Fiscal and monetary policy coordination and debt sustainability in the CEMAC zone: Evidence from a Markov regime-switching model

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ABSTRACT

This paper investigates the nature of fiscal and monetary policy implemented in the Economic and Monetary Community of Central Africa (CEMAC) and its impact on long-run debt sustainability. The study employs a two-state Markov regime-switching model to the fiscal and monetary policy reaction functions of the six CEMAC countries using time series data from 1970 to 2020. The fiscal regime is regarded as active if the coefficient of debt is positive, while it is considered passive if the coefficient is negative and significant. Regarding monetary policy, an active regime is reported if the coefficient of inflation is positive; otherwise, the monetary policy regime is regarded as passive. In addition, the transition probability and time-varying transition probability are estimated to assess the nature of policy-mix coordination. The findings highlight unsustainable fiscal regimes in Equatorial Guinea and Chad, balanced results for Gabon and Congo, while Cameroon and the Central African Republic have sustainable fiscal regimes. Concerning monetary policy, a sustainable monetary regime is found for Cameroon and Equatorial Guinea, with balanced results for Congo, while evidence of an unsustainable monetary regime is found for the Central African Republic, Chad, and Gabon.

Contribution/ Originality: The main contribution of this paper to the literature is its assessment of the nature of fiscal and monetary policy coordination in CEMAC and the effect of the CEMAC countries' policy mix on long-run debt sustainability using a two-state Markov regime-witching model, transition probability, and time-varying estimation.

1. INTRODUCTION

Fiscal and monetary policies are two leading players responsible for macroeconomic stability. The first is dedicated to ensuring the full employment of human capital, while the second has price stability as its main objective. From the theory, it is clear that the main objectives of fiscal and monetary policies are not supposed to be mutually exclusive; fiscal and monetary agents must be coordinated to achieve sustainability. However, the two main objectives pursued by the fiscal and monetary authorities can sometimes diverge, giving place to conflict of objectives (Cochrane, 2009). As a result, each policy tries to pull the economy in the opposite direction, a situation that can arise from a non-optimal policy mix. Indeed, fiscal policy tends to be expansionary (Alesina & Perotti, 1995), particularly in developing countries where fiscal policy appears to be pro-cyclical with an increase in government expenditure during the expansion periods (Kaminsky, Reinhart, & Végh, 2004). In such circumstances, the central bank becomes the authority in charge of macroeconomic stabilization by running an overly contractionary monetary policy characterized by high interest rates to correct the fiscal unbalance. Consequently, the effectiveness of monetary policy

and the credibility of the whole policy mix is affected (Tarawalie, Sissoho, Conte, & Ahortor, 2013). Conversely, the failure of the central bank to adopt a suitably contractionary monetary policy would compromise its objectives in terms of macroeconomic stability. The literature on optimal monetary and fiscal policies is well known. However, the two have often been treated separately, such as in the studies conducted by Chari and Kehoe (1999) and Blanchard and Fischer (1989) and further developed by Cheng (2006), who focused on public debt management and monetary policy, and Maana, Owino, and Mutai (2008), who explored public debt management and fiscal policy. And when their interactions were studied, the focus was mainly on the effects emanating from the non-coordination of the two policies (Sargent, 2013; Sargent & Wallace, 1981). While the literature on debt management focused on supporting fiscal or monetary policies, on the one hand, Barro (1999) acknowledged the role played by debt management in tax smoothing, and, on the other hand, the role of debt management has been identified as necessary to ensure the consistency of monetary policy (Calvo & Pablo, 1990). The main connection between fiscal and monetary policy is thus in the area of debt management. The implementation of monetary policy impacts the debt burden, which either increases or limits the ability of a given government to pursue the funding of a deficit (Friedman & Woodford, 2011).

Hence, there is a need to coordinate fiscal and monetary policy to balance the entire economy. The theory indicates that effective policy coordination requires individual policies, as well as the whole policy mix, to be suitable for sustainable development (Friedman & Woodford, 2011; Togo, 2007). Analyzing fiscal sustainability has long been a component of fiscal policy rules that describe the impacts of the initial level of public debt on the evolution of primary balance. Following Bohn (1995), to ensure sustainability, a rise in the public debt to gross domestic product (GDP) ratio should lead to an increase in primary balance to respect government intertemporal budget conditions.

To the best of our knowledge, few studies have mixed the Markov regime-switching fiscal policy rule and the long-term sustainability test. Indeed, Canzoneri, Cumby, and Diba (2001) studied a time-varying fiscal policy rule and deduced a necessary and sufficient condition in which the government's intertemporal budget constraint could hold in the long run. A widening of Wilcox's (1989) unit root was performed by Davig (2005) while testing a Markov switching framework procedure in which discounted debt could sometimes increase. Lastly, there have been studies on regime-switching monetary and fiscal policy rules that have efficaciously recognized local stabilities in the data wherever fiscal policy (or monetary policy) was either "active" or "passive" (Leeper, 1991).

The current research is firstly motivated by empirical periods in which the public debt to GDP ratio did not respect stationarity with no improvement in primary balance. During these periods, the issue of fiscal sustainability gained much interest, since Bohn's sustainability condition appeared to be violated by chosen fiscal policy, highlighting the issue of long-run fiscal sustainability. Above all, however, the motivation of this study is to contribute to the literature on the coordination of fiscal and monetary policies by assessing the nature of the coordination and its impact on debt sustainability in the long run.

The remainder of this paper is organized as follows: Section 2 reviews the related literature. Section 3 presents the data and methodology. Section 4 discusses the empirical findings. Section 5 concludes.

