Nigeria while the impact of the volatility of these interactions on the Nigerian stock market show that the ASI volatility is largely sensitive to volatility in the interactions between the two policy instruments (Lawal, Somoye, Babajide & Nwanji, 2018).The impact of monetary policies shows that interest rate propels growth of the economy while money supply deters growth of Nigeria's economy and the trade policies maintain negative influence on the economy both the long run and short run (Adegboyo, Keji & Fasina (2021). Emphasis was laid on the use of fiscal policy as it was found to be stimulating force in the country's growth rate while interest rate should be made use of if monetary policy is to stimulate economic growth.

The focus of the work of Zhang and Semmler (2015) is on monetary policy rules under uncertainty which made use of data characterizing regime swift not only in parameters but also in shocks. The paper explored two approaches on the basis of empirical evidence, and they are: adaptive learning and robust control. The approaches were explored to deal with

monetary policy under uncertainty. The first approach hinges on the fact that the sole monetary authority in the economy should not rest on its oars but keep updating its knowledge of economic models. This can be achieved by not only learning from the information available but also considering main parameter uncertainty. The second approach, robust control, holds the views that more general uncertainties need to be admitted. As to adaptive learning, the paper endogenizes uncertain parameters by employing a programming algorithm that is self-motivated with adaptive grids and which must be able to deal effectively with nonlinear relationships. The findings of the paper show that the variables of interest in this regard do not necessarily converge even in a non-stochastic model within the framework of the first approach.

In an attempt to emphasize the distinct nature of the non-linear relationship, Lars and Noah (2018) employed a Markov Jump Linear- Quadratic (MJLQ) approach to examine the design of optimal monetary policy under uncertainty. To estimate the challenges the uncertainty brings about to policymakers, the authors vary discrete modes while using Markov chain and take mode-dependent linear-quadratic approximations of the underlying model. Thus, the effects of uncertainty and potential gains were analyzed. The findings reveal that learning may have significant but beneficial effects on losses. The said effect tends to impact the experimentation component and, in some cases, it can lead to policy weakening.

The stability of money demand in Nigeria by employing two proactive measures of output uncertainty and monetary uncertainty that could affect the public's holding of money was investigated by Aworinde (2019). The results of the study reveal that only monetary volatility exerts a significant impact on the demand for money in Nigeria both in the short run and in the long run while output volatility is not significant both in short-run and the long run. Also, the two uncertainty measures were found to yield a stable demand for money in Nigeria. This implies that monetary uncertainty has stronger substitution effects than precautionary effects and thus cash by shifting to alternative assets by means of substitution in Nigeria.

The effect of monetary uncertainty (MUC) confers a significant influence on the stability of money demand function in Nigeria (Sheu, Hussin & Jauhari, 2016). It was evidenced by the revealed unidirectional causality which runs from MUC to money demand and not the other way round. The paper established that the broad money demand function in Nigeria appeared relatively stable and by implication the monetary policies aimed at monetary targeting could be very effective even when there is the presence of significant MUC.

Wenlang and Willi (2015) explored the uncertainties surrounding parameter and shock in a state-space model with the use of Markov switching technique and the results of the empirical evidence indicate that uncertainties in the U.S. economy appear more pronounced and thus accurately defining monetary policy rules becomes a daunting task. The paper equally explored monetary policy rules under uncertainty using two approaches (the RLS learning algorithm and robust control). The former implies a restrictive framework which gives room for the parameters to be studied or learnt at least for a specified model while the

latter only allows for an elaborate or broader framework. The results within a framework of optimal control show that the variables in this regard do not necessarily converge even in a non-stochastic model. On the contrary, the robust control results show that robust optimal monetary policy rules reveal a stronger reaction to fluctuations in inflation and output during the period of uncertainty than when no uncertainty exists.

Ozili (2021) detects the sources of economic policy uncertainty in Nigeria and their respective implications for Africa as a whole. It was found out that economic policy uncertainty in Nigeria may emerge from a number of sources which include unexpected and sudden central bank intervention; change in government policy after elections; political interference in economic policy making and fall in global oil price. The sources also incorporate oil price shocks, uncertain government response, recession and unethical public policy and practices. These were identified as significant sources of economic uncertainty in Nigeria.

