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**PUBLIC DEBT SUSTAINABILITY IN THE WEST AFRICAN
MONETARY ZONE¹**

WAMI OCCASIONAL PAPER SERIES NO. 17

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¹ This paper is dedicated to Mr. Ismaila Jarju of blessed memory. He was the Director of Research and Statistics Department, West African Monetary Institute (WAMI). The views expressed in this paper are those of the authors and do not reflect the official position of WAMI.

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PUBLIC DEBT SUSTAINABILITY IN THE WEST AFRICAN MONETARY ZONE

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Abstract

WAMZ countries have accumulated high levels of public debt less than two decades after the massive debt forgiveness effected under the Highly Indebted Poor Countries (HIPC) initiative. This has raised sustainability concerns as rising debt levels have the potential to create negative spillover effects and derail the macroeconomic convergence process in the Zone. This study examines the response of WAMZ countries to increases in public debt levels. Utilizing pooled OLS and panel fixed effects (FE) on annual data covering the period 2000 – 2018, the study shows positive response of primary balance to changes in the debt to output ratio across WAMZ countries, indicating that public debt were sustainable during the period. Results from the Panel Smooth Transition Regression (PSTR) model indicate significant positive non-linear response of primary balance to increases in the debt ratio below a threshold debt-to-GDP ratio of 90 percent. The study recommends the continuation of fiscal consolidation efforts aimed at enhancing revenue and rationalizing unproductive expenditures in all Member States.

Keywords: Public debt, primary balance, Panel Smooth Transition Regression, WAMZ.

JEL Classification: C33, H62, H63

1.0 INTRODUCTION

Less than two decades after the massive debt relief/forgiveness to African countries under the Highly Indebted Poor Countries (HIPC) and the Multilateral Debt Relief Initiative (MDRI) programmes, Africa's debt has been on the rise again, with median debt ratio increasing from 31 percent of GDP in 2012 to 53 percent in 2017 (Coulibaly et al., 2019). Owing to this, about one-third of the countries in sub-Saharan Africa are either in or at high risk of debt distress, including the majority of countries that benefitted from the HIPC and MDRI initiatives. Most notable factors that contributed to the rising debts were the global financial crisis in 2007/2008 and the terms of trade shocks in 2014, with associated fiscal challenges and deterioration in economic activity, which culminated in the buildup of debts in most sub-Saharan African countries (Coulibaly et al., 2019). While countries in the West African Monetary Zone (WAMZ)² had achieved substantial reductions in debt burdens and improved growth performance in the wake of the HIPC initiative, most countries in recent years seem to be reverting to the unfavourable conditions prior to the HIPC initiative.

A look at the public debt profile of member countries in the WAMZ raises concern about the upward trend of debt and the associated rising fiscal burden from the mounting debt service payments. There are compositional differences in debt across countries, which are of critical importance to policymakers due to the debt servicing implications for the Zone. While The Gambia, for instance, had the highest ratio of public debt to GDP in 2018 (84.1 percent), its share of external debt represented 54.5 percent of total debt stock, compared to Liberia (70.9 percent) and Sierra Leone (73.0 percent). Similarly, debt service

obligations impose severe upward pressures on the fiscal balances of the two largest economies of the WAMZ (Nigeria and Ghana), with Nigeria channeling approximately half of its revenue to external debt service, while debt service in Ghana is around 40 percent of revenue (AfDB, 2019).

Indeed, the threat posed by unsustainable public debt to the regional integration agenda cannot be overemphasized, its potential to create negative spillover effects and derail the macroeconomic convergence process in the Zone is real. For countries in a monetary union, the issue of rising public debt is enough source of concern and there are strong arguments for national governments to respond to rising public debt by taking measures that would stabilize the debt to GDP ratio around a sustainable threshold. Ekpo (2012) has indicated that for economic integration and eventual monetary union to be sustainable, countries in ECOWAS must ensure fiscal prudence in the management of their economies. The primary insight into this view is that countries with unsustainable debt trajectory creates negative spillover effect on the rest of the monetary union. Among other channels, a country with rising debt to GDP ratio would resort continually to access the capital market of the union, pushing upward pressure on the union interest rates. This in turn, would increase government debt burden of other member countries, which can elicit restrictive fiscal policies across the monetary union. Equally, the upward movement in the union interest rate could lead to undue intervention in the conduct of monetary policy as the monetary authority may be constrained to relax the stance of monetary policy even when other key indicators do

² Member countries of the West African Monetary Zone are The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone.

suggest against such a stance. Thus, the impact of such action could be far reaching.