2. LITERATURE REVIEW

Numerous empirical studies have been conducted on the relationship between monetary and fiscal policies. The first studies that can be found in the literature are those by Blinder (1982) and Nordhaus, Schultze, and Fischer (1994), which demonstrate that in a non-cooperative game, the Nash equilibrium leads to high levels of public spending and an excessively contractionary monetary policy. Leith and Wren-Lewis (2000) examined the circumstances in which one of the two policies can independently affect the price level. Using a sample of European Monetary Union (EMU) countries, their study concluded that the central bank does not need to be concerned about the stabilization of debt levels, which is a part of the fiscal stability pact. Studying the same EMU sample, Lambertini and Rovelli (2003) examined the Nash equilibrium in the relationship between fiscal and monetary policies using a game theory framework. Their analysis found that the scenario in which the fiscal authority initiates the macroeconomic policy

game is the better and more realistic outcome. However, their conclusion affirms that member countries must exercise restraint when establishing budgetary policies and that occasionally authorities may even need to step in and make a decision.

Using data covering 5 countries of the Organisation for Economic Co-operation and Development (OECD), Germany, France, Italy, the UK, and the US, the research of Muscatelli, Tirelli, and Trecroci (2002) demonstrated that fiscal policy's awareness of the business cycle declined after 1980 due to the growing use of monetary and fiscal policy as strategic alternatives. Semmler and Zhang (2003) used quarterly data from France and Germany from 1967 to 1998 to examine the interaction between fiscal and monetary policies over time. Their empirical results on the non-Ricardian assumption of fiscal policy revealed that while the fiscal policy does not appear to directly cause inflation, it does indirectly cause inflation to some extent. The relationships between the monetary and fiscal policies in France and Germany appear to have undergone some global regime changes, but they varied in certain ways.

Dungey and Fry (2009) used the structural VAR technique to separate monetary policy shocks from fiscal policy shocks or other types of shocks in the New Zealand economy, focusing on quarterly data from 1983 to 2006. Their empirical results demonstrate that the authority over fiscal policy can occasionally have a significant impact that cancels out monetary policy shocks. Wesselbaum (2014) sought to analyze the linkages between fiscal and monetary policy in the New Zealand economy using the same type of data but focusing on a more recent period, 1994 to 2014. The findings revealed the existence of two distinct regime types: the first corresponded to a non-accommodative monetary policy regime, in which monetary policy did not react to changes in public debt, and the second was an accommodative monetary policy regime, in which monetary policy did react to changes in public debt.

The research conducted by Fialho and Portugal (2009) used monthly data from Brazil from 1995 to 2003 and aimed to confirm the existence of a regime of monetary or fiscal dominance. Using a Markov regime-switching vector autoregression model, they investigated how Brazil's monetary and fiscal policies interacted while putting the fiscal theory of price level (FTPL) to the test. They concluded that there was a connection between monetary policy and public indebtedness and that macroeconomic coordination in Brazil was characterized by a switching strategy with a dominating monetary regime. In a different study, Arby and Hanif (2010) analyzed the degree of coordination between Pakistan's monetary and fiscal policies using annual data from 1965 to 2009. According to their findings, there was no difference in how the two policies were run before or after the founding of the monetary and fiscal policy coordination board in 1994. Furthermore, they discovered that coordination centered on military regimes, characterizing the macroeconomic stability under those regimes.

The empirical research by Tarawalie et al. (2013) investigated the degree of coordination of the policy mix in the Western African Monetary Zone (WAMZ) and its effect on the achievement of the inflation target and fiscal deficit requirements. Between 1980 and 2011, all countries showed a lack of coordination in their policymaking, which contributed to their noncompliance with the requirements for inflation and fiscal deficit. More recently, research by Alcidi and Thirion (2016) found that most developing countries responded to the recession experienced in developed economies by implementing countercyclical policies in the form of fiscal stimulus, monetary easing, or both. Irungu, Chevallier, and Wagura (2019) looked at the relationship between Kenya's fiscal and monetary policies and public debt management using annual data from 1963 to 2014. Their investigation employed threshold autoregressive models with self-exciting thresholds and regime switching. The empirical data revealed the predominance of unsustainable fiscal regimes and the tendency for monetary policy to respond prudently to the unsustainable fiscal regime. In the case of Kenya, regime switching explained the fiscal regime changes.

3. DATA AND METHODOLOGY

This section first describes the data used in this research before presenting the theoretical framework and model specification.

3.1. Data Description

Table 1 presents the descriptive statistics of our data, covering the six CEMAC countries (Cameroon, the Central African Republic, the Republic of Congo, Equatorial Guinea, Gabon, and Chad) over the study period from 1970 to 2020.

Table 1. Descriptive statistics.

Variables	Unit	Description	Sources
Total debt (% GDP)	Ratio	The ratio of central government total debt, including domestic and external debt	AFDB
Fiscal balance (% GDP)	Ratio	Central government revenue minus expenditure	AFDB
GDP growth	Ratio	Annual GDP growth	WDI & AFDB
Inflation	Ratio	Annual consumer price	WDI & AFDB
Real interest rate	Ratio	Inflation-adjusted lending rate	CEMAC & Knoema.com
Exchange rate	Ratio	Official exchange rate	WDI & AFDB
Government expenditure gap	Ratio	Estimated as the deviation of actual general government expenditure from the long-run trend (Long-run trend estimated using Hodrick-Prescott filter)	Author estimation from the WDI & AFDB database
GDP gap	Ratio	Estimated as the deviation of actual GDP from the long-run trend (Long-run trend estimated using Hodrick-Prescott filter)	Author estimation from the WDI & AFDB database

Source: World Bank database (WDI), African Development Bank database (AFDB), Economic and Monetary Community of Central Africa database (CEMAC), Knoema.com database.

