Fiscal policy and public debt sustainability: Is public debt sustainable in Sub-Sahara Africa?[1]

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Abstract

This chapter investigates developments in fiscal policy in selected Sub-Sahara Africa (SSA) countries from 1980-2016. We evaluate major fiscal and debt sustainability developments and compare different specifications in our sustainability analysis. Firstly, we employ Present Value Constraint (PVC) framework to analyse whether SSA's debt are sustainable. Secondly, we employ both the Bohn's sustainability tests and estimate a two-state Markov-switching model of fiscal sustainability. Our results are heterogenous and interesting. While the PVC show sustainability among SSA countries, Bohn's sustainability test provides varied results. Kenya and Nigeria fiscal policy is unsustainable. Similarly, Burkina Faso and Nigeria show signs of fiscal fatigue. Employing a Markov-switching approach, we find evidence of two regime changes in SSA. Kenya and Nigeria have fiscal sustainability in regime 2 while the rest have regime 1 as sustainable. Botswana and Burkina Faso have the shortest duration in the sustainable regime of 1 year, whereas Equatorial Guinea is persistent with a duration of 28.6 years. Further, Burkina Faso exhibits similar duration of 1 year in both sustainable and unsustainable regimes. Our results improve further with the inclusion of fiscal rules in our Markov-switching specification. Botswana and Cape Verde have both regimes 1 and 2 as sustainable, while Kenya, Nigeria and Equatorial Guinea have regime 2 as sustainable. Similarly, Burkina Faso and Nigeria have regimes 2 and 1 as weakly sustainable, respectively. Our results also show that fiscal rules enhance primary balance to respond to arise in public debt in unsustainable regime. Our findings have important policy implications for fiscal and debt sustainability in developing countries and SSA in particular.

Keywords: Fiscal policy, Debt sustainability, Fiscal rules, Markov-switching

JEL Classification: E620, H630, H110

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4.0 Introduction

For decades now, the nature of fiscal policy across countries has fundamentally shifted. This shift has virtually wiped out balanced budgets resulting into numerous debt crisis and debt reliefs that have been registered since 1990's. A surge in public debt is a serious issue among countries. Concerns on sustainability of increasing government debt already put several developed and developing countries into a crisis, and multilateral institutions had to initiate bailout mechanisms. At the same time, increasing debt has raised the cost of financing of troubled countries in need of financial support. Lately, debt sustainability put Greece into serious financial crisis (between 2010 and 2011) and the International Monetary Fund (IMF) and other European countries had to bail out Greece. The build-up in debt has put the credibility of government's ability to manage the accumulated public debt in question. This is true for developing countries as they endeavour to meet their financing needs, they rely intensively on public debt. In this chapter, we empirically analyse debt and fiscal policy sustainability.

This chapter seeks to improve on the understanding of debt and fiscal sustainability. In particular, we aim to answer the following questions: i) has debt been sustainable in Sub-Sahara Africa (SSA)? ii) How do governments in SSA respond to a rise in public debt? To what extend can fiscal adjustments be deferred without compromising sustainability of public debt? What is the effect of fiscal rules on debt and fiscal sustainability in different regime shifts? And do fiscal rules mediate the effect of primary balance on public debt?

The theoretical framework on debt sustainability shows that when budget deficits follows a stationary process, then the intertemporal budget balances are satisfied and as such a sign of fiscal sustainability (see Trehan and Walsh (1988); Trehan and Walsh (1991); Buiter and Patel (1992); Kremers (1988); Caporale (1995) and Makrydakis (1999)). Similarly, the relationship between government spending and revenue in the long-run signals debt sustainability. In this regard, government spending is within bound and thus government considers revenue being generated in its spending undertakings (Haug (1991); Ahmed and Rogers (1995); Payne (1997); Papadopoulos and Sidiropoulos (1999); Kia (2008)). Further, following Bohn (1998), the theoretical framework on the role of government on fiscal management is clear. Bohn argues that a positive relationship between fiscal instruments like primary balance and lagged public debt enhances fiscal sustainability. In fact, fiscal policy follows a debt stabilizing rule when primary balance responds positively and more than real interest rates in a country, see (Bohn (1998); Daniel and Shiamptanis (2013)). Alternatively, with the application of non-linear fiscal analysis, the literature has turned towards regime switching specifications. The argument among the authors, are that regime switching have a better fitting policy behaviour and can provide evidence of sustainable and unsustainable regimes (see Favero and Monacelli (2005); Davig et al. (2006); Bianchi (2012); Ko and Morita (2015); Burger et al. (2016); Aldama and Creel (2018); Irungu et al. (2019)).

This chapter departs from the above by focusing on countries with fiscal rules in SSA. As noted earlier, we focus on countries that have fiscal rules based on their compliance rate. Secondly, we have a mix of both resource based and non-resource based, as well as those countries that were beneficiaries of HIPC. Similarly, we focus on SSA, a region that has had the highest number of HIPC beneficiaries due to debt distress. We also employ a suite of debt sustainability tests and to our knowledge this is the first study to carry out this analysis under this framework.

In the context of SSA there has been limited studies on fiscal sustainability: Irungu *et al.* (2019) focuses on fiscal sustainability in Kenya using budget balance as the dependent variable in a Markov-switching framework. This chapter departs from Irungu *et al.* (2019) by employing a suite of methodologies, we also consider a set of countries and include other variables that have valuable effect on fiscal policy. In this regard, we include primary balance and according to Bohn (1998) primary balance offers a better view of government response to rising debt. Similarly, we include fiscal rules as a variable to help analyse fiscal policy response to regime shifts.

We focus on SSA and use Kenya, Botswana, Burkina Faso, Equatorial Guinea, Nigeria and Cape Verde as prototype example. Firstly, these countries have undergone fiscal management changes including adoption of fiscal rules for fiscal sustainability. Further, a number of countries are beneficiaries of HIPC and MDR of which Burkina Faso is a beneficiary and thus, acts as a rare inclusion to test for fiscal sustainability. Secondly, some of these countries (such as Kenya and Nigeria) have had numerous episodes of debt distress which have lasted for longer periods (Reinhart & Rogoff, 2009)[3]. Thirdly, the countries provide a wider regional representation of the application of fiscal rules in fiscal management and similarly the availability of a long series data for analysis[4,5]. Fourthly, following the analysis in chapter one, some countries had a higher overall compliance rate (Botswana 100 percent) compared to those with a lower compliance rate (Cape Verde 5 percent), while others had 0 percent compliance rate on some individual rules. As such, this chapter provides a unique avenue to test for debt sustainability and give a comparison among these countries. Fifth, Nigeria is the largest economy in Africa and has significant foothold in several SSA countries, thus, debt distress could have significant negative effect to the region. Similarly, Nigeria and Equatorial Guinea depend on oil revenue and provides an important case study for inclusion for resource-based economies.

Our contribution to literature is three-fold. First, is to establish the linkage of fiscal policy changes and fiscal rules in either sustainable or unsustainable regimes. As such, we do not only identify fiscal regime shifts but show the effect of rules in fiscal management. To the best of our knowledge, this study is the first to employ a fiscal rule in a Markov switching to test for fiscal sustainability. Second, by using four types of methodologies, namely, Markov-switching, fiscal reaction function, cointegration tests and unit root tests allows us to answer some of the important questions raised in literature on the weaknesses of some methodologies. In this chapter, we argue that subjecting a country's debt sustainability to a battery of techniques offers a wider view on the country's fiscal stance and an opportunity to initiate policy mitigation on specific areas that require interventions. Indeed, failure by one technique to detect and account for parameter shifts is a serious form of misspecification that affects policy prescriptions and subjects a country to poor forecasting performance. This is true for some methodologies, as some, offer evidence of stationarity, while others offer the long-run relationship between fiscal

[3] Kenya had 2 debt defaults between 1994-1998 and 2000-2001 with a total duration of 7 years, this was accompanied with 2 banking crises in 1985 and 1992-1994. At the same time Nigeria had 5 episodes of debt defaults between 1982-1992, 1986-1988, 1992, 2001 and 2004-2005 with a total cumulative duration of 18 years. There were also 2 banking crises in 1992 and 1995 respectively (Reinhart & Rogoff, 2009). Nigeria also had a currency crisis in 1983, 1989, 1997 and 2016 (Laeven & Valencia, 2018).

[4] Other countries had banking crisis as follows: Burkina Faso 1990-1994, Equatorial Guinea 1983, Cape Verde 1993, while Botswana had a currency crisis in 1984 (Laeven & Valencia, 2018).

[5] According to Laeven and Valencia (2018) the debt crisis increased public debt as percent of GDP as follows: Kenya 11 percent, Burkina Faso 8.9 percent, Nigeria 63.3 percent (1991-1995) & 8.4 percent (2009-2012) and Cape Verde 18.2 percent.

variables and others provide evidence of numerous regime shifts that require policy interventions.

Several features of this chapter distinguish it from much of the larger literature on debt and fiscal sustainability. Firstly, one of the main features is understanding the sustainability of debt and fiscal policy. In recent years, focus in fiscal policy has increased, with a growing recognition that unsustainable fiscal policy and a debt surge have negative spill over effects on the overall economy. In this regard, policy makers and scholars have endeavoured attempting to foresee future financial crisis prior to their happening given the potential harm to the world economy. In fact, the efforts are used to evaluate the robustness of the public sector and attempt to predict the sustainability of debt. Indeed, developing economies are exposed to both domestic and external imbalances. To this end, the case of developing countries is interesting, as majority have gone through debt distress episodes including benefiting from HIPC and MDR initiatives[6]. Secondly, following Trehan and Walsh (1988) and Trehan and Walsh (1991) under the stationarity and cointegration framework, we find debt to be sustainable in SSA in the long-run. Trehan and Walsh (1991) argue that if budget deficits are stationary at level, that is, they are integrated of order zero $I(0)$, which forms an adequate condition for debt sustainability. As such, the budget deficit will converge to zero over time and deficits shall grow within bound. Therefore, as government deficit converges to zero, the intertemporal solvency condition is satisfied. Further, according to Hakkio and Rush (1991), for sustainability condition to be met, revenue and government expenditure must have a long-run relationship. They argue that, without a long-run relation between spending and revenue, a country will have unsustainable debt.

Third, following Bohn (1998), we perform a baseline specification of fiscal reaction function to test fiscal sustainability in SSA. Our findings are heterogeneous among different specifications. Kenya and Nigeria display no feedback effect of public debt on primary balance, that is, with a rise in public debt, authorities do not respond to increase in primary balance. As such, there is evidence to suggest no fiscal sustainability in the two countries. On the other hand, Botswana, Burkina Faso, Equatorial Guinea and Cape Verde show that public debt responds positively on primary balance. Interestingly, Burkina Faso and Nigeria show evidence of fiscal fatigue on their fiscal policy and presents a worrying scenario of debt build up in future[7]. Fourth, having found mixed results on sustainability of fiscal policy in SSA, with no clear period of sustainability, we employ a Markov-switching approach. As noted earlier, we also find mixed results. While our selected sample shows presence of two regimes (sustainable and unsustainable) changes, the results are heterogeneous. Kenya and Nigeria have fiscal sustainability in regime 2, while the rest have regime 1 as sustainable. Similarly, Botswana and Burkina Faso have the shortest duration in the sustainable regime of 1 year, while Equatorial Guinea is persistent with a duration of 28.6 years. Further, Burkina Faso exhibits similar

[6] Heavily Indebted Poor Countries (HIPC) initiative was launched in 1996 by the IMF and the World Bank to reduce bilateral debt and ensure poor countries have sustainable debt levels. The Multilateral Debt Relief (MDR) Initiative was launched in 2005 to supplement the HIPC by IMF, WB, Africa Development Bank (AfDB) and the Inter-American Development Bank (IaDB) to reduce multilateral debt and help countries meet the Millennium Development Gaols (MDGs).

[7] Fiscal fatigue refers to a situation where the ability of a country's primary balance to increase with a raising public debt decline. According to Echevarria Icaza (2018), this happens when countries facing higher debt levels stop adjusting their primary balance once debt reaches a high level rendering long-term fiscal consolidation ineffective. Accordingly, Ghosh *et al.* (2013), argues that the process of raising primary balance to meet higher interest rates cannot be indefinite. Therefore, in practice it becomes increasingly difficult to continuously cut government spending or increase tax rates. Thus, with a rising debt level and ineffective adjustment of primary balance fiscal fatigue will set in.

duration of 1 year in both sustainable and unsustainable regimes. Fifth, when we employ fiscal rules in our Markov-switching specification, our results improve further. In fact, Botswana and Cape Verde have both regimes 1 and 2 as sustainable, while Kenya, Nigeria and Equatorial Guinea have regime 2 as sustainable. Similarly, Burkina Faso and Nigeria have regimes 2 and 1 as weakly sustainable, respectively. Our results also show that fiscal rules enhance primary balance to respond to arise in public debt.

The remainder of the chapter is structured as follows: Section 5.1 motivates the research by presenting fiscal policy developments in SSA. Sections 5.2-5.3 presents literature review and the theoretical framework. Section 5.4 presents the empirical strategy, while 5.5 presents the dataset. Section 5.6 presents the empirical results for the PVC tests, Bohn's sustainability tests and Markov-switching, respectively. Section 5.7 presents the conclusion and policy implications of the study.

5.1 Fiscal and macroeconomic developments in Sub-Sahara Africa: 1980-2016

This section reviews the recent fiscal and macroeconomic developments in Kenya, Botswana, Burkina Faso, Equatorial Guinea, Nigeria and Cape Verde. We highlight the dynamics of the following variables: primary balance, public debt, total revenue and government spending. *Figures 5.1-5.4* highlight the major fiscal developments in SSA over the period 1980-2016.

Because of numerous episodes of macroeconomic distress, some SSA countries are faced with a debt build-up and unless the situation is addressed timely, in the long-run, the fiscal situation could degenerate to another debt crisis. Broadly speaking, high interest rates, growing public expenditure, elevated corruption and an overall worsening of economic growth has contributed to deterioration of the fiscal stance. For all the countries in the sample, there has been a large decrease in primary balance, with the highest being Equatorial Guinea, with a primary balance of over -500 percent of GDP in 1992 and 1994. Except for Burkina Faso and Cape Verde, all other countries have had a negative primary balance of over 50 percent of GDP. Primary balance is one of the key variables in analysing debt sustainability. A continued decrease in primary balance will increase the likelihood of debt becoming unsustainable in several ways.