The foregoing concerns have heightened interest of policymakers in debt sustainability in the WAMZ, trying to understand whether national governments in the Zone react to the accumulation of public debts. Do these governments take corrective measures to preserve debt sustainability? A number of studies have assessed the sustainability of public debt in African economies, with some scholars using the debt-stabilizing primary balance approach to determine the primary balance that would keep the debt-to-GDP ratio at its current level (e.g. Ncube and Brixiova, 2014). Equally, in the WAMZ, a few studies have utilized the fiscal reaction function developed by Bohn (1998) to assess the sustainability of public debt, based on the response of primary balance to changes in the debt-to-GDP ratio (e.g. Adeyemi, 2018; Amankwah et al., 2018; Nana, 2015). In estimating this function using linear estimation techniques, these studies have implicitly assumed that the primary balance will increase continuously in response to rising debt levels. However, a growing body of research has shown that the response of primary balance to increasing debt could vary at different levels of debt in each country (e.g. Adams et al., 2010; Ghosh et al., 2013; Ostry et al., 2010; Sarangi and El-Ahmadieh, 2017). This raises the possibility of the existence of non-linearities in the response of primary fiscal balance to the debt ratio. One potential explanation for the existence of non-linearities is that the intensity of fiscal policy adjustments varies with the level of debt in a country (Sarangi and El-Ahmadieh, 2017). Surprisingly, despite the growing literature on public debt sustainability, only a few studies have explored nonlinearities in examining the primary balance-public debt relationship in developing economies.

This paper seeks to analyse the sustainability of public debt levels in the WAMZ. It provides useful insights into the debate on debt sustainability in the Zone in two significant ways. First, this paper investigates the possible existence of non-linearities in the primary balance – public debt relationship. In doing so, it determines whether there exists a debt threshold beyond which Member States would not be able to achieve sufficient primary balance to respond to increasing debt levels due to fiscal fatigue. Second, this paper accommodates the heterogeneous composition of debt across countries, by allowing for the smooth variation in the response of primary balance to rising public debt levels, using a panel smooth transition regression (PSTR) approach.

To explore the relationship, this paper also uses the pooled ordinary least squares (OLS) and panel fixed effects (FE) model on annual data covering the period 2000 – 2018. It finds positive response of primary balance to changes in the debt-to-GDP ratio across the WAMZ countries, indicating that public debt were sustainable during the period. Allowing for non-linearities in the estimation, this paper shows a non-linear response of primary fiscal balance to increases in the debt-to-GDP ratio, suggesting that the response of primary balance to public debt varies at different levels of debt. The study establishes a threshold of public debt of 90 percent of GDP for Member States in the WAMZ, beyond which, countries are at risk of slipping into a fiscal ‘fatigue’ position. This implies that countries are at risk of sovereign default when debt ratio exceeds the threshold of 90 percent of GDP. Below the debt threshold, however, countries would be able to preserve debt sustainability, as adjustments are undertaken to ensure fiscal prudence.

This study is organized in five sections. Following this introduction, section two looks at public debt dynamics in WAMZ

countries and section three conducts a review of related literature. Section four presents the model, data and estimation results and

section five concludes with some policy implications.

2.0 PUBLIC DEBT DYNAMICS IN THE WAMZ

Debt levels have been increasing significantly in the WAMZ region in recent years, which has received the attention of policymakers and development partners. Equally, this has heightened interest on debt sustainability issues in the region. While the level of indebtedness of countries in the region has not reached the pre-debt relief initiative periods, there are growing concerns about potential diversion of much needed resources to servicing debt obligations. The following subsections look at the debt-dynamics in the countries of the Zone.

2.1 The Gambia

The total debt stock of The Gambia rose to US\$921.3 million (86.0 percent of GDP³) in 2006, from US\$712.3 million (88.0 percent of GDP) in 2003. Even though, its debt service to exports moderated to 13.4 percent in 2007, from 21.0 percent in 2004, the debt burden was evident, but the country successfully reached the Heavily Indebted Poor Countries (HIPC) and Multilateral Debt Relief (MDRI) initiatives completion point in 2007. This culminated in a huge reduction in the country's public debt, with the debt stock standing at US\$537.0 million (38.2 percent of GDP) in 2007, and the debt service to exports fell to 5.4 percent the following year. However, the country's debt continued to increase after the debt relief owing to fiscal slippages and increased guarantees from state enterprises (MOFEA-The Gambia, 2019). As at 2018, The Gambia's total debt stock outstanding amounted to US\$1.3 billion while its debt to GDP ratio stood at 83.2 percent.

