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Investigating fiscal and monetary policies coordination and public debt in Kenya: evidence from regime-switching and self-exciting threshold autoregressive models

William Irungu Ng'ang'a, Julien Chevallier, and Simon Wagura Ndiritu

Abstract
This study explored the nature of fiscal and monetary policy coordination and its impact on long-run sustainability in Kenya. The study employed annual time series data from 1963 to 2014. Two objectives were investigated. (i) The determinants of monetary and fiscal policy rules under different policy regimes. (ii) The nature of fiscal and monetary policy regimes coordination in Kenya. Markov switching models were used to determine fiscal and monetary policy regimes endogenously. The fiscal policy regime was regarded as passive if the coefficient of debt in the MS model was significant and negative. This fiscal policy regime is regarded as unsustainable since the rise in debt is associated with a deterioration of the fiscal balance. On the other hand, the active monetary policy is synonymous with contractionary monetary policy since real in interest rate reacts positively to an increase in inflation. Robust analysis conducted using self-exciting threshold models confirms that monetary and fiscal policy reaction functions are nonlinear. The study findings show that passive or unsustainable fiscal regime was more dominant over the study period. There is evidence to support coordination between fiscal and monetary policy. There is a tendency for monetary policy to actively and prudently respond to unsustainable fiscal policy. Secondly, monetary policy sequentially responds to fiscal policy. The study recommended the adoption of systematic monetary response to a periodic deviation of fiscal policy from a long-run sustainability path.

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Keywords Policy regimes; fiscal and monetary policy management; Markov-switching; SETAR

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1. Introduction

The primary mandate of macroeconomic policy is the achievement of stability and sustainable growth. Conventionally, there are two leading players responsible for these economic policies. The Fiscal agent, whose main objective is to achieve full employment of resources and the monetary agent who seeks to maintain price stability. While both fiscal and monetary policy ultimately aims at achieving sustainability, economic theory holds that the monetary and fiscal policy objectives are not mutually exclusive. Also, the existence of two autonomous policy agents raises an environment where policy makers have room to pursue conflicting objectives (Cochrane, 2009).

This concern is particularly important in developing economies because one of the key features is the dominance of the fiscal agent. Majority of developing countries' agenda is dominated by infrastructural development forcing fiscal agents to rely on deficit financing (Togo, 2007). An overemphasis on expansionary fiscal policy burdens monetary policies to correct fiscal imbalances by tightening the monetary stance. Ultimately, this compromises the effectiveness of monetary policy and the credibility of the overall policy framework (Lauren& Piedra, 1998; Tarawalie *et al.,* 2013).

The primary interaction between monetary and fiscal policy relates to debt management. Monetary policy conduct affects the cost and availability of debt, which either expands or limits the government's ability to pursue deficit financing (Togo, 2007; Friedman & Woodford, 2011). Therefore, the need for coordination between the fiscal and monetary policy is critical for management of overall wellbeing of the economy. The empirical and theoretical literature generally holds that effective policy coordination requires individual policy's and overall policy mix to be in line with sustainable development (Togo, 2007; Friedman & Woodford, 2011).

Previous studies have either focused on the relationship between public debt management and monetary policy (Cheng, 2006), Public debt management and fiscal policy (Maana *et al.,* 2008), and fiscal and monetary policy coordination (Chuku, 2012; Tarawalie *et al.,* 2013; Mutuku & Koech, 2014). Furthermore, studies on fiscal and monetary policy coordination often assume that both fiscal and monetary policy responses are linear and consequently ignore the fact that both policies may periodically deviate from the sustainability path. This study contends that the investigation of policy coordination requires the understanding of the interaction between public debt, fiscal policy, and monetary policy stance.

The main contribution of this study is to evaluate the nature of fiscal and monetary policy coordination and their effect on long-run sustainability by investigating two main issues: First, an assessment of whether monetary policy and fiscal policy are independently pursuing effective policies and Secondly if the overall policy mix confirms to long-run debt sustainability. Annual time series data from 1963 to 2014 was used for the analysis. Markov-Switching models were used to estimate and identify the fiscal and monetary policy regimes.

Fiscal policy reaction function was based on an extension of Bohn (1995) model, which considers the response of fiscal policy to the previous level of debt. The sustainable fiscal regime was identified by a positive response of fiscal balance to an increase in previous debt level. Sustainability of the monetary policy reaction function was based on the Taylor rule which holds that optimal monetary response requires real interest rate to react by countering an increase in inflation. The main findings may be summarized as follows:

The results show that the regime switching model explains policy regime changes in Kenya. The unsustainable fiscal regime was dominant compared to the sustainable regime. The results confirm

two important policy reactions: First, there is a tendency for monetary policy to actively and prudently respond to unsustainable fiscal policy. Secondly, monetary policy sequentially responds to fiscal policy (lagged monetary policy effect). The study recommended the adoption of a systematic monetary response to a periodic deviation of fiscal policy from a long-run sustainability path.

The rest of the paper is organized as follows: Section 2 reviews the relevant literature. Section 3 introduces the methodology (which articulates the theoretical framework and the empirical specification of the model) and describes the dataset. Section 4 discusses the empirical findings. Section 5 provides the conclusion and policy recommendations.

2. Relevant Literature

This section reviews the theoretical literature on macroeconomic policy coordination. Two main theories explain fiscal and monetary policy coordination: The Fiscal Theory of the Price Level (FTPL) and the Strategic Interaction Theory.

2.1. Fiscal Theory of Price Level

This theory was developed by Eric Leeper, Christopher Sims, and Michael Woodford. The theory holds that price stability requires pursuance of both sound monetary and fiscal policy. As a public policy goal, price stability is arrived at by considering two key issues: How to achieve price stability and secondly, the desirable level of price stability. The former can be addressed by monetary policy. However, FTPL holds that no matter how independent and capable the Central bank is, appropriate fiscal policies are necessary to ensure that the desirable level of price stability is achieved. (Eusepi, 2011; Friedman & Woodford, 2011).