The role played by uncertainty in both monetarist and neo-Keynesian policy recommendations cannot be overemphasized. Monetarists are seen as the advocates of cautious policy responses to exogenous shocks because they were found to have significant impact on the economy (Craine, 2019). The author is also of the opinion that Neo-Keynesians on the other hand hold the view that imperfect information can bring about varied distortions. Also, it is apparent that when uncertainty surrounding the impact of policy is more pronounced, the optimal policy converges to a constant money growth rate, but when uncertainty about the transition dynamics appears prevailing, an active countercyclical policy becomes optimal. Also, a situation when both sources of uncertainty are present, the optimal policy response depends on the relative level of uncertainty. At this point, the policy tends to become more aggressive as uncertainty about the impact of upsurge in policy formulations becomes more apparent.

Policy formulation is not alien to every economy in the world. The peculiar nature of fiscal and monetary policy management and its impact on long run sustainability in Kenya was investigated by Ng'ang'a, Chevallier and Ndiritu (2019). The fiscal policy regime was regarded as being passive if the coefficient of debt appears significantly positive but if coefficient is negative, it is therefore regarded as unsustainable and this is a result of the fact that a rise in debt is associated with a weakening of the fiscal stability. In another dimension, an active monetary policy is tantamount to contractionary monetary policy as the reaction of real interest rate to a rise in inflation may bring about monetary policy uncertainty. The study findings also show that passive or unsustainable fiscal regime was more dominant and the policy coordination between fiscal and monetary policy is evidenced-based. Thus, monetary policy uncertainty has the potential to actively and pragmatically react to unsustainable fiscal policy.

Compared to the existing literature, this paper provides information that enhances a complete systematic characterization of the solution in a progressive New-Keynesian model

with parameter uncertainty. "In fact, a systematic characterization of the solution was available only for retrospective models (Söderström, 2019) Thus, for forward-looking models are seen as models with rational expectations in which, however, no closed-form solution was made available" (Kimura & Kurozumi, 2007). In this case, this study hypothesizes that: *monetary policy is more effective than fiscal policy, under uncertainty in Nigeria.*

3. Methodology

Following the modification of the work of Giannoni (2002), that made use of empirical works of Friedman (1970), Brunner and Meltzer (1972) and Hines (1971) where the positions of two prominent schools of thought (monetarists and Keynesian) are brought to bear, a system of deterministic structural equations was modeled. In the extant literature, optimal policy prescribes the use of inflation to smoothen tax effects over time (Svensson, 2017). The two schools of thought are of the view that output level in the economy is a function of the role of government.

$$y = f(M, F) \tag{1}$$

Where, y is the real output level in the economy; M is the monetary policy and F is the fiscal policy.

During the periods of higher government spending, higher inflation reduces the real value of nominal debt and weakens the expected rise in taxes. Such is indeed an optimal policy, because inflation takes a toll on government debt holders from the *ex post* point of view. Hence, the monetary policy tool used in this study is inflation while that of fiscal policy is tax and this is in conformity with the work of George-Marios (2017).

The focus of this paper is typically on uncertainty and not on the deterministic structural differences as proposed by earlier scholarly authors. Then, the base line equation takes the simple stochastic final form as

$$y = \alpha + \theta\pi + \beta\tau + \varepsilon \tag{2}$$

Where, y is the real domestic output in the economy; π is the rate of inflation (proxy for monetary policy) and τ is the tax rate (proxy for fiscal policy) while ε is the error term.

It is quite apparent that the optimal policy prescription hinges solely on the description the uncertainty possesses rather than the anticipated values of the coefficients (Kim & Ruge-Murcia, 2016; Chari, Lawrence & Patrick, 2014). The aggregate effect of monetary policy on an economy is assumed to be random and therefore it is not perfectly predictable (Kiley & Roberts, 2017). This is owing to the fact that the rate of ownership of assets among

households is not only varying but also remains unknown to the policymaker. Nevertheless, the unpredictable nature of the impact of policy can be portrayed by a probability distribution. Though there is an element of certainty as to which state the process lies, the likelihood of being in each state can be determined using the transition probabilities (Cheung & Erlandsson, 2015). It is assumed that the perceived distinction in a variable between period t and $t + 1$ is an arbitrary likelihood from one of two or more distributions; hence, a switching regression is considered (Hamilton, 1994).