In fact, a continuous decrease in primary balance due to lower tax revenues will render debt to be unsustainable. A reduction in primary balance increases real interest rates because with increase in deficits, governments appetite for borrowing increases. The increased negative primary balance negatively affects growth of real GDP, increases the build-up in debt and constrains fiscal space. Between 2000-2016, countries have improved their primary balance oscillating between 16 and -20 percent of GDP. Burkina Faso stands out as an exception with a surplus of 16 percent of GDP in 2006. The case of Kenya with a negative primary balance of over 80 percent in 1985 signifies the effect of the banking crisis experienced in the country. It was around this period that the banking sector was struggling; with several banks closing due to liquidity shortages and the level of interest rates rising significantly. Kenya, Burkina Faso, Equatorial Guinea and Nigeria primary balances appear to oscillate between -5 and 15 percent of GDP, since 2000, pointing to a relatively sustainable and sound fiscal path (see *Figures 5.1*). Botswana and Cape Verde have a slightly lower primary balance hovering around -20 and -10 percent of GDP over the same period (see *Figure 5.1*).

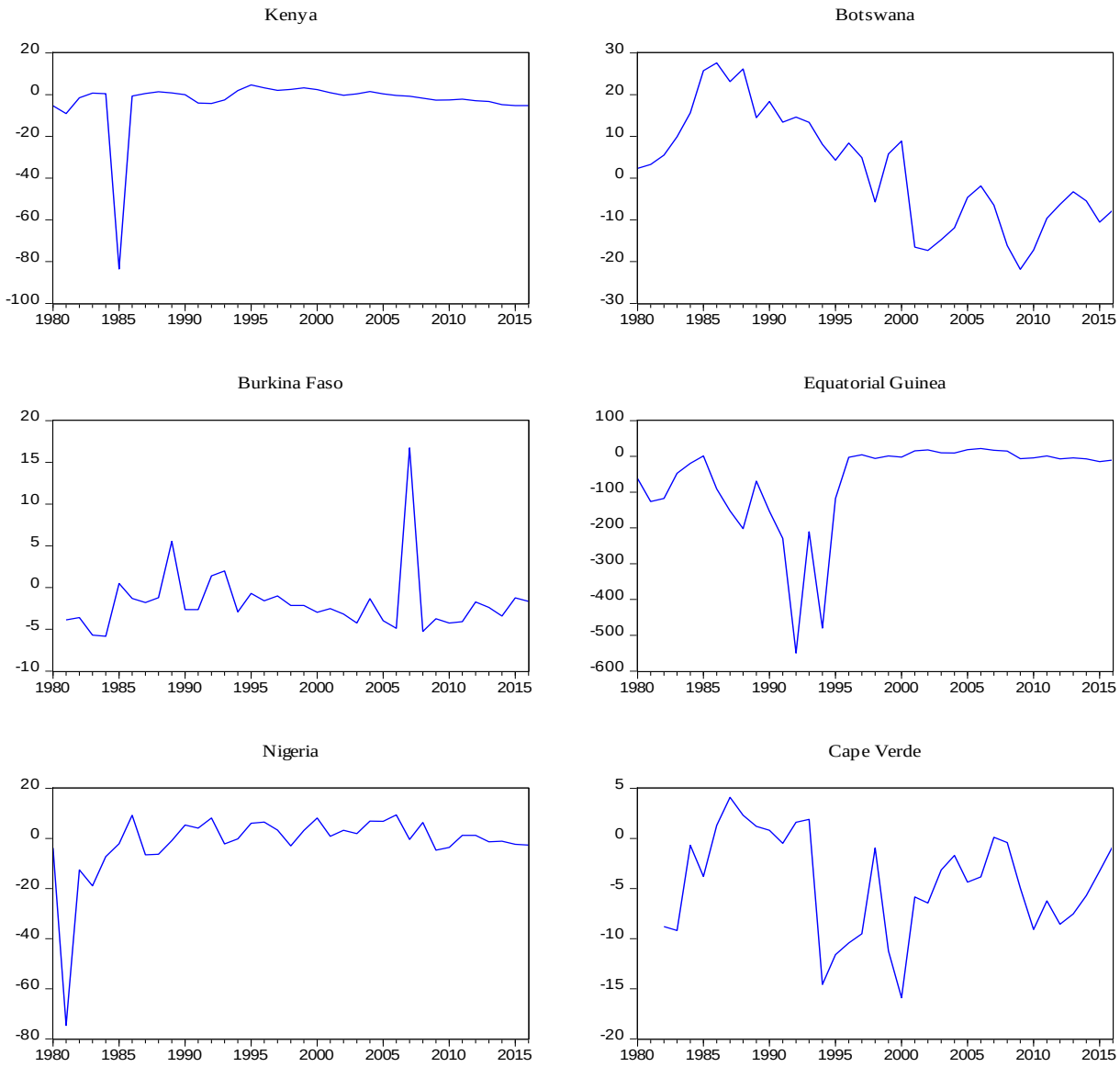

Figure 5. 1: Primary balance in selected SSA countries
Source: IMF/WEO and Authors calculations

Total public debt has been increasing for all the selected SSA countries since 2005. While Botswana and Nigeria public debt has been stable at around 25 percent of GDP between 2005 and 2016, Nigeria had a high public debt of 180 percent of GDP in 1993 and 40 percent of GDP in 1985 in the case of Botswana (see *Figure 5.2*). Burkina Faso public debt declined significantly between 1995 and 2007, this was largely due to the HIPC and MDR initiatives[8]. The country received a total of USD 424 million between 1995 and 2012, this helped reduce the debt burden as well as enhance the country's fiscal space. Public debt in Kenya has had a gradual reduction from 1992 to 2006, after which the debt levels have risen. Increase in public debt has been due to elevated public investment drive and revenue shortfalls. The country has witnessed a faster debt surge since 2013 and it is expected to reach 60.7 percent of GDP, which

[8] In 2000 Burkina Faso reached HIPC decision point and the Multilateral lenders including the IMF, WB, AfDB, IDA and others had approved by then USD 398 million worth of debt relief equivalent to 50 percent of the country's debt stock under the HIPC initiative. Subsequently, in 2002, Burkina Faso reached the completion point and in total the country received USD 424 million (AfDB and IMF HIPC documents 2002).

has raised fiscal vulnerabilities and increased interest payments to nearly a fifth of total revenue[9]. Equatorial Guinea public debt has significantly reduced from over 300 percent of GDP in 1980's to a low of 10 percent in 2007. The reduction is attributed to enhanced fiscal austerity and long booming economy since 1990's when oil exports began. During these years, buffers were built, and public debt were extremely reduced[10].

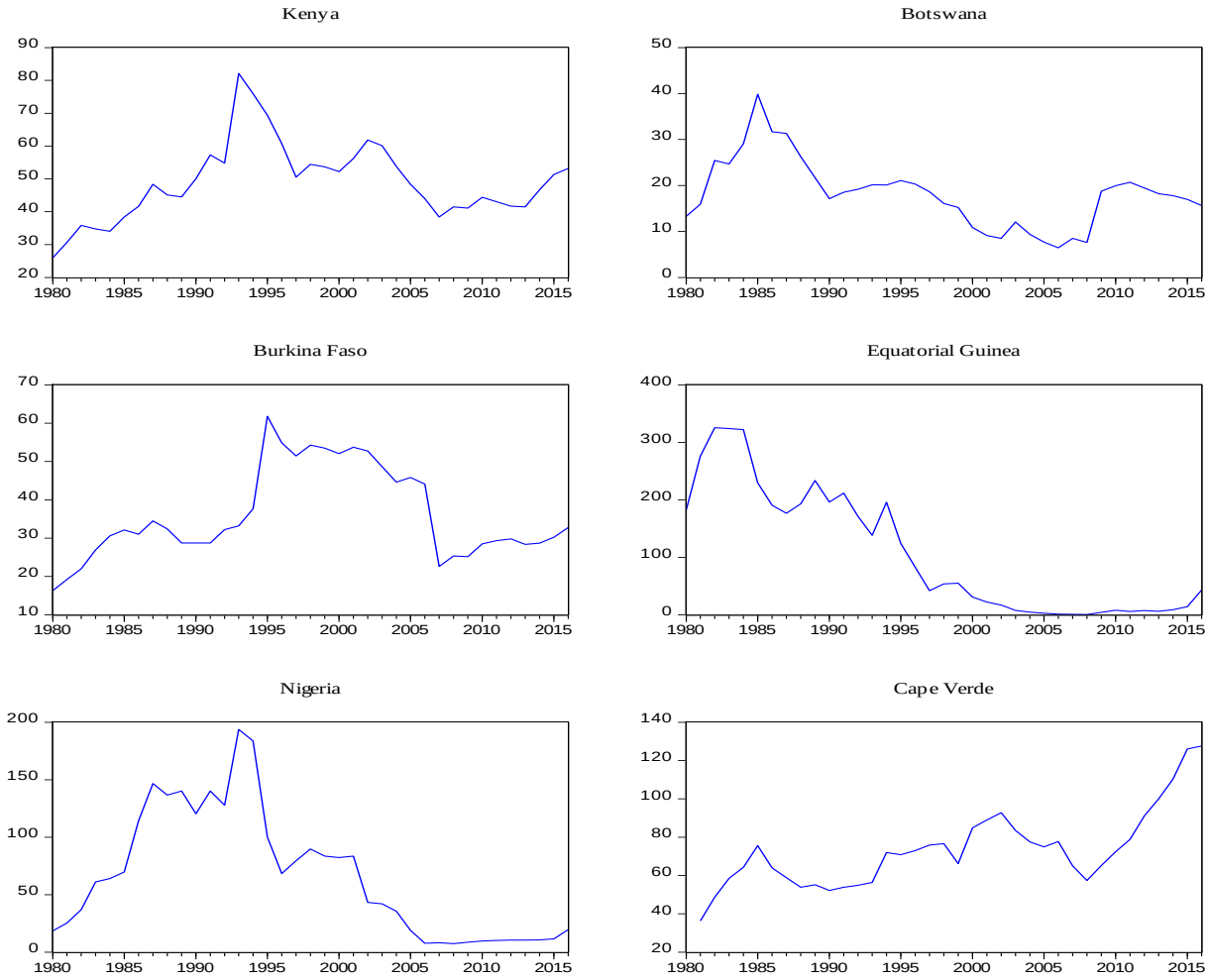

Figure 5. 2: Public debt in selected SSA countries
Source: IMF/WEO and Authors Calculations

Total revenue as a share of GDP in our selected SSA countries has been on the decline between 1980 and 2016. In Kenya, although total revenue has been steady at around 17 percent of GDP, the country experienced a high of 26 percent of GDP in 1981 and a low of 13 percent in 1992. In Botswana, total revenue has declined significantly from a high of 60 percent of GDP in 1986 to 32 percent in 2015. However, Botswana stands out as a stable and sustainable economy in terms of total revenue generation. Among our selected group of countries, Botswana has a higher total revenue to GDP (see *Figure 5.3*).

[9] Source: IMF Article IV/ IMF Country Report No. 18/295.
[10] Source: IMF Country Report No. 18/146.

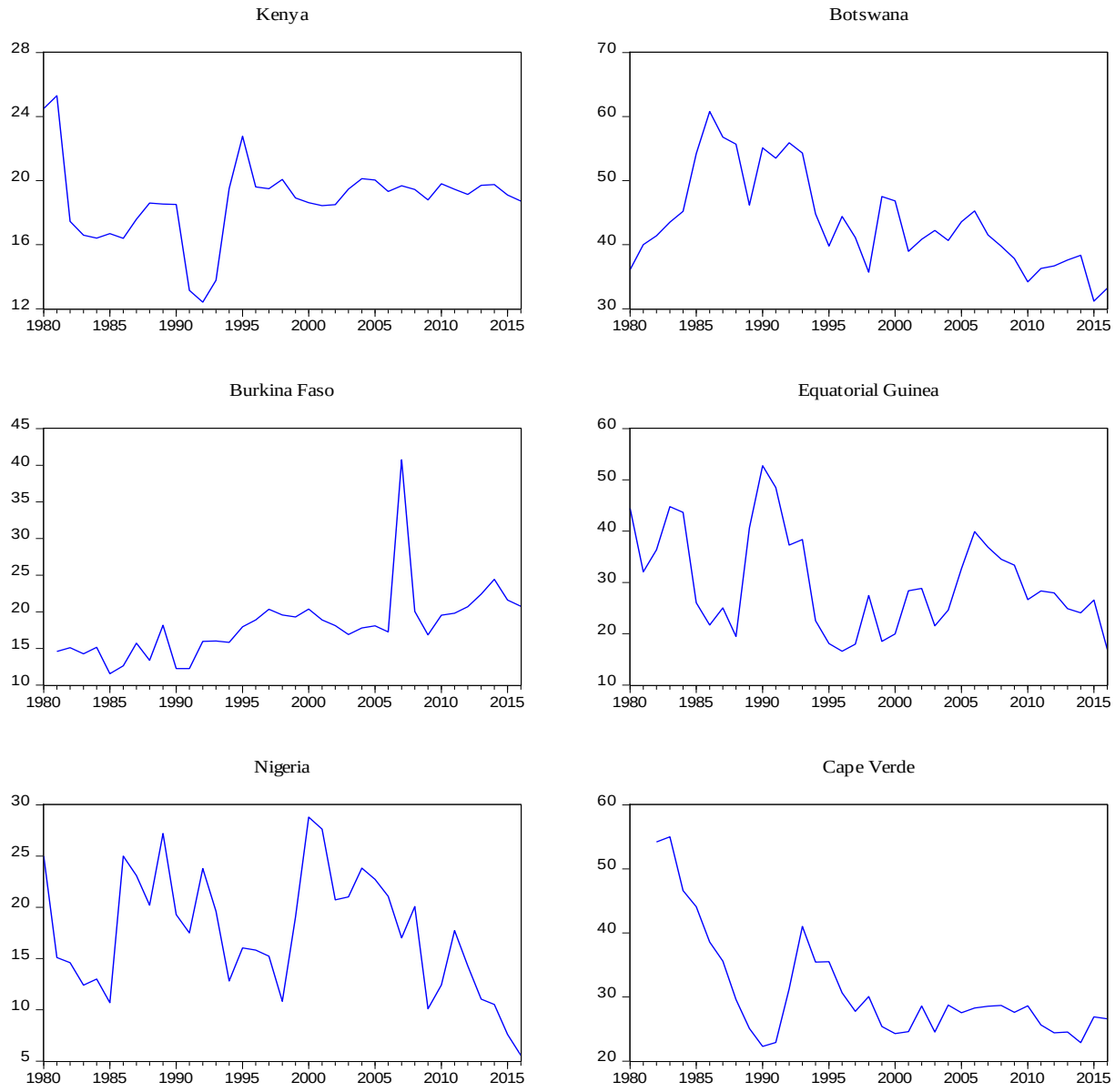

Figure 5. 3: Total revenue in selected SSA countries
Source: IMF/WEO and Authors calculations

One of the main drivers of higher revenues is the numerous tax revenue reforms undertaken and improvements in the resource sector. Burkina Faso has had a steady increase in total revenue between 1980 and 2016. The increase is due to several reforms introduced including the Value Added Tax (VAT) reforms in 1993[11]. Moreover, the increase is also attributed to debt relief the country enjoyed between 1995 and 2012, that enhanced the fiscal space and growth. Nigeria and Equatorial Guinea total revenue has been erratic, this could be attributed to oil price shocks as these countries rely heavily on oil revenue. Cape Verde total revenue has been on the decline since 1980 to 2016 with the exception of 1994.