The theory holds that the desirable level of price stability is linked to the level of public debt. FTPL embraces the non-Ricardian assumption, which holds that the government does not consider the intertemporal budget constraint. Price level does not adjust to government solvency. However, it is the policy mix between a fiscal and monetary policy that determines the price level. This theory, therefore, advocates for policy coordination in order to control inflation (Eupesi, 2011; Tarawalie *et al.,* 2013). This theory is useful to this study as it links fiscal behavior, public debt management, and monetary policy.

2.2. Strategic Perspective Approach

Sargent and Wallace developed this theory in 1981. Unlike FTPL, strategic perspective assumes that the Ricardian assumption of intertemporal constraints holds. This theory adopts a game theory approach to explain the fiscal policy and monetary policy nexus. Assuming Central bank is independent and the first mover, it will set a level of the money supply that is consistent with its inflation target. Fiscal agent will then choose primary surpluses and debt that is in line with the level of the money supply. This means that fiscal policy stance has no role in price determination as Central Banks commitment to price stability is independent of fiscal policy stance (Tarawalie *et al.,* 2013; Friedman & Woodford, 2011).

On the other hand, if fiscal policy moves first, attempts to pursue expansionary fiscal policies through deficit financing prompts an increase in interest rates triggering inflationary tendencies. Strategic perspective holds that effective policies can only be achieved if monetary and fiscal policies coordinate. For example, if fiscal policy is dominant, it becomes the first mover and defines the level of the primary deficit; an attempt by the monetary policy to tighten money supply

in an attempt to avoid explosive debt and counter inflationary shocks might be counterproductive (Tarawalie *et al.,* 2013; Friedman & Woodford, 2011).

2.3. Policy Coordination

Theoretical literature shows that both the FTPL and Strategic perspectives as quoted in Tarawalie *et al.,* (2013) support the view that fiscal and monetary policies are interrelated and therefore need to be coordinated. For domestic debt, maintaining short-term interest rate on debt at a level that does not crowd out private investment is the overbearing factor. On the other hand, interest rate and exchange rate depreciation define the cost implication of servicing external debt. For monetary authorities in a closed economy, fiscal dominance may threaten price stability. In an open-economy setting exchange rate fluctuation, especially under flexible exchange rate regimes may also affect price stability (Togo, 2007; Tarawalie *et al.,* 2013; Friedman & Woodford, 2011).

Policy coordination is, therefore, essential if monetary and fiscal authorities are independent. Coordination of fiscal and monetary policy can be explained by the following equation

$$D_t = (B_t - B_{t-1}) + (M_t - M_{t-1}) \quad (1)$$

Where D_t refers to government budget deficit, $(B_t - B_{t-1})$ refers to the change in the total government debt and $(M_t - M_{t-1})$ refers to change in monetary base caused by changes in credit extended to the government by the central bank.

There are two main coordination criteria. First, the Strategic perspective approach suggests that coordinated simultaneous move games require that both policies move in the same direction. This means that at any given period, effectiveness is achieved if the policy mix is either expansionary

fiscal policy and expansionary monetary policy or contractionary fiscal policy and contractionary monetary policy.

Secondly, sequential-move games coordination entails monetary and fiscal authorities complementing each other to ensure that trade-offs between price stability and full employment of resources objectives are balanced. This implies that it is more logical for monetary and fiscal policies to move in the opposite direction under sequential-move games. In this case, it is possible for fiscal policy to pursue expansionary policies while monetary policy pursues tightening policies at a given period in time (Tarawalie *et al.,* 2013; Friedman & Woodford, 2011). Therefore, a sequential-move game setup requires the monetary policy to pacify unsustainable fiscal policy regimes (Doi *et al*., 2011).

Coordination in a simultaneous-move game setting can be achieved if transparency in the formulation and implementation of fiscal and monetary policies exists. It entails explicit policy arrangements by fiscal and monetary policy authorities where both fiscal and monetary targets and the rules of engagement conform to the authority's policy agenda (Togo, 2007; Eusepi, 2011).

2.4. Empirical Literature

To optimize space, Table 3A (in the Appendix) provides a summary of the relevant empirical studies focusing on the fiscal policy, monetary policy, and debt management.

3. Methodology

This section describes the methodology that was adopted in this study and is organized as follows: The theoretical framework explaining fiscal and monetary policy coordination is presented. After

that, the empirical model specifying the fiscal and monetary policy regimes is discussed to evaluate policy coordination in Kenya. Lastly, the data types, measurements, and variables are introduced.

3.1. Theoretical framework

The theoretical framework used to evaluate fiscal policy coordination is anchored on the utility functions of fiscal and monetary authorities. Three key objectives are considered by both fiscal and monetary agents. These are reducing unemployment, controlling inflation, and stimulating the economy towards potential output (Tarawalie *et al.,* 2013). It is argued that fiscal authorities give more weight to the unemployment target relative to inflation while monetary agents give more weight to inflation relative to unemployment. In this regard, the utility functions of the two agents are given as:

$$U^F = f(\hat{\mu}, \pi, \theta) \tag{2}$$

$$U^M = f(\hat{\pi}, \mu\ , \theta) \tag{3}$$

Where U^F and U^M are the utility functions of fiscal and monetary authorities, respectively. μ, π and θ represents the unemployment rate, inflation rate and potential output growth respectively. The hat implies greater weight is assigned to the priority variable by the respective agents. Unemployment can be modeled as a function of monetary and fiscal policy instruments which include interest rate(r) and fiscal balance (fb) respectively. This specification is particularly applicable to developing countries since the government activity has a large impact on creating productive capacity in the economy (Tarawalie, *et al.,* 2013). Therefore, unemployment is given $\mu = f(r, fb)$ and equation (1) and (2) can be restated as:

$$U^F = f\left(r, fb, \pi, \hat{\theta}\right) \tag{4}$$

$$U^M = f(r, fb, \hat{\pi}, \theta) \tag{5}$$

Equation 4 shows that in the fiscal agent's utility function, greater weight shifts to potential output when policy instruments are introduced in the model. Both instruments are included in the fiscal and monetary policy utility functions to provide for interaction and coordination. The constraints for fiscal and monetary agents are specified as:

$$fb = f(r, \theta, ge, d) \quad (6)$$

Where r, ge and d represent interest rate, government expenditure and debt respectively and.