Then,

$$\eta_t = \beta_1 Z_t + \mu_t; \; if S_{t,} = 1 \tag{3}$$

Where, η_t is the dependent variable, Z_t is a vector of independent variables, β_1 is a coefficient to be estimated, whose value is subject to the behavior of non-observable variables, $S_{t,}$ is a regime or state variable and μ_t is the error term. The regime-generating process in this paper adopts a modification of an Ergodic Markov chain (Brunetti, Mariano, Scotti & Tan, 2018). The process is depicted by η_t which consists of the transition probabilities P_{ij} from state i to state j.

$$\eta_t = Pr \, Pr \, (S_1 = \frac{1}{S_{t-1}} = 1) = P_{11}; Pr \, Pr \, (S_1 = \frac{1}{S_{t-1}} = 2)$$
$$= P_{12}; Pr \, Pr \, (S_1 = 1) = P_{21}; Pr \, Pr \, (S_1 = \frac{2}{S_{t-1}} = 2)$$
$$= P_{22} \tag{4}$$

Thus, $\qquad P_{ij} = Pr \, Pr \, (S_1 = \frac{j}{S_{t-1}} = i) \tag{5}$

In an attempt to capture the uncertainty surrounding macroeconomic policy in Nigeria, the paper employs Markov-switching Dynamic regression model. The model exhibits the dynamic unobserved regimes across states in order to empirically account for structural break or other multiple state phenomena (Cheung & Erlandsson, 2015). The said transition between the unobserved states is believed to practically follow a Markov chain.

The choice of the model is heavily relied on the fact that it is meant only for series that are supposed to transition over a finite or predetermined set of unobserved states (periods). It equally allows the process to evolve independently in each state or period (Dewatcher, 2016). The said transitions are assumed to occur according to a Markov process. The time of transition from one state to another and the duration between changes in state is arbitrarily random (Wu, 2015). For instance, the model can be used to understand the

procedure that governs the time at which the desired macroeconomic policy transitions between short run and long run periods. The two periods, in this case, can be thought of as representing low and high-rate states.

4. DATA ANALYSIS AND RESULTS

Descriptive Statistic Analysis

Data on the variables used for the study are obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin. The descriptive characteristics of all the variables in the model are presented in Table 1. For the purpose of investigating the effectiveness of the conduct of fiscal and monetary policy under uncertainty in Nigeria between 1980 and 2020, descriptive statistics of the data are initially examined. The descriptive statistics of data series provide information about sample statistics such as mean, median, minimum value, maximum value and distribution of the sample measured by the skewness, kurtosis and the Jaque-Bera statistic. All data series used for the econometric analysis span the period 1980 to 2020. For the purpose of this study, data on economic growth (proxy by GDP growth rate), monetary policy (proxy by inflation rate) – MON and fiscal policy (proxy by tax revenue) – FIS are used. However, we take the natural logarithm of tax revenue in the process of estimating the model so as to minimize the problem of outliers.

Table 1. Descriptive Characteristics of Variables

|	GDP (percentage)	FIS (in millions of Naira)	MON (percentage)
Mean	2.842	3.08E+11	9.063
Median	2.709	7.21E+10	9.694
Maximum	3.57	1.35E+12	18.55
Minimum	2.186	1.23E+09	0.03
Std. Dev.	1.427	4.20E+11	5.182
Skewness	0.369	1.21	-0.174
Kurtosis	1.689	2.947	1.986
Jarque-Bera	3.868	10.02	1.961
Probability	0.144	0.007	0.375

Source: Authors' Computation

Table 1 above shows that the standard deviation values of all the variables are positive. The standard deviation values of the variables demonstrate the extent of deviation of the actual dataset. The interdependent variable (MON) appears to have significantly spread out from its average value. This is an indication that the variable is quite unstable and somewhat volatile. Thus, other variables (GDP and FIS) in the study appear to be relatively stable and less volatile as their data cluster around their respective mean values. It is also shown on average between 1980 and 2020 that all the series (GDP, FIS and MON) display a high level of consistency as their mean values are within the maximum and minimum values of these series.