The data used in this paper were mainly extracted from the World Bank's World Development Indicators (WDI), complemented by data from the African Development Bank (AFDB), Bank of Central African States (BEAC), and Knoema.com databases. The data on GDP growth, inflation, and exchange rate were from the WDI, complemented by data from the AFDB for the year 2020. The data on total debt and fiscal balance were exclusively extracted from the AFDB. Finally, the real interest rate was sourced from the BEAC and Knoema.com databases.

3.2. Model Specification

The Markov switching model applied to a two-state fiscal policy reaction function is described as follows:

$$FB_t = a_0(S_t) + \alpha_1(S_t)Debt_{t-1} + \alpha_2(S_t)\theta_t^* + \alpha_3(S_t)RIR_t + (S_t)\mu_t \qquad (1)$$

where the dependent variable FB_t denotes the fiscal balance (% of GDP), and the independent variables are as follows: $Debt_t$ denotes the total debt (% of GDP), and RIR_t denotes the real interest rate. θ^* indicates the control variable, including the output gap and the government expenditure gap, which measure how far GDP and government spending have deviated from their long-term trends; S stands for the number of regimes, and μ_t is the fiscal reaction functions' error term, where $\mu_t \sim I.I.D(0, \sigma fd^2)$.

Equation 1 predicts that the response to the present fiscal balance level will be (FB_t) based on the level of the previous debt $(Debt_{t-1})$. The output gap captures fiscal and monetary policy reactions attributable to cyclical variation in the economy. According to Equation 1, the fiscal policy regime is considered "passive" if the debt coefficient is negative and significant, which means that an increase in the prior debt level causes the fiscal deficit to increase (reduces the fiscal balance). This stance is unsustainable, however, since it implies that the national debt is limitless (Davig, Leeper, & Chung, 2004; Hamilton, 2005). If the debt coefficient is positive, the fiscal policy regime is said to be "active," indicating that when the level of prior debt rises, the government responds appropriately by cutting back on expenditure.

The Taylor rule forms the foundation of the Markov switching model used to define the monetary policy reaction function. Real interest rates should rise in response to rising inflation as part of the ideal monetary response. The following equation describes the Markov switching model for the monetary reaction function:

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$$r_t = \beta_0(S_t) + \beta_1(S_t)\pi_t + \beta_2(S_t)\theta_t^* + \beta_3(S_t)fb_t + \beta_4(S_t)Exc_t + (S_t)\varepsilon_t \qquad (2)$$

where the dependent variable r_t represents the real interest rate, and the independent variables are as follows: π_t represents the inflation rate, Exc denotes the exchange rate, and ε_t refers to the error term for the monetary reaction functions, assumed to be $\varepsilon_t \sim I.I.D(0, \sigma fr^2)$.

Therefore, if the inflation coefficient is greater than zero, the monetary policy regime is said to be "active." Consequently, if the inflation estimate is less than zero, the monetary policy regime is said to be "passive" (Doi, Takeo, & Tatsuyoshi, 2011; Marwan, Khalid, Ahmad, Samsudin, & Ab Halim, 2012).

3.3. Estimation Technique

We first tested the stationarity to define the integration order using the augmented Dickey-Fuller (ADF) and Phillips Perron (PP) techniques. Next, we estimated the Markov switching model based on Equations 1 and 2 for both policy reaction functions. For both models, the transition probability and expected duration of regimes were estimated and used to assess the nature of the coordination between fiscal and monetary policy in the CEMAC zone.

4. EMPIRICAL FINDINGS

Table 2 presents the results of the stationary tests. We tested the stationarity of our variables using ADF and PP unit root tests, and it appears that inflation, fiscal balance, GDP growth, and real interest rate were stationary at the I(0) level for all six countries, except for the real interest rate of Cameroon, which was I(1). Government expenditure was stationary at level I(0) for Gabon and Equatorial Guinea only; Equatorial Guinea alone had a stationary public debt, while for the other countries, public debt was integrated of order 1, I(1). However, for all six countries, the exchange rate was not stationary at level but became so once we took its first difference I(1).

Table 3 provides the results of the Markov switching model applied to the fiscal policy reaction function in the CEMAC countries. The active fiscal regime was identified by a positive coefficient of lagged debt for the Central African Republic (0.2***), Cameroon (0.002*), the Republic of Congo (0.21), and Gabon (0.025), while for Equatorial Guinea (-0.076***) and Chad (-0.19***), the active fiscal regime was identified by a negative and significant coefficient.

During the active regime, the coefficient of the GDP gap was positive and significant for Cameroon (0.58***) and Chad (0.11*). These results imply that a rise in the output gap improves the fiscal balance for Cameroon and Chad, showing how sensitive the fiscal deficit is to the output gap. However, for the Central African Republic, the Republic of Congo, Equatorial Guinea, and Gabon, an increase in the output gap led to an increase in public debt that damaged the fiscal balance (increased the fiscal deficit). The active fiscal regime dominated in almost all the six CEMAC countries with a probability of 81% for the Central African Republic, 94% for Cameroon, 92% for the Republic of Congo, 70% for Gabon, 89% for Equatorial Guinea, and 90% for Chad.

Table 2. Stationarity test results.