$$r = f(\theta, \pi, fb, Exc) \quad (7)$$

Where Exc represent exchange rate. Exchange rate fluctuation is of concern to monetary authorities especially for a small open economy. Inclusion of fiscal balance in the monetary policy reaction function and monetary base in the fiscal policy reaction function captures the interactive effect of seignorage on fiscal and monetary policy functions. This study focuses on the dynamics of fiscal and monetary interaction in pursuance of their respective goals. Fiscal balance and interest rate are used to capture the policy feedback rule between fiscal and monetary agents respectively (Tarawalie, *et al.,* 2013). Therefore, optimizing the constrained utility functions with respect to policy rules yields:

The fiscal policy reaction function: $fb = f(r, \theta, ge, d)$ (8)

The Monetary policy reaction function: $r = f(\pi, fb, \theta, Exc)$ (9)

Equations (8) holds that fiscal policy reaction is a function of interest rate, potential output growth, government expenditure and public debt and Equation (9) specified the monetary policy reaction function such that the interest rate is a function of inflation, fiscal balance, potential output growth, and exchange rate.

3.2. Empirical Model Specification

Markov switching Model is introduced to capture the state or regimes adopted by the respective policy agents. According to Hamilton (2005), Markov-switching method assumes that the transition from one regime to another occurs endogenously, which means that policy regimes are determined within the model. It is logical to limit the number of regimes to two defined as either sustainable or unsustainable.

Fiscal reaction function is based on Bohn's intertemporal government budget constraint, which holds that fiscal policy is sustainable if the present value of primary balance matches totals public debt (Bohn, 1995). This approach considers the response of primary balance to the previous level of debt. Based on Bohn (1995), Davig, Leeper & Chung (2004) and Doi *et al.,* (2011), fiscal policy regime is identified as being sustainable if it responds prudently to public debt dynamics. Therefore, Let S represents the number of regimes such that:

$$S_t = \begin{cases} 1, & Sustainable\ \ regime\ is\ observed\ at\ period\ t \\ 0, & Unsustainable\ \ regime\ is\ observed\ at\ period\ t \end{cases}$$

Markov-switching model estimates both transition probabilities and time-varying transition probability. Transition probability measures the transition probability that policy regime switches from state i to j $\forall i, j = 0,1$ and are assumed to be constant and defined by the matrix $\begin{bmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \end{bmatrix}$

Time-varying probabilities represent the probability that state *i* was observed at period t. Equation (8) and (9) provide the basis of estimating both the fiscal policy reaction and the monetary policy reaction functions (Davig *et al.,* 2004; Hamilton, 2005; Doi *et al*., 2011; Khalid & Marwan, 2012). Therefore, a two-state Markov-switching model for fiscal policy reaction function is presented as:

$$Fb_t = \alpha_0(S_t) + \alpha_1(S_t)Debt_{t-1} + \alpha_2(S_t)\theta_t^* + \alpha_3(S_t)RINT_t + (S_t)\mu_t \quad (10)$$

Where Fb_t refers to fiscal balance as a ratio of GDP, $Debt$ refers to total debt as a ratio of GDP and $RINT$ refers to the real interest rate. θ^* represent control variables which include the output gap and government expenditure which measures the deviation of GDP and government expenditure from the long run path. μ_t Represents the disturbance term for the fiscal reaction functions respectively where $\mu_t \sim I.I.D\left(0, {\sigma_{fd}}^2\right)$

Equation 10 stipulated that the reaction of the current level of fiscal balance (Fb_t) is based on the previous period level of debt ($Debt_{t-1}$). Output gap captures fiscal and monetary policy reaction that can be attributed to cyclical changes in the economy. Given the fiscal reaction function in equation (10), fiscal policy regime is considered 'passive' if the coefficient of debt is significant and negative, this means rise in a a previous debt level reduces the fiscal balance (or increase the fiscal deficit). This position is unsustainable as it implies that public debt is unconstrained (Hamilton, 2005; Davig *et al.,* 2004; Khalid & Marwan, 2012). Fiscal policy regime is considered 'active' if the coefficient of debt is positive which means government responds prudently by reducing government spending in case of a rise in the previous debt level.

Monetary policy reaction function specification is based on the Taylor rule. The optimal monetary response requires real interest rate to react positively to an increase in inflation. The Markov-switching model for the monetary reaction function is given as:

$$r_t = \beta_0(S_t) + \beta_1(S_t)\pi_t + \beta_2(S_t)\theta_t^* + \beta_3(S_t)fb_t + \beta_4(S_t)Exc_t + (S_t)\varepsilon_t \quad (11)$$

Where *Exc* refers to the exchange rate, π refers to the inflation rate, and ε_t represents the disturbance term for the monetary reaction functions which is assumed to be $\varepsilon_t \sim I.I.D(0, {\sigma_r}^2)$.

Therefore, the monetary policy regime is considered 'active' if the coefficient of inflation is greater than zero. Monetary policy regime is considered 'passive' if the coefficient of inflation is less than zero (David, 2004; Doi *et al*., 2011; Khalid & Marwan, 2012).

3.3. Estimation Procedure

Descriptive analysis was conducted to evaluate the key characteristics of the variables under investigation. The trend of public debt, real interest rate, and the fiscal balance were evaluated to discern structural breaks and the general trend. After that, each variable was subjected to stationarity tests to determine the order of integration using the Augmented Dickey-Fuller (ADF) and KPSS test (Enders, 1993; Greene, 2000). Markov-switching model was estimated based on equation (10) and (11) for each of the policy reaction function. For each model transition probability and expected duration regime were estimated and used to evaluate the nature of coordination between fiscal and monetary policy.