There has been a steady rise in government expenditures across countries (see *Figure 5.4*). From 1980, government spending in Kenya has oscillated between 18 percent and 35 percent

[11] The VAT law introduced in 1990's led to increase in tax revenues from a low of 18.2 percent in 1994 to 41.8 percent in 2015 (Public Treasury 2017, VAT Law No. 04/92/ADP).

of GDP. From 2000, government spending has been on the rise and over 80 percent of the period government spending has surpassed revenue. In Botswana, government spending has been above 30 percent of GDP, however, for a considerable period of time expenditure has been below total revenue. Burkina Faso's, government spending has been on the rise from 1993 with a high of 27 percent of GDP in 2014.

Figure 5. 4: Total expenditure for selected SSA countries
Source: IMF/WEO and Authors Calculations

Equatorial Guinea stands out as unique, in that, it had the highest expenditure of over 500 percent of GDP. However, after oil exports started, the government spending reduced significantly from 141 percent in 1995 to 22.9 percent in 1996. This trend has continued up to 2016 with government spending below 50 percent of GDP. The oil discovery accompanied with IMF reform requirements led to enhanced fiscal discipline. In Nigeria government spending has remained below 25 percent of GDP. The expenditures have been stable and at a decreasing trend with a low of 9.5 percent of GDP in 2016. Cape Verde government spending has been on the decline from 1993 and this is attributed to improved fiscal spending.

Table 5.1 shows increase in real interest rates over time and economic growth has played catch up in the period 2010-2016 for the SSA countries. From the literature when $r > g$, public debt tends to keep rising requiring higher budget surpluses to stabilise the economy. Therefore, for Kenya regardless of the degree of austerity efforts employed, the growth rate will be deterred by the rising debt. This will further increase the interest-growth differential making debt containment difficult in the long-run. Except for Botswana, all other countries experience the same situation.

Table 5. 1 GDP growth and real interest rates in percent 2010-2016

Year	2010	2011	2012	2013	2014	2015	2016
Real interest rates (*r*)							
Kenya	12.0	3.8	9.5	11.5	7.8	5.5	7.8
Nigeria	1.1	5.7	6.2	11.2	11.4	13.6	6.7
Botswana	2.3	-2.6	10.8	7.7	-2.6	6.1	-4.3
Burkina Faso	-1.6	-1.4	-0.7	7.6	6.0	8.5	6.5
Cape Verde	10.5	6.9	9.3	9.0	11.1	8.5	9.9
Equatorial Guinea	5.8	5.8	10.3	5.9	4.5	0.8	1.1
Average real interest rates	5.0	3.0	7.6	8.8	6.4	7.2	4.6
Real GDP growth rates (*g*)							
Kenya	8.4	6.1	4.6	5.9	5.4	5.7	5.9
Nigeria	11.3	4.9	4.3	5.4	6.3	2.7	-1.6
Botswana	8.6	6.0	4.5	11.3	4.1	-1.7	4.3
Burkina Faso	8.4	6.6	6.5	5.8	4.3	3.9	5.9
Cape Verde	1.5	4.0	1.1	0.8	0.6	1.0	4.7
Equatorial Guinea	-8.9	6.5	8.3	-4.1	0.4	-9.0	-8.6
Average real GDP growth	4.9	5.7	4.9	4.2	3.5	2.6	1.8
[*r* – *g*]							
Kenya	3.6	-2.3	4.9	5.7	2.5	-0.2	1.9
Nigeria	-10.2	0.8	1.9	5.8	5.0	10.9	8.3
Botswana	-6.2	-8.6	6.3	-3.6	-6.7	7.8	-8.6
Burkina Faso	-10.0	-8.0	-7.2	1.8	1.7	4.6	0.6
Cape Verde	9.0	2.9	8.2	8.2	10.5	7.5	5.2
Equatorial Guinea	14.7	-0.7	2.0	10.0	4.1	9.9	9.7
Average [*r* - *g*]	0.1	-2.7	3.4	4.6	2.9	4.6	2.8

Source: IMF - International Monetary Fund, WEO - World Economic Outlook WDI – World Development Indicators

In fact, countries like Kenya, Nigeria, Burkina Faso and Cape Verde have higher real interest rates and these compounds debt sustainability challenges in the long-run. Policy makers will need to device mechanism to accelerate growth and enhance downward real interest rate pressure and open more fiscal space. Fiscal and debt containment policies should ensure that real interest rates are lower than growth rates. Numerous ways can be employed including: the countries' respective central banks to lower interest rates through monetisation of the domestic debt. Secondly, the government can introduce various stimulus packages financed through domestic borrowing, that is, Eurobonds with the aim of enhancing investment and growth.

Lastly, they can adjust budget balance such that, they can maintain a moderate deficit that sustains growth.

5.2 Literature Review

The theoretical underpinnings of debt sustainability are addressed by various authors. In general, the primary test of debt sustainability is by evaluating the probability that governments fail to comply with the intertemporal budget constraint by testing whether fiscal policy data meets the time series properties to support the theory of expected primary balance being equal to public debt. Another strand of literature tests debt sustainability following Bohn (1998) is by checking the reaction of primary balance to a rise in public debt. In this case, sustainable fiscal policy is achieved when primary balance responds positively to a rise in public debt indicating debt sustainability. A number of studies by Hamilton (1989) have tested fiscal sustainability by characterising different fiscal regime shifts for which fiscal policy is either sustainable or unsustainable. These are the methodologies we follow in the present chapter.

There is abundant empirical literature with numerous approaches employed in testing fiscal sustainability and they include unit root tests and cointegration testing. For stationarity tests, when deficits are non-stationary then subsequently debt will rise and eventually lead to unsustainable fiscal policy, thus, violation of the present value budget constraint and NPG constraint. On the other hand, if the deficit is stationary, it indicates that deficits are mean reverting. In the second case, cointegration approach is employed to explore a long run relationship between revenue and spending. The presence of long-run relationship between spending and revenue shows that the government considers the amount of revenues when undertaking expenditures. Moreover, the government will not fall back on deficiency financing to meet spending requirements, thus, public debt will be sustainable. Hamilton and Flavin (1986) investigates debt sustainability in the US using annual data from 1962 – 1984. The authors test the validity of the PVC and find that US debt was sustainable. Trehan and Walsh (1988); Trehan and Walsh (1991) investigates the stationarity of public debt and deficit in the US. They find that debt is sustainable. Kremers (1988) investigates the sustainability of the US public debt. Several authors have evaluated debt sustainability using the same framework to other countries. Using monthly data from 1964 - 1984 Smith and Zin (1991) investigated debt sustainability for Canada and find that debt was not sustainable. Following the same line for India, Buiter and Patel (1992) using annual data find debt to be unsustainable.

Similarly, other studies utilised cointegration approach to test the sustainability of debt. Haug (1991) investigates a long run relationship between revenue and spending in the US economy. The author finds no long run relationship and concludes that debt us not sustainable. Ahmed and Rogers (1995) investigates the existence of sustainable debt in the European union. They find that public debt is unsustainable. Neaime (2010) investigates the conduct of debt in selected Middle East countries. The findings are mixed across countries: in Tunisia the results show strong sustainable fiscal policy, the results in Egypt show a weak sustainability, Jordan and Turkey experience fiscal unsustainability. Mendoza and Ostry (2008) test the Bohn model on a panel of 22 developed countries over the period 1980-2005 and a panel of 34 emerging countries over the period 1990-2005. They find debt to be sustainable in the selected group of countries.

Bohn (1998) uses suitable assumptions on debt sustainability and checks on the existing positive linear relationship between the primary surplus and public debt. Bohn argues that if a government follows this path, it will have the ability to implement corrective measures and be

on a sustainable path in periods of a surging debt by enhancing primary balance. Bohn (1998) builds a Model Based Sustainability (MBS) framework to analyse fiscal sustainability using fiscal reaction functions

$$s_t = \gamma b_t + \mu_t \qquad 5.1$$

Where, s_t is the primary surplus to GDP ratio, b_t is the end of period public debt to GDP ratio and μ_t is the vector capturing all other effects on the primary surplus ratio. According to Bohn (year) a strictly positive feedback effect $\gamma > 0$ satisfies the No Ponzi Game (NPG) condition[12]. In the case of stricter sustainability condition of debt stabilisation policy rule, the feedback effect should be larger than the growth adjusted real average interest rate on public debt, such that $\gamma > (r - y)/(1 - y)$[13]. On the other hand, fiscal rules are polynomial functions of public debt and they include a quadratic and cubic terms (Bohn, 1998). The specification is motivated by the idea that primary surplus may react more to a lagged public debt or on the contrary may become flatter at higher public level. According to Bohn (1998) a positive response of public debt to primary balance indicates that the government is on a sustainable path and satisfies the present value constraint[14].

Empirical evidence by Bohn (1998) and Bohn (2008) show that government act responsibly when faced with rising debt by raising primary balance. The increase in primary balance, however, will be limited due to difficulty in raising taxes or cutting government spending. In the long-run the increase in primary balance will not catch up with debt related costs and thus debt becomes explosives. Keynes (1923) posits that a government should run budget deficits in recessions, and that debts should be offset by surpluses during expansions in an attempt to avoid public debt escalation. Domar (1944) argues that constant government borrowing results in a rising public debt which can be serviced through taxation. However, continued increase in taxes or introduction of new taxes leads to recessions and default. Burger et al. (2012) estimated the fiscal reaction function to test debt sustainability in South Africa. They employ a variety of techniques including, ordinary least square, Threshold Auto-regressive model, state space and vector error correction models. They find that fiscal policy was sustainable during the sample period and the South African government tightened fiscal policies during periods of negative shocks.

Ghosh *et al.* (2013) follows this approach to account for fiscal fatigue where they derive debt limits as the maximum level of public debt beyond which primary balance can no longer adjust to stabilise debt. Utilising the fiscal fatigue property, they estimate the debt limit and calculate the fiscal space. They find that most of the countries have higher fiscal space. Fournier and Fall (2017) following similar approach like Ghosh *et al.* (2013) find higher fiscal space in the US. Similarly, fiscal rules can be time varying, such that the assumption of constant policy rules does not hold in the face of multiple structural breaks or regime changes. On the other hand, (Afonso and Toffano (2013); Bianchi (2012); Favero and Monacelli (2005)) argue that regime switching fiscal rules has empirically proven that fiscal rules are well described by fiscal regimes.

[12] The Non-Ponzi Game condition states that the present value of public debt tends to zero in the long run, which means the government must pay back the at least part of the interest charges.

[13] Bohn (2007) argues that the upper bound on primary surplus like the fiscal limit requires that public debt be stationary for fiscal sustainability to hold. Recently, there has been a surge in upper bound research including: Bi (2012); Daniel and Shiamptanis (2013).

[14] Bohn (1998) posits that a positive coefficient of the relationship between public debt and primary balance offers reliable and sufficient information that public debt is sustainable. Therefore, a rise in public debt even in periods of negative shocks to an economy will be reversed by the primary balance.

Another strand of literature which follows regime switching in monetary and fiscal rules builds on Leeper's seminal paper, Leeper (1991) that sets the formal conditions for local equilibrium determinacy based on monetary and fiscal rules. According to Leeper, fiscal policy is passive or active[15]. Bi (2012) explore regime switching fiscal policy to derive an endogenous and stochastic fiscal limit. Therefore, the literature shows that fiscal sustainability is a sovereign default probability computed from the distribution of the fiscal limit rather than the generalised conditions on the regime switching fiscal rule. On the other hand, Canzoneri et al. (2001) theoretically investigates time varying fiscal policy rules in which public debt feedback effect on primary surplus is positive or negative. Their analysis shows that primary surplus must react positively to public debt frequently and infinitely in order to satisfy the government intertemporal budget constraint.

Afonso and Jalles (2016) perform panel unit root and cointegration tests on government spending, revenue, primary surplus and public debt of OECD countries and find that debt is unsustainable. While on the other hand, Chen (2016) finds that debt is sustainable in the US. Chen additionally considers the nonlinearities in the connection between fiscal variables. Chen concludes that higher government spending decreases sustainability of US fiscal policy. Favero and Monacelli (2005) use the Markov switching dynamic model to investigate the stability of the monetary and fiscal policy rules in US. Their findings challenge the continuous believe of passive fiscal policy. They infer that Markov-switching are a preferable fitting approach to test the conduct of policy behaviour over constant parameter specifications. Cassou et al. (2017) employ asymmetric reactions of fiscal instruments to lagged debt and output gap that depend on boom of burst periods using the Markov switching Vector Autoregressive models (MSVAR). They find that good economic periods lead to sustainable regimes.