Mackison's critical values												
				1%		5%		10%				
				-3.58		-2.93		-2.6				
Country:	Central African Rep		Cameroon		Rep. of Congo		Gabon		Equatorial Guinea		Chad	
Unit root test	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP
Variables												
Debt	-4.76	-4.8	-5.81	-5.883	-1.486	-6.238	-7.11	-7.2	-4.1***	-3.4**	-6.71	-6.76
Real interest rate	-2.57*	-8.82	-11.3	-11.3	-5.5***	-5.6***	-5.8***	-5.6***	-3.8***	-3.8***	-7.5	-2.6*
Inflation	-2.86**	-2.7**	-4.69***	-4.75***	-3.5***	-3.447	-4.3***	-4.2***	-4.52	-4.3***	5.1***	-5.1***
GDP growth	-7.4***	-7.4***	-4.7***	-4.72***	-3.7***	-3.7***	-5.06***	-5.***	-4.17***	-4.1***	-5.6***	-5.6***
Exchange rate	-5.9	-5.88	-6.3	-6.325	-6.40	-6.398	-6.36	-6.358	-6.3	-6.27	-6.24	-6.22
Fiscal balance	-3.8***	-4.8***	-4.42***	-4.41***	-2.56*	-2.69*	-3.2**	-3.1**	-2.59*	-2.6*	-3.4**	-3.26**
Expenditure	-6.059	-6.03	-7.05	-7.032	-6.456	-6.57	-3.2**	-3.3**	-5.5***	-4.5***	-5.42	-5.4

Note: Numbers with the notation ***; **;* are integrated at the level I(0), those without at the first difference I(1). Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, and * $p < 0.1$.

The expected duration of the active fiscal regime was longer than the passive fiscal regime for Cameroon and Congo; Gabon and Chad showed balanced results, while the Central African Republic and Equatorial Guinea were the only countries with a higher expected duration of the passive fiscal regime compared to the active fiscal regime. During the passive fiscal regime, government expenditure had a negative and significant impact on fiscal balance only in the Republic of Congo, while the other countries showed a positive effect of government expenditure on fiscal balance. This shows how an increase in government expenditure during the passive regime limits fiscal space in the Republic of Congo, explaining the high level of public debt experienced by this country (Ekouala, 2022a; Ekouala, 2022b). The Republic of Congo is currently the only CEMAC country with a debt-to-GDP ratio above 100%.

Table 3. Markov switching model results for the fiscal policy reaction function.

Country	Central African Rep.	Cameroon	Republic of Congo	Gabon	Equatorial Guinea	Chad
Dependent variable: Fiscal balance (% GDP)						
Regime1: Active						
L. debt	0.2*** (0.035)	0.002* (0.017)	0.21 (0.019)	0.025 (0.017)	-0.076*** (0.035)	-0.19*** (0.028)
Real interest rate	0.02 (0.09)	-0.001 (0.047)	-0.043 (0.097)	0.053 (0.035)	0.093 (0.087)	0.0009 (0.037)
GDP gap	-3.35*** (0.55)	0.58*** (0.16)	-0.664 (0.71)	-0.023 (0.35)	-0.24* (0.13)	0.11* (0.06)
Expenditure gap	-3.26*** (0.33)	-0.37 (0.65)	-1.23*** (0.52)	-1.29*** (0.32)	-3.07*** (0.41)	-0.0048 (0.24)
Constant	34.05*** (5.92)	0.23 (7.9)	10.78*** (7.72)	14.41*** (4.05)	38.63*** (4.8)	4.69*** (1.54)
Regime 2: Passive						
L. debt	-0.037 (0.031)	-0.665*** (0.15)	-0.026 (0.019)	-0.082*** (0.02)	-0.0092 (0.035)	0.16*** (0.051)
Real interest rate	0.087 (0.13)	-0.63*** (0.11)	-0.4** (0.05)	0.37*** (0.04)	0.068 (0.079)	-0.165*** (0.026)
GDP gap	0.25 (0.19)	-1.64 (0.78)	-0.554 (0.24)	-1.68*** (0.207)	0.35 (0.099)	0.33*** (0.092)
Expenditure gap	0.158 (0.15)	9.66*** (2.41)	-1.7*** (0.55)	2.539*** (1.08)	0.221 (0.58)	0.11 (0.12)
Constant	-2.32 (2.35)	-35.36* (43.53)	42.007*** (5.09)	-20.41 (6.41)	-7.27 (12.5)	-10.37*** (1.65)
Log likelihood	-131.84	-126.02	-153.93	-131.29	-160.98	-100.04
lnsigma	2.38	2.39	4.18	2.31	4.8	1.26
Diagnostic tests						
Transition probability active regime	0.81	0.94	0.92	0.70	0.89	0.90
Transition probability passive regime	0.13	0.14	0.09	0.27	0.09	0.09
Expected duration active regime	5.34 Years	18.87 Years	13.48 Years	3.35 Years	9.5 Years	10.23 Years
Expected duration passive regime	7.66 Years	6.79 Years	10.55 Years	3.61 Years	10.3 Years	10.26 Years
Common						
Heteroskedasticity	Chi2=2.31 P= 0.128	Chi2=4.52 P= 0.3	Chi2=0.34 P= 0.56	Chi2=2.74 P= 0.097	Chi2=1.72 P=0.189	Chi2=0.269 P= 0.405
Normality test: Jarque-Bera	Z=967.9 P=7.e-211	Z=112.4 P=3.9e-25	Chi2= 0.304 P= 0.85	Chi2=5.45 P=0.65	Chi2=43.9 P=2.9e-10	Z=2.13 P=0.34

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors in parentheses.