3.4. Data

The model was estimated using annual time series data from 1963 to 2014. Table 1 summarizes the description and measurement of variables used for investigation.

Table 1: Description of Data

Variable	Unit	Description	Source
GDP growth	Ratio	Annual GDP growth	WDI & Economic Surveys
Fiscal balance/GDP	Ratio	Fiscal balance is calculated as the difference between Government revenue minus Government expenditure as a ratio of GDP	WDI & Economic Surveys
Inflation	Ratio	Calculated using change in annual consumer prices	WDI
Total Debt/GDP	Ratio	The ratio of total debt which included domestic and external debt as a ratio of GDP	WDI & Economic Surveys
Exchange Rate	Ratio	Domestic Currency/US Dollar	WDI
Real Interest Rate	Ratio	Estimated as the inflation-adjusted lending rate	WDI
GDP Gap/Government expenditure gap	Ratio	Estimated as the deviation of actual GDP and actual government expenditure from long-run Path. The long-run path is estimated using Hodrick-Prescott filter	Estimated

WDI represents the World Bank Database
Kenya's Economic Survey (various issues)

Data used for analysis was sourced from the World Bank and Kenya's Economic surveys. Data on domestic debt and fiscal deficit were sourced Economic surveys. Data on the inflation rate and interest rate were sourced from the World Bank. Structural breaks were introduced to account for the regime changes. The next section presented the findings. Descriptive statistics, including the trend of Real Interest rates, Fiscal balance, and total public debt, are presented in figures 1 and 2.

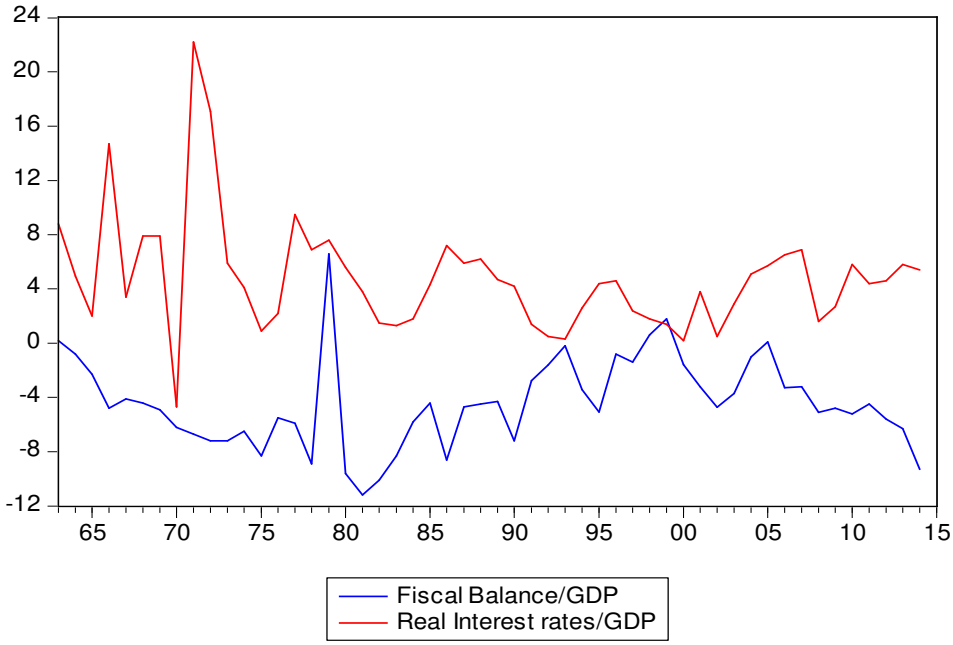

Figure 1: Trending ratio of Fiscal balance to GDP and Real Interest rate from 1963 to 2014

Generally, figure 1 shows that the fiscal balance and real interest rate were volatile from independence in 1963 to 1980. Notably, a sharp increase in interest rates from 1970 to 1980 can be attributed to macroeconomic uncertainty triggered by the global oil crises of 1971, drought and fluctuation of commodity prices. Also, a sharp increase in fiscal surplus to GDP captured between 1978 can be attributed to the coffee boom, which led to a significant increase in export revenue in the country. From the 1980s, though volatile, both fiscal policy and real interest were relatively stable compared to previous periods.

Figure 2: Trending ratio of the ratio of Total Public Debt to GDP from 1963 to 2014

Figure 2 shows that the ratio of total debt to GDP was stable at less than 30 percent from 1963 to 1977. A sharp increase in total debt was registered from 1977 peaking at approximately 80 percent of GDP in1997. Maana *et al*., (2008) explained that the rapid increase in total debt in this period was because Kenya had been running net repayments during the previous periods and thereby forced to borrow domestically to service foreign debt obligations. From 1998, the introduction of structural reforms improved debt management leading to a gradual decline in total debt. Therefore, an evaluation of the trend of interest rates, fiscal deficit, and total debt suggests a possible association between the variables cannot be readily identified. Also, the trends suggest that the introduction of economic reforms in the wake of the decade, management of fiscal policy, debt, and monetary policy significantly improved the macroeconomic policy environment in Kenya.

Stationarity conditions for all variables under investigation were tested using the Augmented Dickey-Fuller (ADF) test and Kwiatkowski-Philip-Schmidt and Shin (KPSS) test. Table 2 shows the results with critical values at a 5 percent level of significance.