Ko and Morita (2015) investigate regime changes in Japan and employ the regime changing Structural Vector Autoregressive model on public debt. Their findings show presence of three regimes in Japan spread between 1970 to 2011. They conclude that higher growth could lead Japan to sustainable fiscal policy. Similarly, employing a Ricardian regime could also enhance fiscal policy. Irungu *et al.* (2019) investigates the nature of fiscal policy regime in Kenya by employing a Markov switching model. They find that sustainable and unsustainable regimes were dominant, and the No-Ponzi game weakly holds in Kenya. Baharumshah et al. (2017) investigates fiscal sustainability in Malaysia using a Markov Switching intercept autoregressive heteroscedasticity error correction model (MSIAH-ECM). They find that fiscal policy has been sustainable in Malaysia and the government should cut deficits when it exceeds a certain level. Baharumshah *et al.* (2017) also find that public debt above 55 percent is negatively correlated with economic activity. Davig (2005) employed a Markov-switching approach to model the two states of a collapsing and expanding discounted debt. They find that expanded discounted debt may not harm directly fiscal sustainability. In the same line, Burger and Marinkov (2012) tests a proposal for adoption of flexible fiscal rules in South Africa in a Markov-switching framework. They find that historically the government has pursued a sustainable fiscal policy and fiscal rules under regime shifts will enhance government's response during periods of recession. Fiscal sustainability in South Africa is also investigated by Burger *et al.* (2016), in a Markov switching model. They find high debt regime since 2010 as primary balance does not respond to a rise in public debt compared to earlier years. Their findings also show that low debt levels in periods prior to 2010 were accompanied with low capital investment and thus there was no improvement in the country's balance sheet.

[15] A monetary policy is active when it reacts aggressively to inflation and passive otherwise.

5.3 Theoretical framework

We follow Hamilton (1989) Markov-switching model. It is a nonlinear time series model that involves multiple equations that can be characterised into different regimes. This characterisation of the model to switch between different regimes captures the complex dynamic patterns embedded in the data. The novelty of the model is in the switching mechanism as is controlled by unobserved state variable that follows first order Markov Chain. The model can used to describe correlated data that possesses distinct dynamic patterns.

It is important to note that the Markov-switching model performs better than other closely related models. In particular, while the threshold model exhibits similar features to the Markov switching model, the latter is easy to implement and does not require a prior choice of thresholds. In this case, the emerging regimes are determined in a probabilistic way from the prevailing data. In relation to the Quandt (1972) random switching model, in a Markov switching; although the data structure may prevail in random, it will be replaced when moving between regimes. Markov-switching also performs better relative to models of structural changes. In this case the Markov-switching model allows for frequent changes at random time points while the structural models changes are only allowed occasionally. Therefore, based on the above strengths, we fit Hamilton (1989) model and estimate the following Markov-switching fiscal rule[16]:

$$s_t = \gamma(z_t)b_{t-1} + X_t'\beta(z_t) + \sigma(z_t)\varepsilon_t \qquad 5.2$$

Where s_t denotes the primary balance, b_{t-1} the end of period debt and X is a vector of control variables that include: the output gap, real interest rates and expenditure gap. The coefficients $\gamma,\ \beta\ and\ \sigma$ are subject to recurring and persistent switches between two regimes according to the hidden exogeneous two state Markov process z_t that consists of transition probabilities p_{ii} for sustainable regime and unsustainable regime given as $\gamma_S > 0$ and $\gamma_{NS} \leq 0$, respectively. The NPG condition requires that the initial debt to GDP ratio be backed by a sum of future expected and discounted primary surplus thus implying a transversality condition as follows:

$$\lim_{T\to+\infty} E_t[\hat{Q}_{t,T+1}b_{t+T}] = 0 \qquad 5.3$$

Where $\hat{Q}_{t,j}$ denotes the j periods growth-adjusted stochastic discount factor in a general equilibrium setup. The theoretical setup is shown in Appendix B, in a dynamic efficient economy and given that $\mu_t(z_t)$ is bounded and as such, a sufficient condition for transversality to hold is given as $\gamma\pi > 0$. Where $\gamma\pi \equiv \gamma_S\pi_S + \gamma_{NS}\pi_{NS}$ is the unconditional expectation of $\gamma(z_t)$, and thus the ergodic probabilities given as follows: $\pi_i = (1-p_{ii})/(2-p_{ii}-p_{jj})$ and the expected duration given as $d_i = {}^{1}/_{1-p_{ii}}$, therefore we can express

$$\gamma_S > |\gamma_{NS}|\frac{d_{NS}}{d_S} \qquad 5.4$$

Given the above, in a regime switching fiscal policy and employing a government budget constraint, then debt follows a Markov-switching autoregressive process

[16] Appendix B provides in detail the Debt sustainability theoretical framework

$$b_t = \varphi(z_t)b_{t-1} + u_t(z_t) \quad 5.5$$

Where $\varphi(z_t) = \frac{1+r_t}{1+y_t}(1 - (1 + y_t)\gamma(z_t)$ and $u_t(z_t) = -(1 + r_t)\mu_t(z_t)$

We can derive the debt stabilisation condition from the strict stationarity of process (5.5), therefore, a stationary debt is given as

$$\gamma\pi > \frac{r - y}{1+y} \quad 5.6$$

Where r and y are real interest rates and growth rate, respectively. If the condition holds then public debt will have an ergodic mean.

5.4 Empirical strategy

We follow a four-step empirical strategy. First, we undertake a unit root and cointegration exercise following (Trehan & Walsh, 1991). Second we undertake cointegration tests between government revenue and spending following (Hakkio & Rush, 1991)[17]. Third, we estimate constant parameter fiscal policy rules and perform standard Model-Based sustainability tests. Fourth, we estimate a two-state Markov-switching fiscal policy rule and assess the global sustainability of fiscal and debt in SSA.

5.4.1 Standard Model-Based Sustainability tests

Following Aldama and Creel (2018), we estimate the following fiscal policy rule:

$$s_t = \alpha + \gamma b_{t-1} + \alpha X_t' + u_t \quad 5.7$$

Where X_t' denotes the covariates that include the output gap, expenditure gap, real interest rates and fiscal rules. We estimate the model with first order autoregressive residuals by employing the Non-linear least squares using a Cochrane-Orcutt procedure. We also account for the non-linearity in the relationship between primary balance and debt by testing quadratic and cubic terms as primary balance reacts to lagged debt.

$$s_t = \alpha + \gamma_1 b_{t-1} + \gamma_2 b_{t-1}^2 + \alpha X_t' + u_t \quad 5.8$$

$$s_t = \alpha + \gamma_1 b_{t-1} + \gamma_2 b_{t-1}^2 + \gamma_3 b_{t-1}^3 + \alpha X_t' + u_t \quad 5.9$$

The polynomial specifications are included in our specifications of a quadratic and cubic account for increasing or decreasing of the primary balance when the level of debt increases.

Markov-Switching Sustainability tests

As stated earlier, we follow Hamilton (1989) and estimate the following Markov-switching fiscal rule:

$$s_t = \gamma(z_t)b_{t-1} + \alpha(z_t) + \alpha_{x,y}(z_t)X_t' + u_t \quad 5.10$$

Where the parameters shift between two regimes in a Markov two-state Markov process z_t.

[17] The appendix C5.1 and C5.2 provide detailed explanations of the theoretical framework for unit root tests and cointegration tests.

5.5 Dataset

We utilise historical data from various sources in order to build time series data for the selected SSA countries on public debt, primary balance, real GDP, government spending, government revenue, real interest rates, budget deficits, fiscal rules and fiscal rules index. Following most studies on debt sustainability and fiscal policy, we use gross public debt and budget deficits. We also employ general government spending and total revenue as well as real interest rates. Using annual data, our study employs various techniques on fiscal sustainability and debt sustainability. The choice of annual data is motivated by the fact and nature of fiscal policy. According to empirical evidence, fiscal policy is set at annual frequency and in most cases, fiscal policy or public finance data especially in developing countries are available at annual frequency[18,19].

5.6 Empirical results

Appendix *Table A5.1-A5.6* reports the stationarity test results. In our results using the ADF and PP stationarity tests ($H_0: \lambda_1 = \beta_2 = 0$) for Kenya and Equatorial Guinea budget deficits, we fail to reject the null hypothesis and thus conclude presence of a unit root in the series (*Table A5.1* and *A5.4*). However, after first differencing, the series becomes stationary suggesting our variables are *I (1)*. For Botswana, Burkina Faso, Nigeria and Cape Verde the ADF and PP tests point to stationary of budget deficits (*Table A5.2-A5.3* and *A5.5-A5.6*). Further, we also test the existence for stationarity in government expenditures and government revenue series. From the literature, the two series meet the intertemporal solvency condition when they are stationary. From the empirical exercise, we find that government expenditure and revenue exhibit a unit root at levels. However, after first difference, the two series become stationary and the null hypothesis is subsequently rejected, indicating that government expenditure and revenue are *I (1)*. From our analysis, we find our fiscal variables are stationary at *I (1)*. As argued earlier, the non-stationary of the budget deficits is sufficient to infer that debt is unsustainable. This therefore means that for Kenya and Equatorial Guinea, the budget deficit will continue to rise, and debt will be unsustainable in the long-run. As such, the intertemporal solvency condition will be violated. In the case of government expenditure and revenue, which are *I(1)*, one must establish existence of a long-run relationship (see Hakkio and Rush (1991)).

Accordingly, we employ Johansen (1995) efficient maximisation likelihood to evaluate the long-run relationship among the variables. Presence of a long-run relationship indicates a sustainable fiscal policy. Theoretically, even if variables drift apart, they will converge in the long-run. *Table 5.2-5.7* reports the cointegration test results. As can be seen from the results, it is evident that there is cointegration between expenditure and revenue series for our selected SSA countries pointing to sustainable fiscal policy. Therefore, based on the cointegration analysis, we infer that fiscal policy is sustainable in Kenya, Botswana, Burkina Faso, Equatorial Guinea, Nigeria and Cape Verde, because expenditure and revenue are cointegrated.

[18] Appendix C5.1 provides detailed explanations and transformation of variables used in the study.

[19] Where data is missing for the variables of interest, we obtain from IMF Article IV as follows: Kenya – Real interest rates are used as interest payments from 1980-1984. Botswana, from 1980-1990, interest payments is provided in millions of SDR. We first convert to local currency and then as a ratio of GDP of which we use to calculate the primary balance. From 1991-1995, interest payments are provided as percentage of GDP while primary balance is provided for 1996-2000. Burkina Faso, from 1980-1986 the interest payments are provided in billions of local currency. We first convert to ratio of GDP and calculate the primary balance. For Equatorial Guinea, we obtain the primary balance data from 1980-1984. Nigeria, real interest rates are assumed for interest payments from 1980-1989. For Cape Verde, we assumed real interest rates as interest payments from 1982-1987 (IMF Article IV various issues).

Our baseline sustainability tests for debt and fiscal policy under unit root and cointegration tests are similar to those in literature. Neaime (2015) examines the sustainability of debt in selected Euro area countries and established that budget deficits were non-stationary. Therefore, they conclude debt unsustainability in those countries. For Germany, they find that debt is on a sustainable path. Kalyoncu (2005) investigates debt sustainability for South Korea, Mexico, Philippines, South Africa and Turkey under the intertemporal budget constraint. They find that for South Korea and Turkey there exist a long-run relationship between revenue and expenditures, thus, the two country's debt is sustainable. For Mexico, Philippines and South Africa, there is no long-run relationship thus the country's fiscal stance is unsustainable. Lusinyan and Thornton (2009) examines fiscal sustainability in South Africa by allowing for structural breaks and finds that revenue and expenditure are *I(1)* and cointegrated, however, the results support a weak deficit sustainability. Neaime (2015) finds varied cointegration results between government revenue and expenditure in Euro area. They find that for Italy and Greece, debt is unsustainable. For France, Spain, Portugal, Ireland and Germany they find debt to be sustainable. Trehan and Walsh (1991) find overall budget deficit to be stationary and conclude that US debt is sustainable.

Table 5. 2 Cointegration test results for Kenya

Hypothesis (Rev & Exp)		Trace statistics	Critical values		Max-Eigen statistics	Critical values	
Null	Alternative		5%	1%		5%	1%
$r = 0$	$r \geq 1$	16.4767	15.41	20.04	12.6715	14.07	18.63
$r \leq 1$	$r = 2$	3.8052	3.76	6.65	3.8052	3.76	6.65

Source: Author's estimates
Notes: Abbreviations: Rev – Revenue, Exp – Government expenditure; *r* denotes the number of co-integrating vectors. 1980-2016 data sample was used.

Table 5. 3 Cointegration test results for Nigeria

Hypothesis (Rev & Exp)		Trace statistics	Critical values		Max-Eigen statistics	Critical values	
Null	Alternative		5%	1%		5%	1%
$r = 0$	$r \geq 1$	20.2555	15.41	20.04	14.7988	14.07	18.63
$r \leq 1$	$r = 2$	5.4567	3.76	6.65	5.4507	3.76	6.65

Source: Author's estimates
Notes: Abbreviations: Rev – Revenue, Exp – Government expenditure.; *r* denotes the number of co-integrating vectors. 1980-2016 data sample was used.

Table 5. 4 Cointegration test results for Botswana

Hypothesis (Rev & Exp)		Trace statistics	Critical values		Max-Eigen statistics	Critical values	
Null	Alternative		5%	1%		5%	1%
$r = 0$	$r \geq 1$	12.2202	15.41	20.04	7.8124	14.07	18.63
$r \leq 1$	$r = 2$	4.4078	3.76	6.65	4.4078	3.76	6.65

Source: Author's estimates
Notes: Abbreviations: Rev – Revenue, Exp – Government expenditure.; *r* denotes the number of co-integrating vectors. 1980-2016 data sample was used.

Table 5. 5 Cointegration test results for Equatorial Guinea

Hypothesis (Rev & Exp)		Trace statistics	Critical values		Max-Eigen statistics	Critical values	
Null	Alternative		5%	1%		5%	1%
$r = 0$	$r \geq 1$	23.6940	15.41	20.04	18.0275	14.07	18.63
$r \leq 1$	$r = 2$	5.6665	3.76	6.65	5.6665	3.76	6.65

Source: Author's estimates
Notes: Abbreviations: Rev – Revenue, Exp – Government expenditure.; *r* denotes the number of co-integrating vectors. 1980-2016 data sample was used.