Table 4 presents the empirical findings of the Markov switching model applied to the monetary policy reaction function, where the active regime and the passive regime are identified using the Taylor rule. According to the coefficient of inflation estimates, it appears that the active monetary regime is identified by a positive coefficient for

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Cameroon (0.506***), Congo (0.08), and Equatorial Guinea (2.34***). Except for Congo, these results are statistically significant. For the Central African Republic (–0.69***), Gabon (–9.36***), and Chad (–1.01***) the active monetary regime is identified by a negative and significant coefficient. The passive monetary regime is identified by a negative coefficient for the Central African Republic (–0.88***), the Republic of Congo (–1.27***), Gabon (–1.15), and Chad (–0.65***); except for Gabon, these results are statistically significant, while the passive monetary regime is identified by a positive and significant coefficient of inflation for Cameroon (2.67***) and Equatorial Guinea (1.44***). The positive coefficient of fiscal balance estimates for Cameroon, the Central African Republic, and Equatorial Guinea confirms the efforts of monetary policy to respond to the expansionary fiscal policy even during passive regimes. The transition probability shows that the active monetary regime is expected to last longer than the passive monetary regime for the Central African Republic (40 years active vs 15 years passive), Cameroon (13 years active vs 5 years passive), and Congo (6 years vs 2 years). In contrast, for Gabon (18 years passive vs 9 years active), Equatorial Guinea (14 years passive vs 9 years passive), and Chad (more than 50 years passive), it shows that the passive monetary regime is expected to last longer than the active monetary regime.

Table 4. Markov switching model results for the monetary policy reaction function.

Country	Central African Republic	Cameroon	Congo Republic	Gabon	Equatorial Guinea	Chad
Dependent variable: Real interest rate						
Regime1: Active						
Inflation	–0.69***	0.506***	0.08	–9.36**	2.34***	–1.01***
	(0.09)	(0.14)	(0.95)	(4.06)	(0.19)	(0.29)
GDP gap	–0.35*	1.39***	–0.75***	–27.15*	6.34***	0.73
	(0.21)	(0.25)	(0.26)	(3.44)	(0.64)	(0.9)
Exchange rate	–0.005	–0.104***	–0.61***	0.801***	–0.207	0.104
	(0.004)	(0.007)	(0.004)	(0.208)	(0.15)	(0.04)
Fiscal balance	0.28***	0.26**	–0.106*	–2.01	3.8	–3.47***
	(0.55)	(0.14)	(0.06)	(3.7)	(3.18)	(0.78)
Constant	9.55***	54.9***	36.5***	–398.9***	–211.4***	–63.3***
	(2.3)	(3.5)	(2.31)	(65.9)	(55.08)	(9.29)
Regime2: Passive						
Inflation	–0.88***	2.67**	–1.27***	–1.15	1.44***	–0.65***
	(0.1)	(1.06)	(0.09)	(1.28)	(0.45)	(0.11)
GDP gap	–0.24	4.307***	–0.038	–30.15***	–0.18	–0.044
	(0.55)	(1.9)	(0.311)	(3.1)	(0.22)	(0.25)
Exchange rate	0.011**	–0.07***	0.02**	–0.9	0.031	0.006
	(0.005)	(0.017)	(0.01)	(0.099)	(0.02)	(0.008)
Fiscal balance	0.046**	2.08***	–0.97***	–2.24	0.18	–1.32***
	(0.16)	(0.5)	(0.1)	(1.91)	(0.28)	(0.3)
Constant	13.6****	38.68***	13.35**	130.7**	–20.5*	3.7
	(2.36)	(6.49)	(6.73)	(56.88)	(12.4)	(4.8)
Log likelihood	–133.19	–175.102	–153.42	–288.76	–228.57	–169.19
lnsigma	2.79	5.62	3.31	56.13	17.28	6.01
Diagnostic tests						
Transition prob. active	0.97	0.92	0.85	0.89	0.92	0.97
Transition prob. passive	0.06	0.19	0.36	0.54	0.05	0.01
Expected duration active regime	40.71 Years	13.36 Years	6.73 Years	9.88 Years	9.79 Years	39.68 Years
Expected duration passive regime	15.7 Years	5.14 Years	2.72 Years	18.2 Years	14.45 Years	54.45 Years
Common						
Heteroskedasticity (Breusch-Pagan)	Chi2=0.39 P=0.53	Chi2=13 P=0.3	Chi2=22.4 P=0.1	Chi2=4.38 P= 0.063	Chi2=1.56 P= 0.212	Chi2=0.2 P=0.67
Normality test	Z=967.9	Z=104	Chi2=2.3	Chi2=83.7	Chi2=0.311	Z=0.3
(Jarque-Bera)	Chi2= 7.e-211	P=4.e-227	P= 0.31	P=6.7e-19	P=0.85	P=0.8

Note: *** p < 0.01, ** p < 0.05, * p < 0.1. Standard errors in parentheses.

4.1. Discussion

4.1.1. Determining Fiscal and Monetary Policy Rules under Different Policy Regimes

The empirical findings in Tables 3 and 4 suggest a dominant period of active fiscal policy for Cameroon and Congo, balanced results for Chad and Gabon, while the Central African Republic and Equatorial Guinea were the only countries to have a dominant period of passive fiscal policy. In general, the results suggest the dominance of passive fiscal policies in the CEMAC region, with 4 out of 6 countries having balanced results, such as those of Gabon and Chad, for years but with more months of passive fiscal policy periods. We can also note the positive effect of the GDP gap on improving fiscal balance during passive fiscal regimes for the Central African Republic, Equatorial Guinea, and Chad.