Table 2: Stationarity Tests Results

Variable	Type of the Test and Test Statistics					Conclusion
		ADF Test		KPSS Test		
		Test statistic	Critical value	Test statistic	Critical value	
GDP Growth	Level	-6.11	-2.929	0.4350	0.4630	StationaryI(0)
Fiscal Balance/GDP	Level	-4.899	-2.924	0.1829	0.4630	StationaryI(0)
Real Interest rate	Level	-3.969	-2.92	0.405	0.4630	StationaryI(0)
Inflation	Level	-3.555	-2.92	0.1912	0.4630	Stationary I(0)
GDP Gap	Level	-5.039	-2.92	0.1003	0.4630	StationaryI(0)
Exchange Rate	Level	-0.265	-2.92	0.894	0.4630	Stationary with a trend
	1st Difference	-10.401	-2.92	0.194	0.4630	

Critical values at 5 percent significant level

Stationarity test presented in table 2 shows that with the exception of the exchange rate, all other variables are stationary as shown by both ADF and KPSS tests. Stationarity of variables that are traditionally considered to be I(1) may be attributed to the fact that all variables were measured in ratio form.

4. Empirical Results

This section presented the result findings. The first objective sought to identify the nature of fiscal and monetary policy regimes in Kenya. To address the objective, equations (9) and (10) are estimated, and both transition probabilities and time-varying probabilities were interpreted. The second objective sought to investigate determinants of monetary and fiscal policy rules under different policy regimes. The coefficients of the Markov switching model specified in equation (9) and (10) were used to address the objective.

Table 3: Markov Switching Model: Fiscal Policy Reaction Function

Dependent Variable: Fiscal Balance/GDP	Coef	Z-Stat	P-Value
Regime 1(Active)			
Total Debt: Lag 1	-0.15	-3.62	0.000***
Output GAP	1.007	3.39	0.000***
Government Expenditure GAP	-1.183	-1.967	0.0491**
Real Interest Rate	0.064	0.836	0.4032
Constant	7.512	3.33	0.000***
Regime 2 (Passive)			
Total Debt: Lag 1	0.009	0.277	0.7817
Output GAP	0.012	0.155	0.3936
Government Expenditure GAP	-1.307	-2.645	0.008**
Real Interest Rate	0.096	0.103	0.1936
Constant	-6.92	-5.482	0.000***
Common			
Log(Sigma)	0.5012	3.874	0.000***
Diagnostics			
Probability (Active)	0.68		3.15 Years
Probability (Passive)	0.93		7.76 Years
Log-likelihood		-117.28	
Normality Test (Jarque-Bera)		16.936	0.000***
Key: *** Significant at 1%, **Significant at 5%, *Significant at 10%			

Table 3 shows that the most parsimonious model was specified without the constant and lagged values of the independent and dependent variables. Review of diagnostics shows that the null hypothesis of normality as per the Jarque-Bera's test was not rejected at 1 percent level. However, scrutiny of the residual graph (see figure 1A in the appendix) shows that for the most part, residuals were within the acceptable band. The Durbin Watson statistic of 2.02 was deemed acceptable meaning that serial correlation was not present.

Table 3 shows that the Regime switching model adequately explained the fiscal policy cycles in Kenya. The active fiscal regime was identified by the coefficient of the lagged total debt of -0.15, which was significant at 1 percent. During the active regime, the coefficient of the output gap at 1.007 was significant. These results suggest that an increase in the output gap increases fiscal balance implying that fiscal deficit is highly sensitive to output fluctuation.

The passive regime was dominant with a probability of 93 percent. The expected duration for the passive (unsustainable) fiscal regime is likely to last twice as long as the duration of the active regime. During the passive regime, government expenditure gap had a negative and significant impact on fiscal balance, implying that a temporary surge in government expenditure during unsustainable régime further limits fiscal space. Table 4 shows the results of the monetary policy reaction function where sustainable and unsustainable regimes were identified based on the Taylor rule.

Table 4: Markov Switching Model: Monetary Policy Reaction Function

Dependent Variable: Real Interest Rate	Coef	Z-Stat	P-Value
Regime 1(Active)			
Inflation	-0.23	-1.18	0.2366
Output GAP	-0.0289	-0.31	0.7564
Fiscal Balance/GDP	0.045	0.195	0.8451
Change in Exchange rate:	-0.21	-1.546	0.8479
Constant	3.56	2.49	0.013**
Regime 2 (Passive)			
Inflation	-0.31	-2.79	0.005***
Output GAP	0.09	0.13	0.8945
Fiscal Balance/GDP	1.36	5.70	0.000***
Change in Exchange rate	-0.20	-1.54	0.1222
Constant:	20.34	11.39	0.000***
Common			
Log(Sigma)	1.36	11.67	0.000***
Diagnostics			
Probability (Active)	0.88		8.3 Years
Probability (Passive)	0.89		9.3 Years
Loglikelihood		-158.38	
Normality Test (Jarque-Bera)		10.91	0.004**
Key: *** Significant at 1%, **Significant at 5%, *Significant at 10%			

Based on the results presented in table 4, the coefficient of the lagged total debt of -0.23, though the coefficient is negative, it was not significantly different from zero and therefore identified as the active monetary regime. The passive monetary regime was identified by the coefficient of inflation of -0.31, which was significant at 1 percent level. Notably, the fiscal balance had a coefficient of 1.36, which was significant. This confirms efforts by monetary policy to respond to expansionary fiscal policy even during passive regimes prudently. Transition probability results show that active monetary policy regime was expected to last for eight years while the expected

duration for a passive monetary policy regime was nine years. Residuals for the monetary policy reaction function can be inspected in Figure 2A (see the Appendix).

4.1 Determinants of monetary and fiscal policy ruled under different policy regimes

Based on the findings in table 3 and 4, there is evidence to suggest the dominance of unsustainable (passive) fiscal policy. However, based on the expected duration, the monetary response was more balanced during the study period. Notably, the temporary rise in GDP as measured by the output gap plays a critical role in improving fiscal balance in Kenya. On the other hand, fiscal space is limited during the unsustainable regime. It is also important to note that fiscal balance had a positive influence on real interest rate during passive monetary policy regimes suggesting that fiscal policy reaction may directly influence monetary policy.