Moreover, the skewness and kurtosis statistics provide useful information about the symmetry of the probability distribution of various data series as well as the thickness of the tails of these distributions respectively. The coefficients of Kurtosis show that the variable FIS is leptokurtic (sharply peaked with heavy tails) while other variables such as GDP and MON have flat peaks with lighter tails. None of these variables exhibits the properties of Mesokurtic kurtosis; therefore, the variables do not portray the elements of exact normal distribution. Thus, the variables are not symmetric in their data distribution as they portray elements of asymmetric distribution in their data spreading. However, the coefficients of skewness also support the asymmetric nature of the data distribution. This implies that the data are either positively skewed or negatively skewed to the right or to the left. Thus, the distributions are not symmetric. The Jarque-Bera statistic is used in testing for the normality or asymptotic property of a particular series. The decision criteria for Jarque-Bera test for normality is that JB (P-value) be greater than 0.005. The results imply that the data are normally distributed and that the data can be used for further analysis.

Patterns of Fiscal and Monetary Policies Growth in Nigeria (1980 – 2020)
The patterns of growth of both Fiscal and Monetary policies in Nigeria between 1980 and 2020 are shown in the Figures 1 and 2 below. The figures apparently depict the fluctuations surrounding the growth rates of these macroeconomic variables.

Figure 1. Nigerian Inflation Rate in Percentage (%) (1980 – 2020)
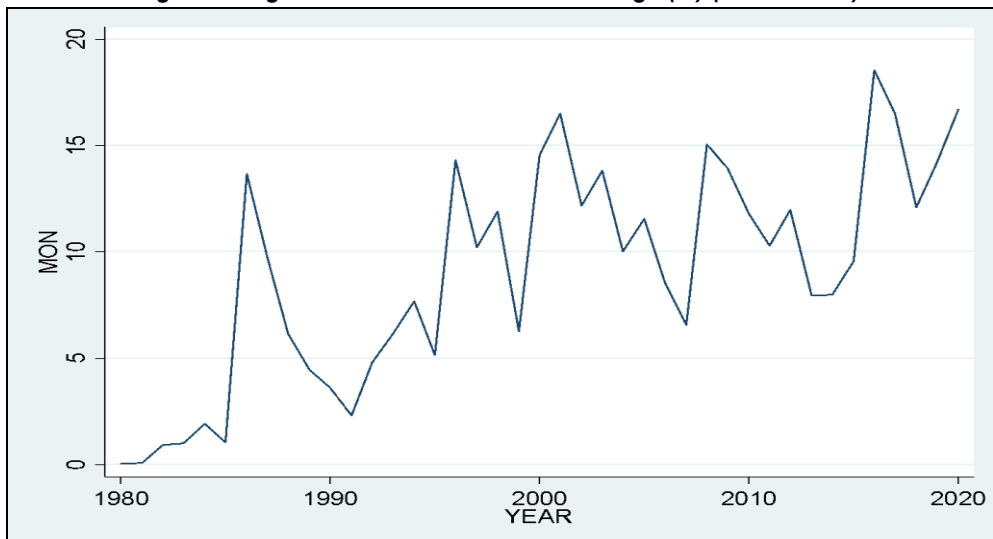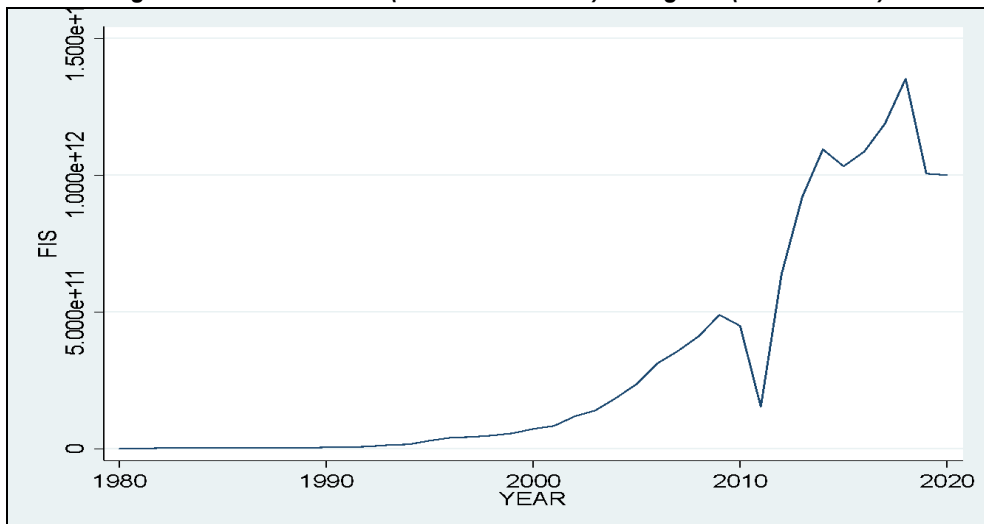