In addition, based on the expected duration, the monetary policy response achieved more balanced results during the study period. Indeed, for the Central African Republic, Cameroon, and Congo, active monetary policy was dominant in our study period, while Gabon, Equatorial Guinea, and Chad had a dominant passive monetary policy. Moreover, the reactivity of the monetary policy stances to expansionary fiscal policy, even during passive monetary policy regimes, was present in CEMAC countries, particularly the Central African Republic, Cameroon, and Equatorial Guinea, where the fiscal balance had a positive coefficient.

4.1.2. The Nature of the Coordination between Fiscal and Monetary Policy

The research results suggest that an active fiscal policy is equivalent to an unsustainable fiscal policy for Equatorial Guinea and Chad since a rise in the level of public debt will decrease the fiscal balance or increase the fiscal deficit. However, for the Central African Republic and Cameroon, an active fiscal policy is synonymous with a sustainable fiscal policy since a rise in debt will lead to an improvement in fiscal balance through the reduction of fiscal deficits. Gabon and the Republic of Congo have undetermined results since the positive coefficient of the lagged debt estimates is not significant.

Moreover, while an active monetary policy is regarded as a contractionary monetary policy for Cameroon, Congo, and Equatorial Guinea; it is regarded as an expansionary monetary policy for the Central African Republic, Gabon, and Chad. We plotted the time-varying probability of active fiscal and monetary policy below in Figures 1 to 6 to illustrate the nature of fiscal and monetary policies in CEMAC countries. The volatility of time-varying probabilities of fiscal and monetary policies confirms the switching tendency from sustainable to unsustainable in all six countries.

Figure 1 shows a low degree of coordination for the Central African Republic. Indeed, we can see that there are a few periods where the dominating passive fiscal regimes are followed by an active monetary policy, even if the reaction is somewhat lagged. The active monetary policy attempts to correct the period of unsustainable fiscal policy, but it takes time to react. The coordination has been more accurate since 2010, with evidence of contractionary monetary policy while the fiscal policy is passive. In general, active fiscal policy periods are supported by a pro-cyclical monetary policy.

Figure 2 shows some coordination between fiscal and monetary policy in Cameroon. Periods of passive fiscal policy are followed by an active monetary policy through contractionary policies (although the reaction is not instantaneous), even during some periods of active fiscal policy. Thus, the dominance of an active fiscal regime is supported by an active and contractionary monetary policy; this indicates that the fiscal and monetary policies of Cameroon show evidence of coordination.

Figure 3 shows an ambiguous tendency between fiscal and monetary regimes in Congo. The reaction of active monetary policy to the unsustainable fiscal policy regimes is very volatile, highlighting the instability of monetary policies in Congo. Indeed, the monetary regimes switch from active to passive during a passive fiscal policy regime, which represents a weakness of monetary policy to properly manage and adjust the passive fiscal regime during the study period.
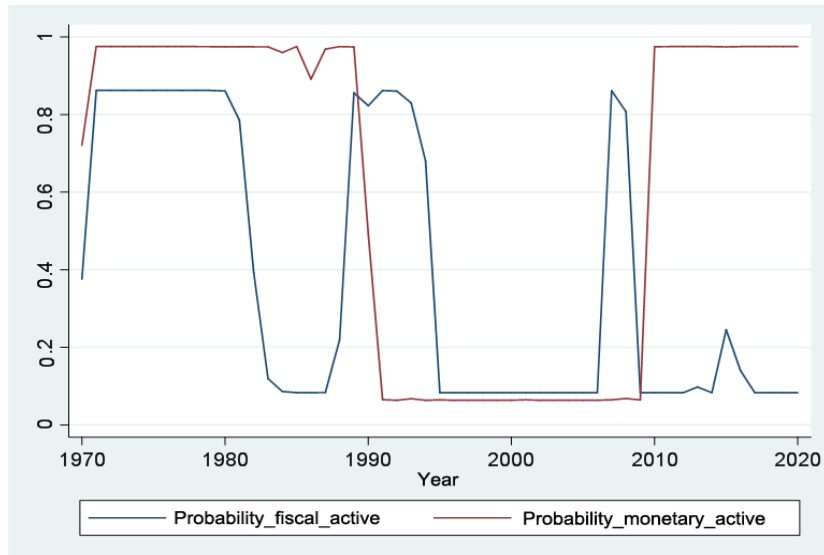
Figure 1. Fiscal and monetary policy regimes of the Central African Republic.
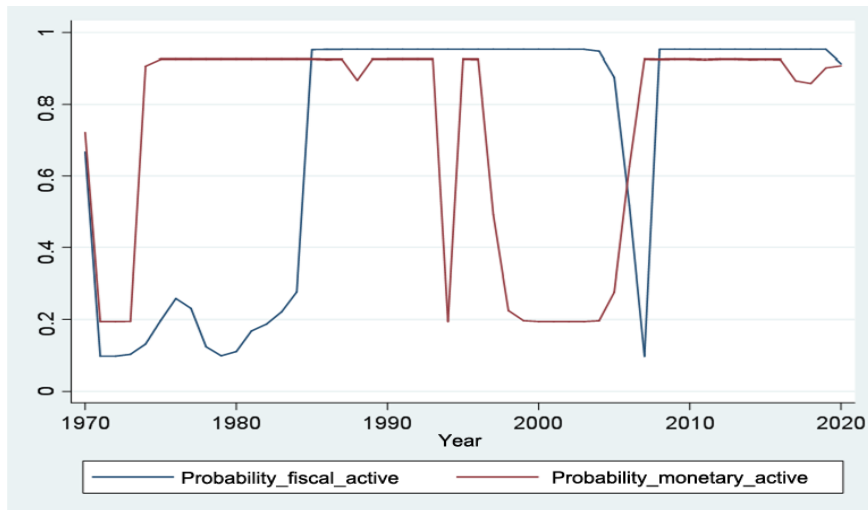