Table 5. 6 Cointegration test results for Burkina Faso

Hypothesis (Rev & Exp)		Trace statistics	Critical values		Max-Eigen statistics	Critical values	
Null	Alternative		5%	1%		5%	1%
$r = 0$	$r \geq 1$	36.6651	15.41	20.04	31.7980	14.07	18.63
$r \leq 1$	$r = 2$	4.8671	3.76	6.65	4.8671	3.76	6.65

Source: Author's estimates
Notes: Abbreviations: Rev – Revenue, Exp – Government expenditure; *r* denotes the number of co-integrating vectors. 1981-2016 data sample was used.

Table 5. 7 Cointegration test results for Cape Verde

Hypothesis (Rev & Exp)		Trace statistics	Critical values		Max-Eigen statistics	Critical values	
Null	Alternative		5%	1%		5%	1%
$r = 0$	$r \geq 1$	19.4777	15.41	20.04	10.6410	14.07	18.63
$r \leq 1$	$r = 2$	8.8367	3.76	6.65	8.8367	3.76	6.65

Source: Author's estimates
Notes: Abbreviations: Rev – Revenue, Exp – Government expenditure; *r* denotes the number of co-integrating vectors. 1982-2016 data sample was used.

5.7 Standard Model-Based Sustainability tests

Table 5.8 presents the baseline specification results for fiscal reaction function in linear, quadratic and cubic form. We present the results for each country in turn. For Kenya's case, primary balance does not positively respond to a rise in public debt. As such, in our model-based specification for Kenya we would have concluded in favour of unsustainable fiscal policy all over the period under consideration, thus, indicating that a build-up in public debt do not seem to positively correlate with significant increase in primary balance. For the non-linear specifications, the results are not significant. Overall, we find no evidence of fiscal sustainability in Kenya. For Botswana, Burkina Faso and Equatorial Guinea primary balance responds positively to a rise in public debt for both the linear specification and quadratic specification. In fact, in this category of countries, the effect of primary balance increases with an increase in public debt and this is evident with the positive and significant coefficient of the linear specification.

Interestingly, the negative and significant quadratic coefficient of Burkina Faso exhibits signs of *fiscal fatigue* and fiscal unsustainability. This means that, at very high public debt, the fiscal effort must be so high that they may become untenable. On the other hand, Equatorial Guinea displays a positive and significant cubic coefficient; indicating no signs of fiscal fatigue. Further, in Nigeria we find no evidence of fiscal sustainability as there is no significant positive

feedback effect of public debt on primary balance. In fact, Nigeria presents evidence of weak sustainability and fiscal fatigue as the quadratic specification is negative and significant. This indicates that at very high public debt, the fiscal effort must be so high to contain the rising public debt. For Cape Verde, we find significant evidence of a strictly positive feedback effect of public debt on primary balance. Overall, under the standard model-based sustainability analysis, we find evidence of unsustainable fiscal policy in Kenya and Nigeria. Botswana, Equatorial Guinea and Cape Verde exhibit sustainable fiscal policy while Burkina Faso's fiscal policy is sustainable but higher public debt makes the fiscal policy vulnerable.

These results are in line with those found in related literature. Aldama and Creel (2018) examines the Bohn's test in US and finds unsustainable fiscal policy as there is no significant positive feedback of public debt on primary balance. Semmler et al. (2007) investigates whether the Euro area countries (Germany, France, Italy and Portugal) passed the Bohn's test. They find that the response of primary balance to public debt was positive and significant and thus, the countries were on a sustainable path. In the same line of debt and fiscal sustainability, our results are similar to Bohn (1998) for the US. For Nigeria and Burkina Faso, which experience fiscal fatigue, we provide evidence of fiscal fatigue that are similar to other results in literature see (Ghosh *et al.*, 2013). Ghatak and Sánchez-Fung (2007) investigates fiscal sustainability in selected developing economies applying competing techniques. They find that the benchmark condition for government budget surplus does not hold in Peru, South Africa, Thailand and Venezuela. Applying Bohn's tests, the findings indicate weak fiscal sustainability with mixed results among the countries under investigation. De Mello (2008) examines the conduct of Brazil's public debt by employing Bohn's sustainability test. They find debt to be sustainable for the period under investigation. Burger *et al.* (2012) investigates Bohn's test for fiscal sustainability in South Africa, they find that fiscal policy has been sustainable by primary balance responding positively to a rise in public debt.

5.8 Markov-switching Model-Based Sustainability tests

We find two regimes in our estimation, see (*Table 5.9*). We report results for each country in turns. For Kenya, there is a strong and significant positive response of primary balance to lagged debt in regime 2, which in our case we label *sustainable*. While the response of primary balance to lagged debt is negative and non-significant in regime 1, which we label as *unsustainable*. A similar situation is experienced in Nigeria, where regime 2 is sustainable compared to regime 1. Equivalently, Botswana, Burkina Faso, Equatorial Guinea and Cape Verde have two regimes. However, regime 1 turns out to be sustainable compared to regime 2 in this group of countries. As such, there is a strong and significant positive response of primary balance to lagged debt in regime 1, while a non-significant primary balance response to lagged debt in regime 2. On the other hand, the expected duration between the sustainable and unsustainable regimes are heterogeneous. Equatorial Guinea has a persistent expected duration in a sustainable regime of 28.6 years compared to other selected countries (e.g. Kenya has expected duration of 2.5 years in sustainable regime, Botswana has 5.7 years in regime 1). Similarly, for Botswana the expected duration between the sustainable regime 1 and unsustainable regime 2 seem to be same at 1 year and 1.3 years respectively.

Table 5.10 presents the effect of fiscal rules on fiscal policy and debt sustainability. Evidently, fiscal rules are important in debt sustainability management. Our results indicate that in the presence of fiscal rules, we find that each country has two regimes consistent with regime

identification in the baseline Markov-switching specification. However, with introduction of fiscal rules, we find some countries having both regimes sustainable. This indicates that fiscal rules support the response of primary to a rising public (e.g. fiscal rules as a numeric constrain helps to stabilise the effect of a rising debt in order for primary balance to respond). In cases where the fiscal rules are significant while relationship between primary balance and debt are not significant, it shows fiscal rules are important to enhance the efficacy of primary balance. For Kenya, regime 2 is sustainable while regime 1 is unsustainable. In fact, fiscal rules are positive and statistically significant, as such, they support an increase in primary balance in the event of a build-up in public debt. For Botswana and Cape Verde, both regimes 1 and 2 are sustainable. For Burkina Faso regime 1 is sustainable while regime 2 is weakly sustainable. However, fiscal rules are positive and statistically significant and seems to strengthen primary balance in the event of an increase in public debt.

For Equatorial Guinea, regime 2 is sustainable while regime 1 is unsustainable. However, our results are an opposite of the baseline specification without the fiscal rules in terms of the duration. We find that it only takes about 3-year period on average for fiscal policy consolidation postponement as long as 1-year period is used for policy consolidation for sustainability. This is contrary to the 29-year period we found in the baseline specification. For Nigeria, regime 2 is sustainable while regime 1 is weakly sustainable. However, fiscal rules seem to support improvement of primary balance in case of increase in public debt in a weakly sustainable policy environment.

Figure 5.4 reports the filtered probabilities for each country under investigation. It is evidently clear that our filtered probability shows occurrences that are consistent with each country's historical events. We present the results for each country in turn. For Kenya, the sustainable regimes occurred from 1986-1990, 1994, 1996-2001, 2003-2006 and 2009-2015 while the unsustainable regimes occurred in 1985, 1991-1993, 1995, 2002 and 2007-2008. The events of 1980-2002 and 2003-2012 correspond to the Moi and Kibaki administrations, respectively. As noted earlier, Kenya had the banking crisis in 1985 that led to an almost collapse of the financial sector. Four banks and twenty-four non-bank financial institutions that accounted for 30 percent of the financial system had liquidity and solvency problems and the government intervened to save two local banks. Similarly, in 1985 the country experienced the worst famine that required government's intervention with major spending implications. The period between 1991- 1992 corresponds to major political instability in the country, in which section 2A of Kenya's constitution was repealed to allow for multiparty politics, eventually culminating to elections in 1992. Moi's administration flip-flopped on fiscal policy in early 1990s with either to increase taxes or lowering them to stimulate the economy. The country witnessed an aimless fiscal policy and the government lost in the morass of political uncertainty. They resorted to debt rescheduling as they could not access international financial support. The propagated political uncertainty continued due to the opening of political space, the country experienced tribal clashes in most parts of the country especially those perceived to be opposition zones. A similar pattern was witnessed in 2002, as the government faced off with a united opposition of which, the government lost the election. The post-election violence of 2007-2008 led to loss of over 1000 lives due to fighting on the disputed elections. These events had a lot of negative effects to Kenya's economy before a coalition government was formed.

Botswana seems to have enjoyed a sustainable fiscal policy for long period of time. The major events in the country matches both the sustainable and unsustainable regimes outlined. The

periods of 1984, 1986, 1988, 1990-1992, 1994, 2000, 2005-2006, 2008-2010 and 2015 largely correspond to major events in the country. Botswana had a currency crisis in 1984 that led to the devaluation of the Pula in relation to the US dollar. The country experienced a major drought in 1991-1992 which affected the agricultural sector. In 1992, there was a significant weakening of the diamond sales after the international cartel imposed a sales quota of 75 percent in 1992 and later 85 percent in 1993. This resulted in a slowdown in diamond production. The housing corporation scandal of 1992 had a major effect to the economy and at the same time the government lost the Zimbabwe textile export market due to major economic reforms in Zimbabwe and this exacerbated external competitiveness. Devaluation of the Pula was continued in 1991 and 1994 at 5 and 3.5 percent to US dollar[20]. The Botswana economy slowed down in 2014-2015 due to reduction on the mining GDP and the drought affecting the country as well as reduction of South African Customs Union receipts[21].

Burkina Faso has gone through long periods of unsustainability and this is evident due to various political events that have taken place in the country. The periods of 1982-1989, 1993-2003, 2010-2011 and 2014-2016 corresponds to the various political events including change of regimes through coups that greatly affected the country fiscal path. Following independence in 1960, the country went through several episodes of regime changes. In the period of 1980s alone, Burkina Faso had around four successful coups. This frequent change in governments negatively affected the economy including a reduction in investment[22]. Similarly, being a landlocked country, it faced a lot of drought that greatly affected the agricultural sector. Burkina Faso devalued the CFA franc by 50 percent in 1994 which helped restore competitiveness and accelerate growth. The country had a banking crisis from 1990-1994 and during this period the nonperforming loans were estimated at 34 percent.

Equatorial Guinea has had a stable fiscal policy after the discovery of oil and exports from 1990s. The events of 1985, 1990, 1993, 1996, 2000 and 2004-2005 matches both political events and fiscal policy changes that have taken place in the country. It is estimated that during the banking crisis in 1983, two of the country's largest banks were liquidated. Oil discovery of 1990s and eventual exports improved the country's reserves and revenue. These events have also led to political instability in the 1990's although there has been improvement on the political front. In 1993, multiparty was introduced and elections were held in the country. In 1996, new elections were held of which the government was elected. During periods of election could have led to fiscal unsustainability in the country. Similarly, in 2004, there was unsuccessful coup in the country that led to political tensions[23].

Nigeria seems to have a sustainable path of fiscal policy especially after impressing democratic political space. The unsustainability events of 1985, 1987, 1990, 2001-2003, 2006, 2009-2010, 2012 and 2014 correspond to political and fiscal policy changes in the country. Nigeria had a debt default in 1982-1992, 2001 and 2004-2005 and this affected the country's rating and access to the borrowing market. In 1985 General Babangida seized power through a coup and promised reforms and handover of government to a civilian rule through democratic elections. The promise led to short-lived stability. However, in the build-up to elections, presidential primaries were cancelled and when they were eventually held the results were cancelled in June

[20] Source: IMF Article IV 1994, 1996 & 2001
[21] Source: IMF Article IV 2016/ IMF Country Report No. 16/103.
[22] Source: IMF Article IV 1986
[23] Source: IMF Article IV Various Issues

1992. In 1987 the country experienced high inflationary pressures and a build-up of domestic liquidity overhang. At the same time there were prolonged bad weather conditions. The oil price collapse in 1980s led to substantial financial imbalances and with recourse the government resorted to bank financing[24]. Nigeria had also a banking crisis in 1992 and 1995 which had an effect to other sectors of the economy with long term effects felt from 1990-2000s. In 1990, Nigeria suffered severe oil price fluctuations and the government's preoccupation with a return to civilian rule negatively affected the economy. At the same time, the country faced large debt service obligations leading to prolonged rescheduling negotiations[25]. Between 2001 and 2003, Nigeria faced a higher fiscal imbalance as the overall fiscal balance shifted from a surplus of 3 percent in 2000 to a deficit of 2.5 percent in 2001[26]. Similarly, inflation accelerated to 18.9 percent in 2001 from 6.9 percent in 2000, the same situation was experienced in 2003. The currency crisis in the country corresponds to the unsustainability period the country experienced. Similarly, the country was in recession in 2017, the worst after 25 years, which greatly affected the government's outlay.

Cape Verde has tried to improve the fiscal policy. It has had a long period of fiscal sustainability, with introduction of major fiscal policy changes to keep fiscal policy sustainable. The events of 1988-1991, 1993-1996, 2001, 2003, 2005, 2007-2008 and 2015 matches changes in the country. The country has had a stable political system, however, its reliance on agriculture coupled with a small population has greatly affected the country's growth. The country had a banking crisis in 1993, with great negative effect on the financial sector. During this period, the level of nonperforming loans accounted for 30 percent of the GDP. The period 1988-1991 also corresponds to the period of economic and political reforms in the country. During this time, significant reforms were introduced for multiparty democracy and elections were held in 1991 and a new government was elected. Due to political tension of change in political reforms, various sectors of the economy were affected. The country also experienced low rainfall that led to poor agricultural production and a slowdown in public investment. In 2001, the ruling party lost the election in the country and a new government was formed. The country had a worst Volcano in 2014 in which over 1500 people were displaced[27].