4.2 The nature of Fiscal and Monetary Policy Coordination

The next step is to evaluate the nature of regime changes for both fiscal and monetary policy. Time-varying probabilities for active fiscal policy and active monetary policy were plotted and compared in figure 3. This study asserts that active fiscal policy is synonymous with an unsustainable fiscal policy to the extent that rise in debt is associated with expanding the fiscal deficit, while the active monetary policy is synonymous with contractionary monetary policy. An evaluation of the nature of fiscal and monetary policy regimes yields the figure below:

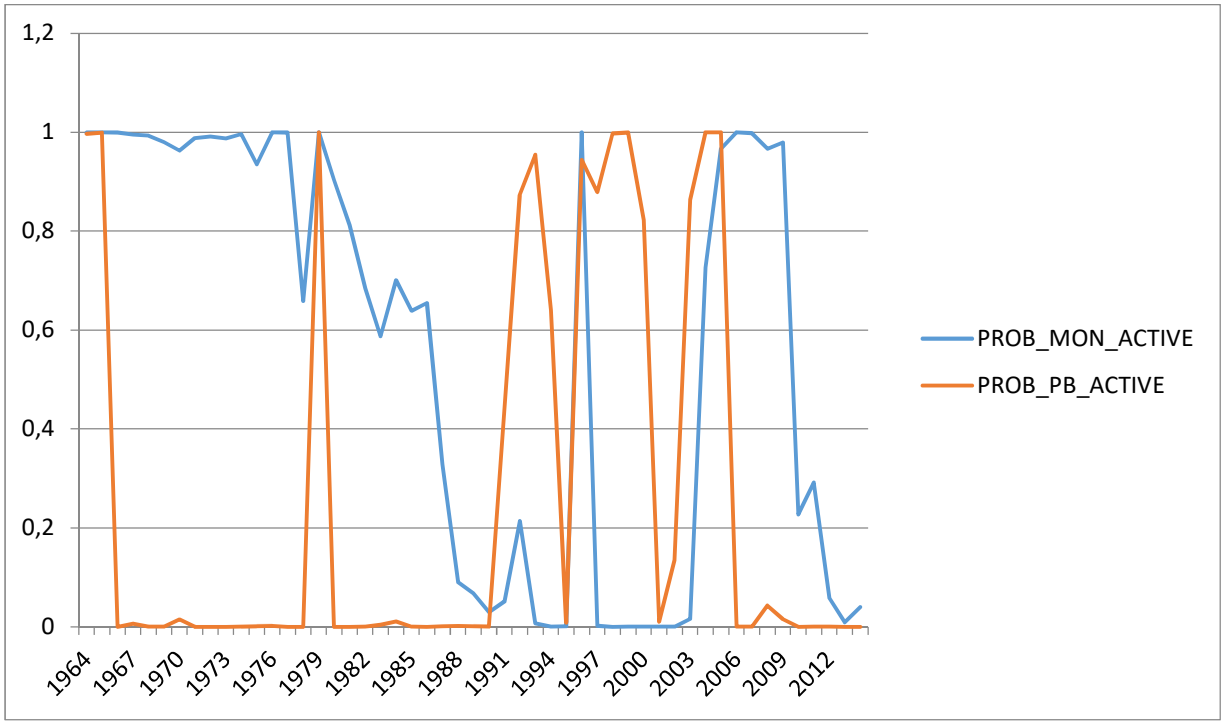

Figure 3: Comparing Active Fiscal and Active Monetary Policy regimes in Kenya

The results in figure 3 show that fiscal and monetary policy regimes are aligned to the historical policy landscape in Kenya. Also, the results confirm the tendency for both fiscal and monetary policy to switch from active (sustainable) to passive (unsustainable) regimes over the years.

Figure 3 traces out some degree of coordination between fiscal and monetary policy. It can be observed that passive or unsustainable fiscal policy regimes are either coincided or closely followed by active monetary policy. This implies that despite the dominance of unsustainable fiscal policy, long-run fiscal sustainability is supported by an active monetary policy regime which reacts prudently by pursuing contractionary policies (as indicated by active monetary policy) when unsustainable fiscal policy regime is observed. Given the dominance of fiscal policy, monetary policy reacts by pursuing restrictive policies when fiscal policy is deemed unsustainable.

The results demonstrate that monetary policy pacifies the effect of fiscal policy to ensure sustainability is achieved despite the deviation of fiscal policy from the long run path.

4.3 Sensitivity analysis

For robustness checks, Self-exciting models were estimated for both the specified fiscal and monetary policy reaction functions (See table 1A and 2A in the appendix). Generally, both models were consistent with the corresponding Markov switching estimation. It is worth noting that the most parsimonious specification for the fiscal policy reaction function had three lags proving that both fiscal and monetary policy reacts with a lag.

5. Conclusion

In conclusion, this study sought to investigate the level of coordination between fiscal and monetary policy towards achieving long-run fiscal sustainability. Fiscal policy reaction function was modeled as a regime-switching function, shifting between sustainable to unsustainable periods. This is an extension of Bohn (1995) seminal paper which considers the response of fiscal policy to the previous level of debt. Monetary policy reaction function was also assumed to switch from sustainable regimes to unsustainable regimes as articulated by the Taylor rule.

The results show that the regime switching model explains policy regime changes in Kenya. The unsustainable fiscal regime was dominant compared to the sustainable regime. The results confirm the existence of essential policy reactions: There is a tendency for monetary policy to actively and prudently respond to unsustainable fiscal policy. This occurs sequentially, suggesting a lagged monetary policy effect.

Two recommendations are made. Firstly, there is a need for the dominant unsustainable fiscal policy regime to be balanced by a commitment to fiscal consolidation, and supportive monetary response to check periodic deviation of fiscal policy from long-run sustainability path.

Secondly, and the main recommendation of this study is that as Kenya seeks to implement the East African Community Monetary Union (EACMU) protocol, CBK's ability to pacify unsustainable fiscal policy may be compromised by a constrained monetary policy regime at the national level. Therefore, the study recommends that if the migration to a constrained monetary regime occurs, adoption of prudent fiscal policy will be paramount.