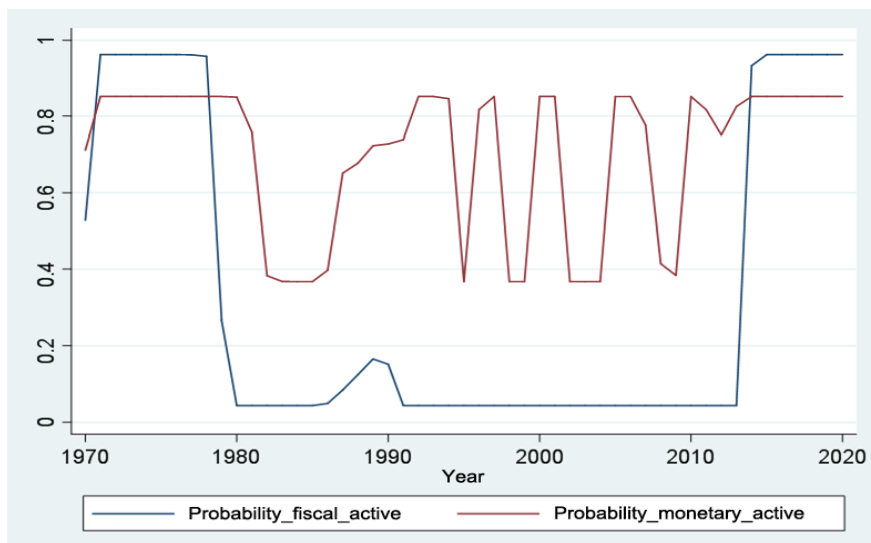**Figure 2.** Fiscal and monetary policy regimes of Cameroon.

Figure 3. Fiscal and monetary policy regimes of the Republic of Congo.

Figure 4 shows how both fiscal and monetary regimes switch from active to passive in Gabon. The fiscal and monetary regimes show little coordination in Gabon: only after 2010 when the active period of fiscal balance is followed by a passive monetary policy. However, there are multiple periods in which fiscal and monetary regimes are both either active or passive, which is not a good sign as an active monetary policy is synonymous with an expansionary monetary policy in Gabon. Since 2010, there is more coordination, with a passive monetary policy in response to an active fiscal regime. In general, the reaction of the monetary policy to the fiscal policy seems to be pro-cyclical; the active fiscal policy is accompanied by an expansionary monetary policy.
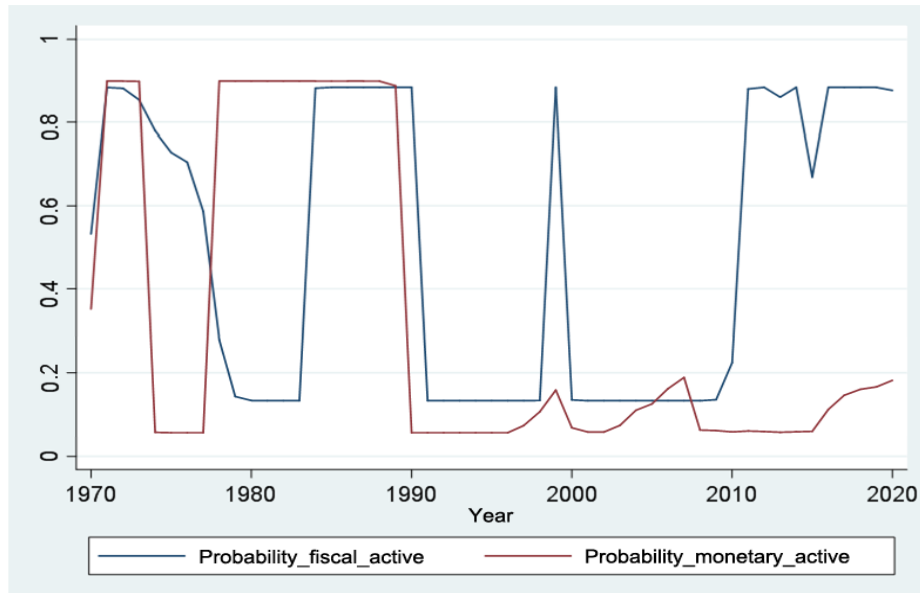
Figure 4. Fiscal and monetary policy regimes of Gabon.

Figure 5 shows some signs of coordination between fiscal and monetary policies in Equatorial Guinea. Indeed, the dominance of the passive fiscal regime is supported by the active monetary regime through a contractionary monetary policy. This confirms the objective of the monetary policy to balance the effect of the expansionary fiscal policy in the country.
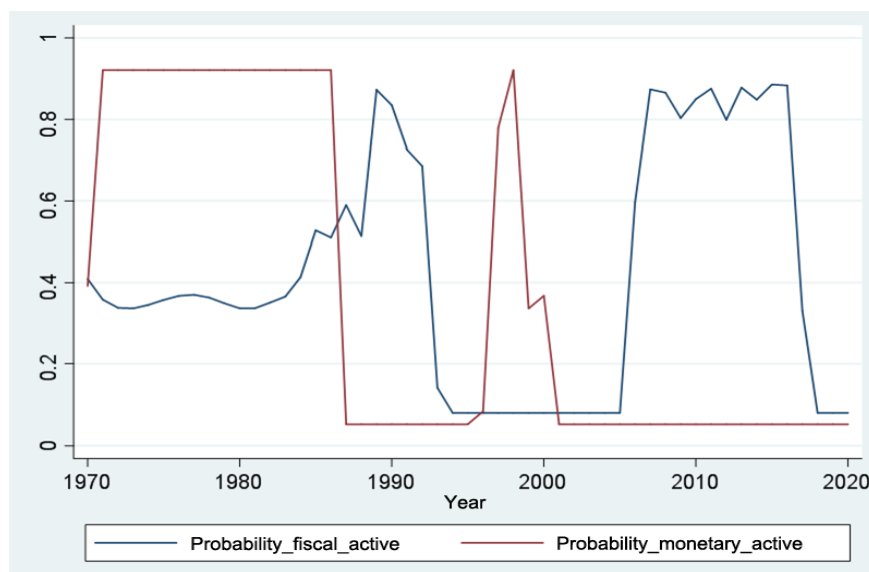