Our Markov-switching regime for fiscal sustainability are in line to those in literature. Aldama and Creel (2018) examines fiscal sustainability for the US by employing both the Bohn's test and Markov-switching models. They find a strong positive relationship between primary balance and public debt in a sustainable fiscal regime, and the expected duration differ in both sustainable and unsustainable regimes. Irungu *et al.* (2019) examines fiscal regime shifts in Kenya and finds a positive relationship between primary balance and debt in a sustainable regime while the expected durations are similar for both sustainable and unsustainable regimes[28]. Burger and Marinkov (2012) investigates the conduct of fiscal sustainability in South Africa in a Markov-switching framework. They authors find that if South Africa employs

[24] Source: IMF Article IV 1989- SM/89/174
[25] Source: IMF Article IV 1991- SM/91/186
[26] Source: Public information Notice: IMF concludes Article IV consultation with Nigeria 2003 and 2004 Reports.
[27] Source: IMF Article IV Various Issues
[28] There are several reasons for the difference in results in this chapter and the paper by Irungu *et al.* (2019). First, we use primary balance data in our modelling process while they use budget balance. Second, our data sample ranges from 1980-2016, while Irungu uses a longer period 1964-2014. In this chapter we employ fiscal rules as an additional variable to capture policy changes over time. This policy changes have been advocated by both several national governments, IMF and World Bank to enhance fiscal sustainability.

fiscal rules (e.g. deficit and debt rule) the country will achieve fiscal sustainability and the primary balance will positively adjust to increase in public debt[29].

[29] Burger and Marinkov (2012) support for adoption of a flexible fiscal rule in South Africa. Using different scenario analysis, they find that a deficit band and debt rule will enhance fiscal sustainability in South Africa.

Table 5. 8 Standard Model-Based Sustainability tests for selected SSA countries

	Kenya			Botswana			Burkina Faso			Equatorial Guinea		
VARIABLES	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
Lagged debt	0.114	0.139	0.156	0.679**	0.892**	1.085	0.302**	0.292**	0.004	1.341***	1.222**	-0.933
	(0.102)	(0.088)	(0.098)	(0.267)	(0.341)	(0.656)	(0.145)	(0.140)	(0.321)	(0.463)	(0.478)	(0.909)
Quadratic lagged debt		0.011**	0.016		-0.052	-0.036		-0.014**	-0.019**		-0.008	0.052***
		(0.004)	(0.014)		(0.045)	(0.066)		(0.007)	(0.008)		(0.010)	(0.019)
Cubic lagged debt			-0.000			-0.003			0.001			0.001***
			(0.000)			(0.010)			(0.001)			(0.000)
Output gap	0.326	0.351*	0.356*	0.235	0.341	0.343	0.588**	0.648**	0.619**	-0.689	-0.759	-0.647
	(0.224)	(0.195)	(0.198)	(0.272)	(0.277)	(0.281)	(0.263)	(0.257)	(0.264)	(0.521)	(0.524)	(0.643)
Expenditure gap	0.110	-0.244	-0.238	-0.433	-0.314	-0.318	-0.116	0.068	0.039	-1.532***	-1.578***	-0.877***
	(0.260)	(0.234)	(0.238)	(0.324)	(0.342)	(0.348)	(0.368)	(0.372)	(0.383)	(0.152)	(0.155)	(0.171)
Real interest rates	0.043	-0.016	-0.023	-0.239	-0.298	-0.287	0.050	-0.025	-0.083	0.072	0.460	-0.451
	(0.067)	(0.061)	(0.064)	(0.185)	(0.195)	(0.201)	(0.099)	(0.103)	(0.118)	(0.820)	(0.927)	(0.969)
Fiscal rules	-0.830	-0.138	-0.125	1.914	1.508	1.569	1.217	1.399	1.579	-35.923	-40.565	39.273
	(0.848)	(0.734)	(0.744)	(2.077)	(2.214)	(2.261)	(1.211)	(1.198)	(1.261)	(69.909)	(73.803)	(38.805)
Constant	0.107	-0.342	-0.424	-0.486	0.723	0.657	-0.999	-0.262	0.084	30.870	31.941	-40.022
	(0.743)	(0.628)	(0.664)	(1.261)	(1.681)	(1.721)	(0.862)	(0.922)	(1.007)	(57.857)	(63.712)	(31.326)
Observations	34	34	34	34	34	34	35	35	35	34	34	34
R-squared	0.154	0.341	0.347	0.366	0.385	0.388	0.282	0.374	0.399	0.795	0.807	0.636
DW Statistics	1.99	2.29	2.39	2.07	1.89	1.90	2.35	2.31	2.13	1.73	1.75	1.83

Note: Abbreviations: DW – Durbin Watson. Dependent variable is primary balance. Standard errors are reported in parentheses *** denotes significance at 1 percent ** denotes significance at 5 percent and * denotes significance at 10 percent. All models control for serially correlated residuals using a Cochrane-Orcutt procedure.

Table 5.8: Model-Based sustainability tests continued

	Nigeria			Cape Verde		
VARIABLES	Linear	Quadratic	Cubic	Linear	Quadratic	Cubic
Lagged debt	0.018	-0.005	0.076	0.228**	0.142	0.168
	(0.045)	(0.045)	(0.080)	(0.093)	(0.105)	(0.196)
Quadratic lagged debt		-0.002*	-0.002**		0.017	0.019
		(0.001)	(0.001)		(0.010)	(0.014)
Cubic lagged debt			-0.000			-0.000
			(0.000)			(0.001)
Output gap	0.190	0.126	0.022	-0.018	-0.016	-0.013
	(0.319)	(0.303)	(0.303)	(0.325)	(0.321)	(0.329)
Expenditure gap	-0.420	-0.529*	-0.528*	-0.275**	-0.251*	-0.255*
	(0.276)	(0.266)	(0.262)	(0.122)	(0.123)	(0.128)
Real interest rates	-0.076	-0.140	-0.148	-0.295	-0.380*	-0.370
	(0.122)	(0.120)	(0.119)	(0.214)	(0.221)	(0.236)
Fiscal rules	-1.505	-2.300	-2.516	2.153	2.259	2.162
	(2.336)	(2.182)	(2.123)	(1.903)	(1.926)	(2.067)
Constant	1.099	2.465**	2.832**	0.260	-0.223	-0.312
	(1.078)	(1.179)	(1.168)	(1.118)	(1.183)	(1.334)
Observations	34	34	34	33	33	33
R-squared	0.148	0.250	0.298	0.345	0.405	0.405
DW Statistics	2.18	2.18	2.19	2.17	2.14	2.22

Note: Standard errors are reported in parentheses *** denotes significance at 1 percent ** denotes significance at 5 percent and * denotes significance at 10 percent. All models control for serially correlated residuals using a Cochrane-Orcutt procedure

Table 5. 9 Estimated Markov-switching sustainability tests for selected SSA countries

	Kenya		Botswana		Burkina Faso		Equatorial Guinea		Nigeria		Cape Verde	
	Unsust.	Sustainable	Sustainable	Unsust.	Sustainable	Unsust.	Sustainable	Unsust.	Unsust.	Sustainable	Sustainable	Unsust.
VARIABLES	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2
Lagged debt	-0.114	0.223***	3.698***	0.164	0.253***	-0.299***	1.061***	-0.504	-0.200**	0.130***	0.307***	0.084
	(0.112)	(0.083)	(0.899)	(0.141)	(0.044)	(0.070)	(0.311)	(0.736)	(0.099)	(0.038)	(0.068)	(0.094)
Expenditure gap	1.839***	-0.816***	-1.366**	-0.479*	-0.028	0.578***	-0.811***	-2.294***	-1.832**	-0.413**	-0.231***	-0.304***
	(0.233)	(0.172)	(0.671)	(0.254)	(0.128)	(0.213)	(0.087)	(0.298)	(0.788)	(0.210)	(0.083)	(0.046)
Output gap	0.289	0.701***	1.045	-0.012	0.538***	0.500***	-0.128	-22.906***	0.706	0.076	0.279***	0.519***
	(0.183)	(0.169)	(0.715)	(0.167)	(0.087)	(0.150)	(0.254)	(3.524)	(0.461)	(0.251)	(0.109)	(0.196)
Real interest	-0.241	-0.007	-0.966**	-0.321**	-0.071***	-0.150*	-0.291	-1.350	-0.752***	-0.139	0.037	-0.195***
	(0.180)	(0.075)	(0.454)	(0.129)	(0.026)	(0.089)	(0.417)	(2.419)	(0.244)	(0.098)	(0.129)	(0.056)
Constant	-1.415**	-0.661	2.261	2.180*	-0.551**	4.989***	-11.542	-30.755	0.829	3.547***	-2.373**	3.655***
	(0.699)	(0.436)	(3.834)	(1.119)	(0.225)	(0.791)	(7.037)	(41.032)	(3.266)	(0.829)	(1.106)	(0.056)
Regime invariant parameters												
AR (1)	-0.311		0.439**		-0.799***		-0.020		-0.227***		-0.669***	
	(0.165)		(0.184)		(0.144)		(0.237)		0.066		(0.113)	
Standard error σ	0.152		1.205***				3.469***		1.169***		0.229*	
	(0.133)		(0.136)				(0.123)		(0.145)		(0.138)	
Regime properties												
Transition p_{11}	0.60		0.16		0.10		0.97		0.36		0.63	
p_{22}	0.68		0.82		0.23		0.71		0.72		0.73	
Duration d_1	2.5		1.2		1.0		28.6		1.6		2.7	
d_2	3.2		5.7		1.3		3.5		3.6		3.7	
Ergodic π_1	0.44		0.18		0.46		0.91		0.30		0.42	
π_2	0.56		0.82		0.54		0.09		0.70		0.58	
DW Statistics												
Observations	34	34	34	34	34	34	34	34	34	34	34	34

Note: We control for regime invariant first-order serial correlation in the residuals. Standard errors are in parentheses *** denotes significance at 1 percent ** denotes significance at 5 percent and * denotes significance at 10 percent. Abbreviations: Unsust. – Unsustainability.

Table 5. 10 Estimated Markov-switching sustainability tests for selected SSA countries

	Kenya		Botswana		Burkina		Equatorial Guinea		Nigeria		Cape Verde	
	Unsust.	Sustainable	Sustainable	Sustainable	Sustainable	Unsust.	Unsust.	Sustainable	Unsust.	Sustainable	Sustainable	Sustainable
VARIABLES	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2	Regime 1	Regime 2
Lagged debt	-0.077	0.358***	0.295**	2.085**	0.491***	-4.238***	0.193	0.496**	-0.158***	0.139***	0.585**	0.168***
	(0.052)	(0.073)	(0.140)	(0.964)	(0.099)	(0.878)	(0.337)	(0.193)	(0.057)	(0.036)	(0.257)	(0.058)
Real interest	-0.066	-0.037	-0.360***	-1.767***	0.115*	-0.785***	-0.857	-0.041	-0.874***	-0.047	-0.473	-0.078
	(0.046)	(0.033)	(0.115)	(0.436)	(0.063)	(0.282)	(0.662)	(0.271)	(0.189)	(0.108)	(0.825)	(0.114)
Output gap	1.009***	0.853***	-0.239*	3.000***	0.465**	2.084***	-0.007	0.024	0.735**	-0.104	-0.724	0.456**
	(0.168)	(0.125)	(0.136)	(0.313)	(0.220)	(0.596)	(0.043)	(0.028)	(0.343)	(0.262)	(0.770)	(0.229)
Expenditure gap	2.149***	-0.666***	-0.714***	3.214***	-0.319	0.851	0.001	-0.017**	-1.689***	-0.489**	-0.734**	-0.154
	(0.190)	(0.124)	(0.190)	(1.028)	(0.352)	(0.756)	(0.012)	(0.008)	(0.416)	(0.206)	(0.320)	(0.203)
Fiscal rules	3.439***	-0.846	1.525	11.808***	0.525	6.586**	-2.838	2.023	5.978**	-3.509**	4.544	-0.400
	(0.720)	(0.558)	(1.579)	(4.046)	(1.148)	(3.359)	(2.806)	(2.049)	(2.892)	(1.752)	(3.605)	(1.824)
Constant	-1.906***	0.351	0.277	5.713	-1.602*	5.188*	-3.033	0.739	-1.748	4.439***	-6.036	1.579
	(0.506)	(0.440)	(1.073)	(3.583)	(0.931)	(2.709)	(1.988)	(1.629)	(1.565)	(0.835)	(7.085)	(1.285)
Regime invariant parameters												
AR (1)	-0.579***		0.283		-0.532***		0.477**		-0.256***		-0.514	
	(0.149)		(0.184)		(0.164)		(0.199)		(0.061)		(0.403)	
Log (Sigma)	-0.107		1.035***		1.052***		1.138***		1.125***		0.784***	
	(0.138)		(0.129)		(0.135)		(0.136)		(0.141)		(0.193)	
Regime properties												
Transition p_{11}	0.45		0.87		0.84		0.17		0.47		0.11	
P_{22}	0.61		0.58		0.15		0.63		0.72		0.71	
Duration d_1	1.8		7.9		6.4		1		1.8		1	
d_2	2.6		2.4		1		2.7		3.6		3.4	
Ergodic prob. π_1	0.41		0.76		0.84		0.31		0.35		0.25	
π_2	0.59		0.24		0.16		0.69		0.65		0.75	
DW Statistics												
Observations	34	34	34	34	35	35	34	34	34	34	33	33

Note: We control for regime invariant first-order serial correlation in residuals. Standard errors are in parentheses *** denotes significance at 1 percent ** denotes significance at 5 percent and * denotes significance at 10 percent. Abbreviations – Unsust. – Unsustainable.