Source: Author's Compilation, 2020

The graph shows that inflation has two states (rising and declining states). The movement of inflation rate as a measure of monetary policy effectiveness between 1980 and 2020 was oscillating around 10%. The graph reveals that the Nigerian economy experienced a double digit inflation rate for the first time in the year 1986. This may not be unconnected with the Structural Adjustment Programme (SAP) introduced by the then government. Though, it reverted to a single digit rate in the subsequent years but the rate has been predominantly more of double digit than single digit.

This is no doubt an indication of loss of peoples' welfare as higher inflation rate corrodes peoples' purchasing power. Thus, the fluctuation surrounding the monetary policy rate as shown in the Figure 1 above suggests a sheer ineffectiveness of the conduct of monetary policy in Nigeria. This is quite in disagreement with the work of Kim and Ruge-Murcia (2016) which submits that it is optimal to increase the current level of the money growth even where there is a tendency for a shift as regards the uncertainty about the impact of policy in the future which tends to surpass the current uncertainty.

Figure 2. Tax Revenue (millions of Naira) in Nigeria (1980 – 2020)

Source: Authors' Compilation, 2020

The graph depicts a rise in the tax revenue by the government between 1980 and 2008. Though it fell sharply between 2009 and 2010, the momentum changed in 2011 when it rose to a higher level and began to fall again in 2020. The astronomical increase in the tax revenue necessitated by a rise in tax rate (as a measure of fiscal policy of the government) could be attributed to two factors namely: a high tax rate imposed by the government and an improved level of GDP. The eventual fall in tax revenue in the year 2020 could be as a result

of the fact that productive activities of many manufacturing firms were brought to a halt following the months-long lockdown necessitated by the outbreak of the COVID-19 pandemic.

It is revealed from the Figure 2 above that fiscal policy of government is indeed a propelling factor that that enhances growth in Nigeria and this is in line with the work of Adegboyo, Keji and Fasina (2021) which lays emphasis on the use of fiscal policy as it is found to be stimulating force of the country's growth rate.

Order of Lag Selection

The maximum number of lags for the model used in this paper was determined using Likelihood test, LR test statistic, Final Prediction Error (FPE), Akaike information criterion (AIC), Schwarz Information Criterion (SC), Hannan-Quinn information criterion (HQIC) and Structural Bayesian Information Criterion (SBIC). The results are presented in Table 2.

Table 2. Selection Criteria Results

LAG	LL	LR	FPE	AIC	HQIC	SBIC	P-Value
0	-1479.81		1.3e+31	80.152	80.198	80.283	
1	-1414.89	129.84	6.3e+29	77.129	77.314*	77.652*	0.000
2	-1405.24	19.295*	6.2e+29*	77.094*	77.417	78.009	0.023
3	-1401.22	8.0570	8.3e+29	77.363	77.824	78.669	0.528
4	-1393.93	14.566	9.6e+29	77.456	78.054	79.154	0.104

Source: Authors' Computation

It was shown the LR, FPE and AIC indicated 2 as the optimal lag order. The selection of lag length is therefore based on the outcome of LR, FPE and AIC criteria which depict 2 as the optimal lag order. This is the consensus of the greater number of the selection criteria Thus, the lag length of order 2 indicated by AIC criterion was therefore employed in the analysis.

Table 3. Markov-Switching Dynamic Regression Results

Dependent Variable: GDP					
Method: Markov-Switching Dynamic Regression					
Regimes	Prob. of Transitioning	Variables	Coefficients	SD	P-Value
		MON	-4.4872**	1.9268	0.0200
		FIS	1.9200***	9.4400	0.0000
State 1			1614.1***	57.252	0.0000
State 2			216.57***	112.83	0.0000
	P_{11}		0.94	0.0381	
	P_{21}		0.35	0.1905	
Key: *** Significant at 1%, ** Significant at 5%, * Significant at 10%,					

Source: Authors' Computation

The results reveal that inflation rate as a prominent measure of monetary policy has a significant negative relationship with GDP. This is an indication that the policy of the monetary authority in the economy confers an indirect significant impact on the output level. This, therefore, implies a contractionary monetary policy as found out by Ng'ang'a et al. (2019) that a contractionary monetary policy is in most cases found to be more active than an expansionary monetary policy. This also is in consonance with the findings of Craine (2019), that reduced spending contracts the economy more than the similarly sized tax increases do. On the other hand, tax revenue as a measure of fiscal policy has a significant positive relationship with GDP. This is an indication of expansionary fiscal policy. Thus, the two policy thrusts of the government go in two different directions. This supports the claim of George-Marios (2017) that a reduced expenditure is superior to tax increases and that such reduction may not contract the economy.