Figure 5. Fiscal and monetary policy regimes of Equatorial Guinea.

Figure 6 shows that monetary policy remained steady in response to passive fiscal policy regimes in Chad. There is evidence of very little coordination between fiscal policy and monetary policy in the country: only between 1970 and 1980. However, from 1990 to 2020 the fiscal policy was too volatile, and the monetary policy apparently did not react to the period of active fiscal policy. In general, periods of unsustainable fiscal policy are followed by an expansionary monetary policy.
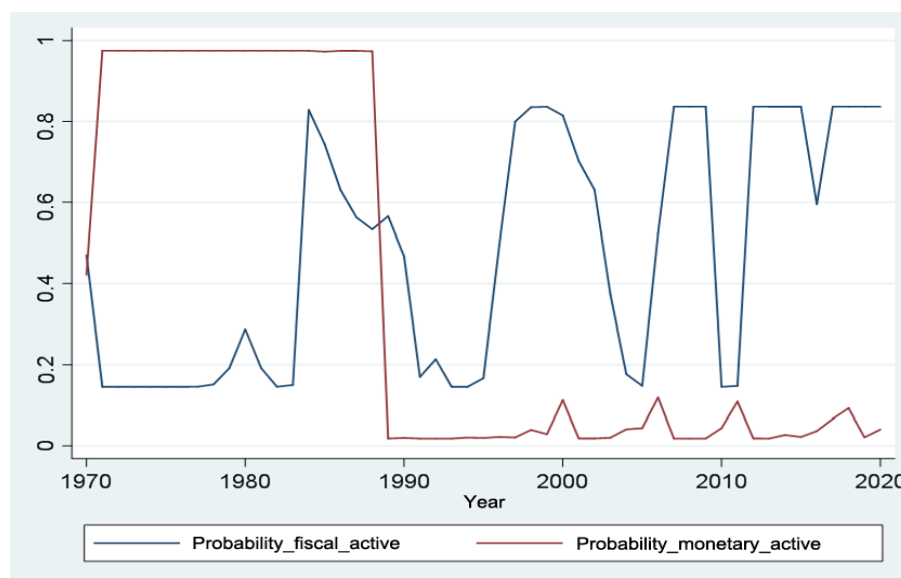

Figure 6. Fiscal and monetary policy regimes of Chad.

5. CONCLUSION

This study investigated the degree of coordination between fiscal policy and monetary policy to achieve fiscal sustainability in the six countries of the CEMAC region. To achieve this purpose, we used the Markov regime-switching model to assess the switch of the fiscal reaction function between active and passive regimes. The fiscal reaction function is an extension of Bohn's (1995) intertemporal budget constraint, which assumed the reaction of fiscal policy to the level of previous debt. On the other hand, the Markov switching model was also applied to the monetary reaction function based on the Taylor rule, which assumed switches between active and passive regimes.

Using yearly time series data from 1970 to 2020, our empirical findings suggest a dominant period of the passive fiscal regime for the Central African Republic and Equatorial Guinea, and balanced results for Gabon and Chad, while Cameroon and the Republic of Congo are the only countries to have a period in which an active fiscal regime dominated. Moreover, the fiscal policy is regarded as sustainable for Cameroon and the Republic of Congo as the coefficients of debt are positive and significant.

Furthermore, the results of the monetary reaction function are more balanced, with evidence of an active monetary regime in the Central African Republic, Cameroon, and Congo, where the active monetary regime is synonymous with contractionary monetary policy for Cameroon and Congo but synonymous with an expansionary monetary policy in the Central African Republic. In general, the reaction of the active monetary regime is lagged. However, in the case of Gabon, Equatorial Guinea, and Chad, passive monetary regimes are observed during the study period, which are characterized by expansionary monetary regimes when the monetary policy becomes active in Gabon and Chad, whereas in Equatorial Guinea, active monetary policy is synonymous with contractionary monetary policy. There is, however, evidence of balanced performances with a clear intention of monetary policy to react actively and carefully to the passive period of fiscal balance observed in the region. Nevertheless, the reaction of the active monetary regime is lagged.

Globally, the fiscal policy is sustainable for the Central African Republic and Cameroon, while it is undetermined for the Republic of Congo and Gabon and unsustainable for Equatorial Guinea and Chad. Regarding monetary policy, it is sustainable for Cameroon and Equatorial Guinea, undetermined for the Republic of Congo, and unsustainable for the Central African Republic, Gabon, and Chad. Overall, we can conclude that there is a clear fiscal and monetary policy coordination problem in CEMAC countries; therefore, we recommend that the monetary authorities react more efficiently to any deviation (unsustainability) of fiscal policy and implement a contractionary monetary policy during the period of unsustainable fiscal policy to ensure the long-run sustainability of both fiscal policy and public debt.

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