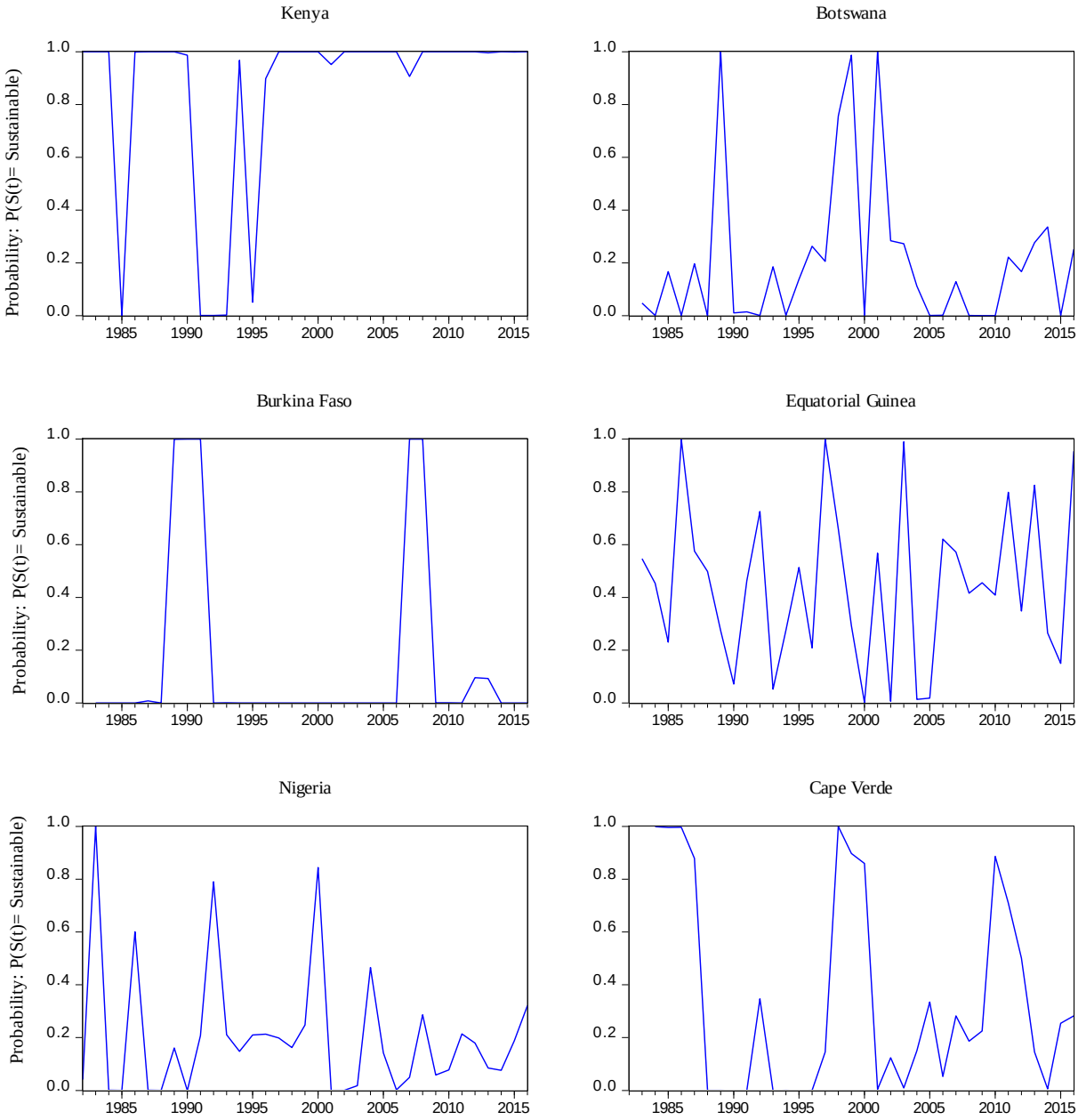

Figure 1.4. Regime filtered probabilities

Figure 5. 5: Regime filtered probabilities for selected SSA countries

5.9 Conclusions

The study has thoroughly investigated fiscal sustainability in SSA with the objective of highlighting public debt sustainability and their fiscal solvency thereof. The build-up in public debt raises several concerns among them: is public debt sustainable? And how long is it possible to delay fiscal consolidations efforts before public debt explodes? The paper has employed a four-strategy approach and tested the PVC, Bohn's sustainability test and fiscal regime cycles of the selected countries. Therefore, our results are fourfold.

Firstly, we conduct unit root tests for fiscal data in SSA. The unit cost tests have revealed, except for Kenya and Equatorial Guinea, that budget deficits are sustainable for all SSA countries. Secondly, we conduct cointegration tests to evaluate the cointegration of revenue and expenditure series. The empirical analysis reveals the presence of cointegration, thus, indicating debt sustainability in SSA. Thirdly, we estimate different specifications of Bohn's sustainability tests. The estimates reveal fiscal sustainability in Botswana, Burkina Faso, Equatorial Guinea and Cape Verde. For Kenya and Nigeria, the results do not allow rejection of fiscal unsustainability: the feedback coefficient on public debt is not significant. Further, for Nigeria and Burkina Faso, the results provide evidence of fiscal fatigue. Fourthly, we estimate a Markov-switching regime changes with fiscal rules and without. The Markov-switching allows us to identify the sustainable and unsustainable regimes for fiscal policy prescriptions.

The Markov-switching results without fiscal rules, reveal that on average, about 3-year period of fiscal policy postponement does not preclude future sustainability in Kenya as long as fiscal consolidation lasts for 3 years. For Botswana, on average a 6-year period of fiscal policy consolidation postponement does not preclude future sustainability instead they provide fiscal policy consolidation that lasts for 1 year on average. For Burkina Faso, a 1-year fiscal policy consolidation delay does not affect future sustainability as long as fiscal consolidation takes 1 year. For Equatorial Guinea, on average 29-year period of fiscal policy delay does not preclude future sustainability as long as fiscal policy consolidation takes about 4 years. In Nigeria, a 2-year period of fiscal policy postponement does not preclude future sustainability as long as fiscal consolidation takes 4 years on average. For Cape Verde, on average a 4-year period of fiscal policy consolidation delays cannot preclude future fiscal policy consolidation, provided that a fiscal policy lasts for 3 years. We find that the introduction of fiscal rules in our Markov-switching specification improves our results significantly. As such, some countries have both regimes to be sustainable. In the case of unsustainable or a weakly sustainable regime fiscal policy rules plays a significant role to enhance primary balance response to increase in public debt.

Our results have important policy implications in fiscal and debt sustainability. In this regard, there is need for immediate fiscal reforms to ensure that observed deficits do not translate into explosive public debts leading to a further call for debt reliefs. Fiscal policy reforms geared tax revenue enhance the effectiveness of fiscal policy response to increased public debt. This should be pursued by SSA countries as it enhances their ability to respond to rising public debt. Further, spending should be undertaken in sectors that have long-term returns to guarantee future revenue in an environment of limited fiscal revenue. Continued fiscal policy reforms should be undertaken. In particular, our findings support the view that adoption of fiscal rules actually made SSA countries fiscal policy more sustainable. The steps taken by SSA countries to adopt fiscal rules that have been subsequently revised for years now is important for fiscal

management going forward. These rules offer specified timelines and fiscal targets for which the SSA countries must achieve to instil public finance discipline. Therefore, policy reforms to strengthen fiscal rules can help enhance the efficacy of fiscal instruments. As noted earlier, well monitored fiscal rules can support compliance with fiscal rules and efficiency of rules in response to fiscal unsustainability. However, some countries' fiscal targets are quite ambitious given the history of SSA economies. In view of the current fiscal policy and political environment in SSA, it is hard to structure a sound fiscal consolidation to enhance both development and public debt reduction, that could be actualised quickly and successfully. The various fiscal policy changes and improved political environment in SSA, will help these countries to grow out of debt and modernise: the tax system, create productive and competitive sectors to enhance revenue.

Appendix A5.0: Unit root test results

Table A5. 1 Unit root tests for Kenya

	Revenue		Expenditure		Deficits		Debt	
	TS	CV	TS	CV	TS	CV	TS	CV
Cst								
ADF	-2.682	-2.978	-0.942	-2.975	-1.900	-2.975	-2.232	-2.972
ADF & FD	-4.687	-2.978**	-8.923	-2.975**	-3.867	-2.978**	-3.711	-2.975**
Cst & TT								
ADF	-3.471	-3.564	-1.330	-3.564	-1.785	-3.564	-2.140	-4.288
ADF & FD	-4.588	-3.568**	-8.190	-3.564**	-3.862	-3.563**	-3.660	-3.564**
Cst								
PP	-3.487	-3.675	-3.086	-3.675	-2.010	-2.969	-2.333	-2.969
PP & FD	-5.083	-2.972**	-6.775	-2.972**	-3.504	-2.972**	-5.572	-2.972**
Cst & TT								
PP	-3.643	-3.556	-3.090	-3.556	-1.939	-3.556	-2.191	-3.556
PP & FD	-5.143	-3.560**	-7.428	-3.560**	-3.456	-3.216**	-5.559	-3.560**

Source: Author's estimates

Notes: ADF is the Augmented Dickey-Fuller test, PP is the Phillips Perron, FD is the First Difference: TS are the Test Statistics, CVs are Critical Values. The unit roots are performed assuming the presence of either a Constant (Cst) or a Constant and Time Trend (TT) in the series. The number of lags used are the proper lag lengths based on various lag length selection criterions. Unless otherwise stated all variables become stationary base on 5 percent level of significance. A * denotes stronger rejection at 1 percent.

Table A5. 2 Unit root tests for Nigeria

	Revenue		Expenditure		Deficits		Debt	
	TS	CV	TS	CV	TS	CV	TS	CV
Cst								
ADF	-2.201	-2.972	-2.180	-2.972	-2.919	-2.678***	-1.512	-2.972
ADF & FD	-6.127	-2.975**	-4.587	-2.975**	-5.711	-2.975**	-4.580	-2.975**
Cst & TT								
ADF	-2.440	-3.560	-3.083	-3.560	-3.135	-3.560	-2.784	-3.560
ADF & FD	-6.234	-3.564**	-4.531	-3.564**	-5.704	-3.564**	-4.728	-3.564**
Cst								
PP	-2.858	-2.969	-2.594	-2.969	-4.085	-2.969**	-1.414	-2.969
PP & FD	-7.120	-2.972**	-7.185	-3.682**	-11.385	-2.972**	-4.914	-2.972**
Cst & TT								
PP	-2.989	-3.556	-3.516	-3.556	-4.634	-3.556**	-2.474	-3.556
PP & FD	-7.137	-3.560**	-7.089	-3.560**	-11.605	-3.560**	-4.986	-3.560**

Source: Author's estimates

Notes: See Table A5.1.

Table A5. 3 Unit root tests for Botswana

	Revenue		Expenditure		Deficits		Debt	
	TS	CV	TS	CV	TS	CV	TS	CV
Cst								
ADF	-1.618	-2.972	-2.703	-2.975	-2.984	-2.972**	-1.727	-2.972
ADF & FD	-5.100	-2.975**	-4.422	-2.978**	-5.708	-2.975**	-3.768	-2.975**
Cst & TT								
ADF	-3.298	-3.560	-2.547	-3.564	-4.553	-3.566**	-2.448	-3.560
ADF & FD	-5.265	-3.564**	-4.516	-3.568**	-5.574	-3.564**	-3.670	-3.564**
Cst								
PP	-1.916	-2.969	-2.953	-2.969	-2.582	-2.969	-1.752	-2.969
PP & FD	-6.419	-2.972**	-4.298	-2.972**	-5.306	-2.972**	-5.411	-2.972**
Cst & TT								
PP	-3.390	-3.556	-2.852	-3.556	-3.354	-3.214**	-2.431	-3.556
PP & FD	-6.503	-3.560**	-4.250	-3.560**	-5.247	-3.560**	-5.348	-3.560**

Source: Author's estimates
Notes: See Table A5.1.

Table A5. 4 Unit root tests for Equatorial Guinea

	Revenue		Expenditure		Deficits		Debt	
	TS	CV	TS	CV	TS	CV	TS	CV
Cst								
ADF	-2.545	-2.975	-2.001	-2.975	-1.994	-2.975	-1.700	-2.972
ADF & FD	-3.549	-2.978**	-3.385	-2.978**	-3.494	-2.978**	-4.717	-2.975**
Cst & TT								
ADF	-2.771	-3.564	-2.615	-3.564	-2.571	-3.564	-1.647	-3.560
ADF & FD	-3.488	-3.221**	-3.328	-3.221**	-3.435	-3.221***	-5.022	-3.564**
Cst								
PP	-2.918	-2.969	-2.671	-2.969	-2.782	-2.969	-1.029	-2.969
PP & FD	-5.393	-2.972**	-9.393	-2.972**	-9.642	-2.972**	-5.721	-2.972**
Cst & TT								
PP	-3.049	-3.556	-3.428	-3.556	-3.552	-3.556	-2.365	-3.556
PP & FD	-5.280	-3.560**	-9.257	-3.560**	-9.503	-3.560**	-5.760	-3.560**

Source: Author's estimates
Notes: See Table A5.1.

Table A5. 5 Unit root tests for Burkina Faso

	Revenue		Expenditure		Deficits		Debt	
	TS	CV	TS	CV	TS	CV	TS	CV
Cst								
ADF	-2.836	-2.975	-0.905	-2.980	-6.784	-2.975**	-2.031	-2.972
ADF & FD	-6.751	-2.978**	-3.710	-2.983**	-10.289	-2.978**	-4.237	-2.975**
Cst & TT								
ADF	-3.909	-4.306	-3.547	-3.572	-6.680	-3.564**	-1.943	-3.560
ADF & FD	-6.642	-3.568**	-3.341	-3.226**	-10.142	-3.568**	-4.270	-3.564**
Cst								
PP	-4.182	-2.972	-2.067	-2.972	-6.899	-2.975**	-2.100	-2.969
PP & FD	-9.685	-2.975**	-8.724	-2.975**	-14.301	-2.978**	-5.699	-2.972**
Cst & TT								
PP	-6.001	-3.560	-3.913	-4.288	-6.795	-3.564**	-1.971	-3.556
PP & FD	-9.527	-3.564**	-8.589	-3.564**	-14.195	-3.563**	-5.708	-3.560**

Source: Author's estimates
Notes: See Table A5.1.