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Appendix

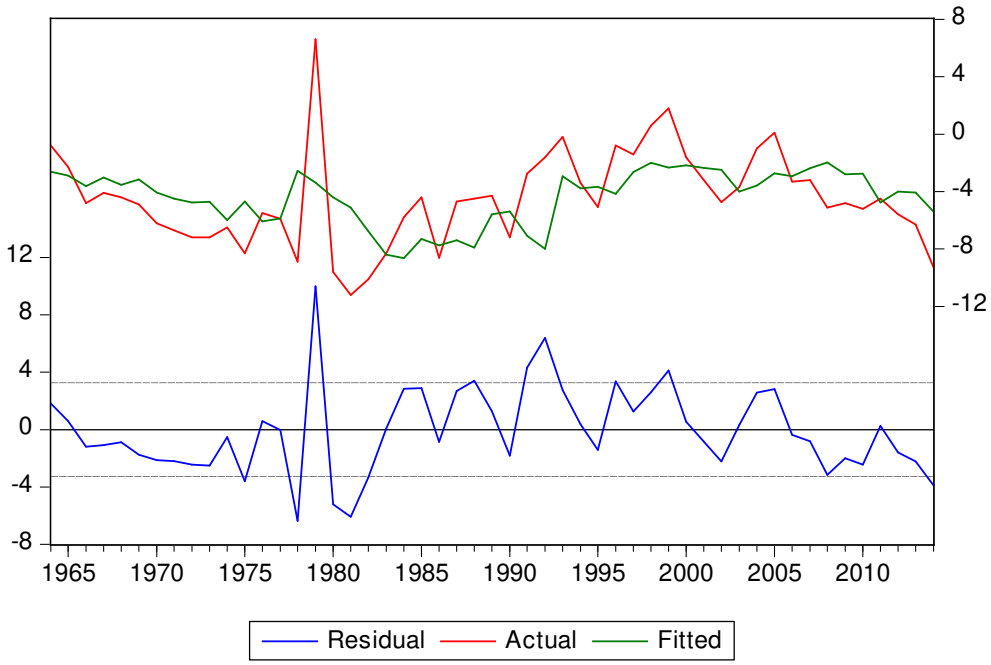

Figure 1A: Residual from Markov Switching Fiscal Policy Reaction Function

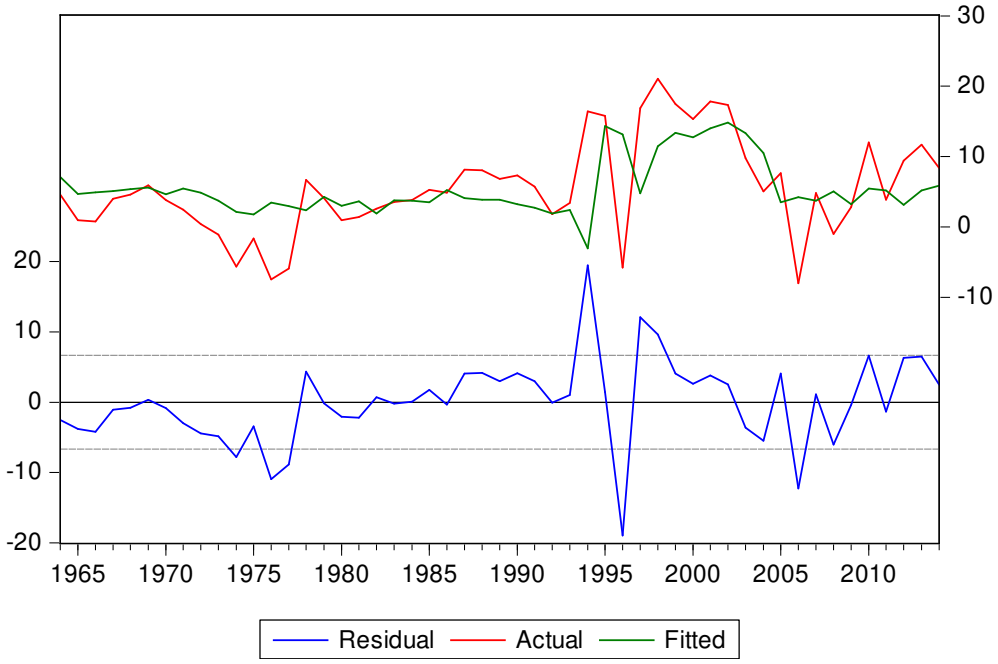

Figure 2A: Residual from Markov Switching Monetary Policy Reaction Function

Table 1A: Self-Exciting Fiscal Policy Reaction Function

Dependent Variable: Fiscal Balance/GDP	Coef	t-Stat*	P-Value
Threshold Value: FB_GDP > 6.7 (10 Observations)			
Constant	6.454	7.075	0.000***
Total Debt: Lag 1	-0.305	-1.84	0.073*
Output GAP	0.085	0.374	0.819
Real Interest Rate	0.731	1.967	0.056**
Threshold Value: FB_GDP < 6.7 (38 Observations)			
Constant	-10.496	-6.75	0.000***
Total Debt: Lag 1	0.125	3.867	0.000***
Output GAP	-0.035	-0.628	0.5333
Real Interest Rate	0.054	0.673	0.505
Diagnostics			
Adjusted R Square			0.2916
Serial correlation test (Breusch-Godfrey)		3.611	0.057*
Heteroskedasticity (Breusch-Pagan-Godfrey)		114.35	0.045*
Normality Test (Jarque-Bera)		2.1137	0.3475

Key: t-stat estimated using Newey-West estimator
*** Significant at 1%, **Significant at 5%, *Significant at 10%