The number of observations in this paper has been evenly distributed over two regimes namely: low-rate state and high-rate state. State 1 is a low-rate state. GDP, which is a resultant output of the optimal interaction between monetary and fiscal policies of the government, has a mean value of 429.4, while State 2 is a high-rate state with a mean value of 1614.08. The probability of transitioning to State 1 given State 1 is 0.94, this implies that there is a high tendency of the economy remaining in State 1 of moderate-rate despite the aggressive nature of the policy thrust of the government. Also, the probability of transitioning to State 2 given State 1 is 0.06, this implies that there is a high tendency of the economy remaining in State 1. Therefore, the results show that the resultant output of the optimal interaction between monetary and fiscal policies of government performs better in State 1 with a low-rate state than a high rate state given that the economy is in a low-rate state

The results imply that the uncertainty surrounding the optimal implementation of fiscal and monetary policy in Nigeria is overwhelming as indicated by the higher probability value. It could also be inferred that frequent change in policy options of the government has not been yielding desired results. The findings of this paper are in line with the work of Kiley and Roberts, (2017) which reveals that the aggregate impact of monetary policy on an economy is assumed to be random and therefore it is not perfectly predictable.

The probability of transitioning to State 1 given that the economy is in State 2 is 0.35, this implies that there is a high tendency of the economy remaining in State 2. The probability of transitioning to State 2 given State 2 is 0.65, this also implies that there is a high tendency of the economy remaining in State 2. Therefore, the results show that the resultant output of the optimal interaction between monetary and fiscal policies of the government performs better in State 2, which is a high-rate state than a moderate rate state given that the economy is in a high-rate state.

The results also reveal a significant distinction between probability values of P_{11} and P_{22} for the two durations. The higher value of P_{11} is an indication that there is only a lower chance of moving away from lower fiscal and monetary policy rates. On the other hand, the higher P_{22}

value implies that there is more stability in the regime of higher rate and the chance of transitioning to a lower regime state is indeed slim.

The results of the transition probability show that the uncertainty surrounding the impact of macroeconomic policy in the future outstrips current uncertainty as indicated by the higher probability values. The results support the findings of Ng'ang'a et al. (2019) which show that passive or unsustainable fiscal regimes were more prevailing and there is a need to enhance synchronization between fiscal and monetary policy. The findings are also in consonance with the monetarist assumption as submitted by Kim and Ruge-Murcia (2016) that it is ideal to enhance an increase in the existing level of the money growth rate when there is a predictable fundamental change.

5. Conclusion

The paper investigates the effectiveness of the conduct of fiscal and monetary policy under uncertainty in Nigeria. It is concluded from the results that monetary authority of the Nigerian economy undoubtedly faces serious challenges and this may occur during the course of dealing with uncertainty as regards the state of the economy. The results reveal an ineffective conduct of fiscal and monetary policy under uncertainty in Nigeria as it is shown that the uncertainty about the impact of fiscal and monetary policy in the future surpasses the existing uncertainty as indicated by the higher probability values. Also, the findings of the paper reveal that frequent change in policy options of the government has not been yielding desired results. This may be as a result of the fact that monetary policy appears to be more unstable and volatile than fiscal policy as revealed by the findings of this study. The study recommends a dominance of more aggressive monetary policy rather than fiscal policy if the policy thrust of the government is to reduce policy uncertainty in the economy both at current and future periods. Although this study examines the relative effectiveness of macro-economic policies under uncertainty in Nigeria, there is still an avenue that can be explored by future researchers. First, future studies should incorporate other African nations to see what is obtainable for comparative analysis. Another interesting area of research should be an investigation of the effectiveness of foreign exchange policy under global health uncertainty (COVID-19) and economic policy uncertainty in Nigeria.

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