Table A5. 6 Unit root tests for Cape Verde

	Revenue		Expenditure		Deficits		Debt	
	TS	CV	TS	CV	TS	CV	TS	CV
Cst								
ADF	-3.086	-3.689	-2.933	-2.980	-3.453	-2.978**	-0.506	-2.975
ADF & FD	-3.131	-2.980**	-3.503	-2.980**	-5.741	-2.980**	-3.199	-2.978**
Cst & TT								
ADF	-2.615	-3.564	-3.343	-3.572	-3.372	-3.221***	-1.739	-3.564
ADF & FD	-5.251	-3.568**	-3.391	-3.223**	-5.579	-3.572**	-3.367	-3.221***
Cst								
PP	-3.076	-3.689	-3.091	-3.689	-3.453	-2.975**	-0.591	-2.972
PP & FD	-4.911	-2.978**	-5.800	-2.978**	-7.025	-2.978**	-4.639	-2.975**
Cst & TT								
PP	-2.629	-3.564	-2.937	-3.564	-3.436	-3.564**	-1.512	-3.560
PP & FD	-5.260	-3.568**	-5.982	-3.568**	-6.933	-3.568**	-4.697	-3.564**

Source: Author's estimates
Notes: See Table A5.1.

Appendix B5.1: Debt sustainability framework

The concept of debt sustainability starts with the government financing constrain which relates the primary deficit plus nominal debt servicing to changes in outstanding debt. The following dynamic equation helps to relate the stock of debt in period t, last periods debt plus debt service and primary balance.

$$B_t = (1+r)B_{t-1} - S_t \qquad B5.1$$

Where B_t is the outstanding debt at the end of period t and r equals the ex-post return on government debt which is assumed to be constant. Government financing as represented with equation above describes the time path of stock of debt. We can also infer from the above equation that: if the government runs a primary surplus/balance equal to zero then the stock of debt will grow at a rate equal to interest rate. Iterating the Equation B1.1 forward n periods and summing up we get the following

$$B_{t-1} = \sum_{j=0}^{n} \frac{R_{t+j}}{(1+r)^{J+1}} - \sum_{j=0}^{n} \frac{G_{t+j}}{(1+r)^{j+1}} + \frac{B_{n+1}}{(1+r)^{n+1}} \qquad B5.2$$

Where G is government expenditures excluding interest payments and R is government tax revenues. When the last term in A1.2 approaches zero as the number of periods increases then the No-Ponzi Game constraint will be satisfied, that is

$$\lim_{n \to \infty} \frac{B_{n+1}}{(1+r)^{n+1}} = 0 \qquad B5.3$$

Equation B1.3 of the NPG states that the present value of government debt in the indefinite future converges to zero. For this condition to be met, then debt B in the numerator must grow more slowly than the rate of interest r. Therefore, government cannot finance the interest payments on debt by continuously issuing new debt. If the condition is met, then Eq. B1.2 reduces to

$$B_{t-1} = \sum_{j=0}^{n} \frac{R_{t+j}}{(1+r)^{J+1}} - \sum_{j=0}^{n} \frac{G_{t+j}}{(1+r)^{j+1}} + \frac{B_{n+1}}{(1+r)^{n+1}} \qquad B5.4$$

Thus, if we assume that debt is growing over time at a constant rate y of which we can have $B_{t+j} = (1+\delta)B_{t+j-1}$, for all j, it follows that Eq. B1.3 is equal to:

$$\lim_{n \to \infty} \left(\frac{1+y}{1+r}\right) B_0 = 0 \qquad B5.5$$

Thus, for Eq. B1.5 to converge to zero then y should be less than r, that is, the growth rate of debt should be less than the real interest rates in the economy. Furthermore, the literature helps to relate the PVC to the accounting approach by assessing fiscal sustainability with a focus on debt ratios to GDP. Theoretically, the current GDP (Y_t) is equal to the previous GDP (Y_{t-1}) plus GDP times the growth rate (g) as follows:

$$Y_t = (1+g)Y_{t-1} \qquad B5.6$$

Therefore, by expressing Eq. B1.1 as a ratio of GDP we get the following:

$$b_t = \left(\frac{1+r}{1+g}\right) b_{t-1} \; - \; s_t \qquad B5.7$$

Where the small letters refer to the ratio of GDP, rearranging Eq. B1.7 and solving for s we get the following:

$$s_t = \left(\frac{1+r}{1+g}\right) b_{t-1} \; - \; b_t \qquad B5.8$$

Therefore, if debt is stable, then it will not grow overtime, thus

$$b_{t-1} = b_t \qquad B5.9$$

Plugging Eq. B1.9 in B1.8 and solving we get the following:

$$s_t = \left(\frac{r \; - \; g}{1+g}\right) b_{t-1} \qquad B5.10$$

We can therefore deduce that debt depends on the spread between the real interest rates and GDP growth rates. If $g > r$, then public debt stabilizes even with a budget deficit. If $g = r$, public debt stabilizes because the budget is balanced and $r > g$, debt will keep on growing over time even during periods of budget surplus.

Appendix C5.1: Stationarity and cointegration framework

The stationarity or non-stationarity of the data series is established by applying both the Phillips-Perron (PP) and the Augmented Dickey-Fuller (ADF) unit root tests. We estimate the following regressions:

$$\Delta X_t = \beta_1 + \beta_2 X_{t-1} + \sum_{i=1}^{k} \delta_i \, \Delta X_{t-i} + \varepsilon_t \qquad C5.1$$

Where Δ is the first difference operator, (X_t) represents government revenue, expenditure, public debt and deficit respectively. δ_i, β_i are constant parameters and ε_t is the stationary stochastic process. The number of lags is determined based on various specifications for both the ADF and PP. To establish the order of integration, C5.1 is modified to include the second differences on lagged first and *k* lags of second difference given as:

$$\Delta^2 X_t = \lambda_1 \Delta X_{t-1} + \sum_{i=1}^{k} \mu_i \, \Delta^2 X_{t-i} + \varepsilon_{1t} \qquad C5.2$$

Where $\Delta^2 X_t = \Delta X_t \; - \; \Delta X_{t-1}$, λ and μ are constant parameters while ε_{1t} is a stationary stochastic process.

C5.2: Johansen Cointegration tests

Our cointegration tests are based on Maximum Likelihood that proposes two distinct tests for determining the likelihood ratios, including the trace statistics and the maximum eigenvalue statistics. The trace statistics helps to determine *r* cointegrating vectors null hypothesis with a substitute *n* cointegrating vectors hypothesis. If the value of *r* is 0, we can conclude that there

is no long-run relationship between the non-stationary variables, thus, no cointegration. The maximum eigenvalue test determines r cointegrating vectors null hypothesis alongside alternative hypothesis of r+1 cointegrating vectors. The Johansen tests begins with a Vector autoregressive (VAR) of order p given as:

$$x_t = \mu + A_1 x_{t-1} + \ldots\ldots\ldots + A_p x_{t-p} + \varepsilon_t \qquad C5.3$$

Where x_t represents an $(n \times 1)$ integrated variables vector generally represented as I(1) while ε_t represents an $(n \times 1)$ innovation vector. There are two likelihood tests and they include the trace statistics and maximum eigenvalue statistics given as follows:

$$J_{trace} = -S \sum_{t-r+1}^{n} ln(1 - \hat{\beta}) \qquad C5.4$$

$$J_{max} = -Sln(1 - \beta_{r+1}) \qquad C5.5$$

S is used to determine the sample size, shows the biggest correlation. The Johansen model is advantageous as it can be used in estimation of several cointegrating relationships.

Appendix: Description and Measurement of Variables

Table A5. 7 Description and Measurement of variables

Variable	Description	Source
Public debt	The ratio of total debt which includes domestic and foreign debt as a ratio of GDP. Debt levels put a constraint on the countries development as they endeavour to meet their debt obligations. Further, we expect a priori increase in lagged debt to respond positively with primary balance.	IMF/WEO & WDI
Primary balance	Is the governments net borrowing excluding interest payments and is calculated as $s_t = Revenue_t - Spending_t$ $(less\ r_t)$.	IMF/WEO
Output gap	Is calculated as $\frac{(GDP_{actual} - GDP_{potential})}{GDP_{potential}}$. We use a standard HP filtered output gap measure taking the cyclical component of log of real GDP over the entire sample.	IMF & Authors calculations.
Expenditure gap	Is the cyclical component of public spending and we use the HP filter and choose our smoothing parameter $\lambda = 100$. It is calculated as $\frac{(Exp_{actual} - Exp_{potential})}{Exp_{potential}}$	IMF and Authors calculations
Real interest rates	Is the lending interest rate adjusted for inflation as measured by the GDP deflator. Where possible it is taken as a proxy for interest payment on public debt	WB & WDI
Fiscal rules	Is a dummy variable, with 1 when a fiscal rule in place and 0 otherwise.	IMF database
Fiscal Rules Index (FRI)[1]	Index between 0 and 1 of the fiscal rule characteristics. We construct the FRI's using the characteristics as outlined in the FR's database.	IMF & authors construction

Note: IMF – International Monetary Fund, WB – World Bank, WEO – World Economic Outlook, WDI - World Development Indicators. [1]We follow Foremny 2014 to construct our FRI.

Table A5. 8 Summary of Empirical studies on fiscal and debt sustainability

Author(s), Year	Case study	Study period	Model(s) or Estimation strategy	Variables included	Key findings
Aldama et al. (2018)	USA	1940-2016	Bohn's tests & Markov switching	**Dependent:** Primary balance to GDP ratio **Independent:** Public debt, output gap, expenditure gap	Bohn's tests: No positive feedback of public debt on primary balance. Markov-switching: positive feedback of public debt on primary balance in sustainable regime.
Irungu et al. (2019)	Kenya	1963-2014	Markov-switching	**Dependent:** fiscal balance to GDP ratio **Independent:** public debt, output gap, expenditure gap & real interest rates	Positive feedback of public debt on primary balance in sustainable regime.
Baharumshah (2017)[1]	Malaysia	1980-2014	Markov-switching intercept autoregressive heteroskedasticity error correction model (MSIAH-ECM)	Dependent: Primary balance to GDP ratio Independent: public debt (total debt, domestic debt & external debt), government revenue and expenditure	The fiscal deficits path is sustainable except for Asian financial crisis and global financial crisis periods.
Ko et al. (2015)	Japan	1970-2011	Markov-switching VAR (MSVAR)	**Dependent:** primary balance to GDP ratio, discount factor & public debt.	Regime switch occurred in 1990s, Ricardian was adopted in first regime and no feedback effect of debt on primary balance in second regime. Domar growth strategy is adopted and reduces debt.
Doi et al. (2011)	Japan	1980-2010	Markov-switching	**Dependent:** primary balance to GDP ratio/tax revenue/average overnight call rate **Independent**: public debt, output gap, expenditure gap, deviation of real effective exchange rate & inflation rate	Primary balance does not positively respond to rising debt, thus, debt is explosive. They find active fiscal policy (tax revenue does not rise with increase in debt), monetary policy is passive (interest rates do not respond to a rise in inflation), therefore, debt is not sustainable.
Kia (2007)	Iran & Turkey	1970-2003 1967-2001	Cointegration tests Bohn's tests	**Dependent**: primary balance to GDP ratio **Independent**: public debt, output gap, expenditure gap, energy revenue to GDP ratio.	Fiscal budgets in both Iran & Turkey is not sustainable.
Neaime (2015)	Euro area	1977-2013	Unit root tests & Cointegration tests	Variables: Output, revenue, expenditure, debt, deficit, primary balance.	Under cointegration tests: sustainable fiscal policy in Germany & France, while in Ireland, Spain, Italy & Portugal they were sustainable in 1970s and 80s. Greece has unsustainable fiscal policy. Unit root tests: France, Italy, Greece, Ireland, Portugal & Spain unsustainable while Germany is sustainable fiscal policy.

Neaime (2010)	MENA	1960-2009	Unit root tests & Cointegration tests	**Variables:** budget deficit, government revenue, expenditure, public debt.	Strong sustainability of fiscal policies in Tunisia & weak sustainability in Egypt. Jordan & Turkey have unsustainable fiscal & debt while Morocco the results are mixed.
De Mello (2011)[1]	Brazil	1995-2004	Bohn's tests & Cointegration tests	**Dependent:** Primary balance to GDP ratio **Independent:** public debt, output gap, government revenue, expenditure & inflation.	Debt is found to be sustainable as primary balance positively responds to increase in public debt.
Bohn (1998)	US	1916-1995	Bohn's tests	**Dependent:** Primary balance to GDP ratio **Independent**: public debt, output gap & expenditure gap.	Debt is sustainable as primary balance is found to be an increasing function of public debt.
Elton Beqiraj (2018)	OECD	1991-2015	ECM Panel Cointegration	**Dependent:** cyclically adjusted primary balance to GDP ratio **Independent**: public debt, debt to potential GDP, output gap & expenditure gap	There is a long-run relationship between public debt and structural primary balance which is negative, and the governments are not supporting actions to counteract public debt
Bravo Santos et al. (2001)	Euro area	1960-2000	Cointegration tests	**Variables:** Government revenue & expenditure	Fiscal sustainability in Austria, France, Germany, Netherlands and the UK. Belgium, Denmark, Ireland, Portugal, Italy & Finland have unsustainable debt.
Brady et al. (2017)	Italy	1862-2013	Unit root tests, Cointegration tests & Markov switching	**Variables:** Public debt and deficits.	Moderate debt & deficit in regime 1 and high public debt & deficit in regime 2. The results are persistent and that the sustainable state will persist for 30 years while unsustainable lasts 66 years.
Burger et al. (2012)	South Africa	1974-2008	Bohn's tests, TAR, State space & VECM	**Dependent:** primary balance **Independent**: public debt, output gap & expenditure gap	Fiscal policy has been sustainable during the sample period by primary balance reacting positively to increase in public debt.
Gabriel et al. (2010)[1]	Selected countries[2]	1975-2004	Markov-switching Cointegration model	**Variables:** Government revenue and expenditure	Fiscal policy has been sustainable during stable regimes as primary balance responds positively.

Source: Authors compilation

Notes: Abbreviations: MENA – Middle East & North Africa, OECD – Organisation for Economic Co-operation and Development, ECM – Error Correction Model, VAR – Vector Auto Regressive, VECM – Vector Error Correction Model and TAR – Threshold Auto Regressive Model. [1]Use quarterly dataset. [2]Selected countries include: South Africa, Bahamas, Finland, France, Thailand & US.