Table 2A: Self-Exciting Monetary Policy Reaction Function

Dependent Variable: Real Interest rates	Coef	t-Stat*	P-Value
Threshold Value: Real interest rate<4.819 (27 Observations)			
Constant	5.659	3.174	0.0029***
Inflation	-0.029	-0.23	0.004**
FB_GDP	0.389	0.374	0.716
Output Gap	-0.005	-0.0051	0.959
Change in Exchange Rate	0.731	1.967	0.045**
Threshold Value: Real interest rate >4.819 (22 Observations)			
Constant	14.8	5.054	0.000***
Inflation	-0.21	1.306	0.1991
FB_GDP	0.785	1.473	0.1486
Output Gap	-1.083	2.451	0.0188
Change in Exchange rate	-0.228	-2.383	0.0221**
Adjusted R Square			0.307
Serial correlation test (Breusch-Godfrey)	5.578		0.018**
Heteroskedasticity (Breusch-Pagan-Godfrey)		4.654	0.863
Normality Test (Jarque-Bera)		5.51	0.064*

Key: t-stat* estimated using Newey-West estimator to provide for autocorrelation
*** Significant at 1%, **Significant at 5%, *Significant at 10%

Table 3A: Summary of Empirical Studies

Authors	Sample	Objective	Methodology	Remarks
Leith and Lewis (2000)	European Monetary Union (EMU).	To identify the conditions under which either fiscal and monetary policy alone determines the price level.	The study uses simulation analysis to establish policy regimes under the EMU fiscal policy pact.	The results conclude that the central bank does not need to seek the level of debt stabilizing level implied by the fiscal stability pact.
Muscatelli et al. (2002)	Quarterly data, seasonally adjusted where possible for 5 OECD countries – Germany, France, Italy, the UK, and the USA.	To examine the response of monetary and fiscal policy to macroeconomic targets, and the interdependence between the two policy instruments.	The study adopted two complementary VAR methodologies. First, a conventional structural VAR and secondly, the study attempted to identify regime changes further by computing time-varying VAR estimates.	The findings illustrated that while monetary and fiscal policy had been increasingly used as strategic complements, the responsiveness of fiscal policy to the business cycle had decreased after the 1980s.
Lambertini and Rovelli (2003)	European Monetary Union (EMU).	To investigate the relationship between monetary and fiscal policy in the process of macroeconomic	The study proposes a game theory framework and analyzes the interaction of the	The study concluded that the preferable and most probable outcome is the one where the fiscal authority takes the lead in the macroeconomic policy game. The conclusions, however, support the idea that the setting of fiscal policies by

		stabilization within a Stackelberg equilibrium framework.	fiscal and monetary policies in a Nash equilibrium.	member countries needs to be disciplined, and in some instances possibly over-ruled, by the EC authorities.
Semmler and Zhang (2003)	Quarterly data from 1967 to 1998.	To investigate the interaction over time between monetary and fiscal policies in France and Germany in the 70s, 80s, and 90s.	The paper started by undertaking some tests of fiscal regimes with a VAR model, then conducted Granger-Causality tests to check whether fiscal policy granger-causes inflation. Finally, the paper applied a state space model with Markov switching to estimate the time-varying vector of parameters of a simple model.	The results can be summarized as follows: A non-Ricardian fiscal policy applies in this case; Fiscal policy does not seem to Granger-cause inflation, but Inflation does Granger-cause fiscal policy to some extent; Finally, there seem to be some regime changes in the monetary and fiscal policy interactions in the two countries but somehow different in the two countries.
Dungey and Fry (2009)	Quarterly data from 1983 to 2006.	To trace out the interaction between monetary policy shocks, fiscal shocks and other economic shocks in New Zealand	The paper uses a structural VAR to disentangle monetary, fiscal policy, and other shocks. The methodology combines identification via sign restrictions,	The results show that the influence of fiscal policy stance is sometimes substantial to the extent that it outweighs the contribution of monetary policy shocks.

			cointegration, and traditional exclusion restrictions.	
Fialho and Portugal (2009)	Monthly data from 1995 to 2003.	To verify the predominance of a monetary or fiscal dominance regime in Brazil in the post-Real period.	To study the interactions between monetary and fiscal policies in Brazil using a Markov-switching vector autoregression model while applying the fiscal theory of price level.	The results can be summarized in two parts. (i) That there is a relationship between public debts and their measure of monetary policy, and (ii) The nature of macroeconomic coordination in Brazil follows a substitution approach with a dominant monetary regime.
Arby and Hanif (2010)	Annual data from 1965 to 2009.	To explore how the monetary and fiscal policies have coordinated with each other in Pakistan.	Granger causality tests were applied to test for independence, A macroeconomic matrix and a policy response matrix were used to examine coordination.	The results do not establish any difference in how monetary and fiscal policies were conducted before and after the establishment of the Monetary and Fiscal policies coordination board in 1994. Further, coordination is found to be clustered around the military regimes, justifying the macroeconomic stability observed during such regimes.

Chuku C.A (2012)	Quarterly data from 1970 to 2008.	To examine the nature of monetary and fiscal policy interactions in Nigeria.	The paper used vector autoregression and a State Space model with Markov-switching.	The results indicated that monetary and fiscal policies in Nigeria have interacted in a counteractive manner, establishing some evidence of weak coordination.
Tarawalie *et al.* (2013)	Annual data for the period 1980-2011.	To examine the level of coordination between fiscal and monetary authorities in the Western African Monetary Zone (WAMZ) countries and its implications for the attainment of the inflation and fiscal deficit criteria.	The paper uses the Set Theoretic approach (STA) and the Vector autoregressive (VAR) estimation techniques.	The results reveal weak policy coordination in all WAMZ countries during the period, which contributes to the non-compliance concerning inflation and fiscal deficit criteria. The results of the STA models show that explicit policy coordination scores in the WAMZ countries are less than 50 percent. The study recommends that WAMZ should strengthen policy coordination by putting in place formal coordination platforms and institutional arrangements.
Wesselbaum (2014)	Quarterly data from 1994 to 2014.	To characterize the interactions between fiscal and monetary and policy in New Zealand.	A multivariate Markov switching model was used to document the different policy changes.	The results map out two regimes: (i) A non-accommodative monetary policy regime, where the monetary policy does not respond to changes in public debt and (ii) an accommodative monetary policy regime where monetary policy responds to changes in public debt.