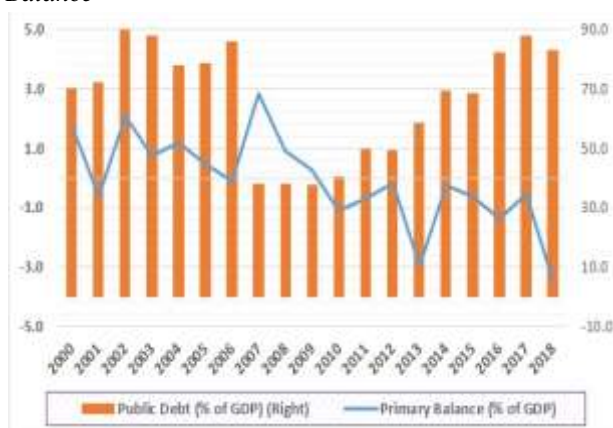
The external debt stock increased by 13.0 percent to reach USD 725.3 Million in 2018. It constituted about 55 percent of the total public debt stock. Domestic debt stock stood at US\$ 606.4 million with a share of 45 percent of the total public debt. The domestic debt comprised marketable and non-marketable instruments; commercial banks held 52.1 percent of the outstanding domestic debt stock, followed by the Central Bank of the Gambia which held 32.2 percent in 2018 (MOFEA-The Gambia, 2019). Interest rate risk was, however, moderate for the public debt portfolio as fixed interest rated debts are a significant proportion of the external debt. The variable rated debt in the external debt portfolio is insignificant and only 11.2 percent of it would need re-fixing in 2019. It is important to mention that about 54 percent of the total debt portfolio is exposed to foreign exchange risk especially the USD (MOFEA-The Gambia, 2019).

The country has the highest debt to GDP ratio among the WAMZ economies with the ratio growing higher than the ECOWAS macroeconomic convergence criteria threshold of 70 percent and debt raising sustainability concerns and posing significant challenges to the Gambia's economy. The IMF debt sustainability analysis indicated that the country is in external debt distress, with debt service absorbing more than half of domestic revenue.

³The Gambia rebased its national accounts from 2004 to 2013 base year, which yielded an upward revision of the GDP, resulting in changes in the debt to GDP and debt service to export ratios.

Gambia's primary balance registered the highest surplus of 2.9 percent in 2007 owing largely to the debt write-off in line with the debt relief initiatives, which served to ease fiscal pressures. Even though the country recorded primary surpluses of 0.9 percent and 0.3 percent in 2008 and 2009 respectively, it was negative between 2010 and 2018, averaging 1.2 percent during the period.

The Gambia: Evolution of Public Debt and Primary Balance



2.2 Ghana

The debt to GDP ratio in Ghana rose slightly from 69.3 percent in 2017 to 71.7 percent in 2018, mainly driven by the bailout and orderly exit of some banks and a depreciated exchange rate. The figures, however, improved upon a rebasing of the country's GDP by the statistical bureau in 2018, which shot-down the debt to GDP to 57.9 percent in 2018 (MOFEP-Ghana, 2019).

The country's external debt declined from US\$4,035.1 million (14.1 percent of GDP) in 2006 to US\$2,172.9 million (10.7 percent of GDP) as at end- December 2006 as a result of the HIPC initiative. Since then, the level of total external debt has been rising steadily until it reached US\$15,781.9 million (44.7 percent of GDP) in 2014. At the end of December 2017, the country's total external debt stood at US\$17,160.4 million representing 36 percent of GDP. The outstanding external debt stock of Ghana increased to US\$17,868.5 million, at end-December 2018. The increment largely resulted from US\$750 million Eurobond issued in 2018 with a long term maturity of 30 years and some disbursements. External

loans in USD commanded 67.2 percent of the loan stock during the period, which makes the appreciation of the USD a burden for debt service (MOFEP, Ghana, 2019). Commercial debt accounted for 50.6 percent of the external debt portfolio in 2018, a significant amount of which was on Eurobonds⁴ and Export Credit Agencies. Multilateral and bilateral debt represented about 35.8 percent and 13.7 percent, respectively. External debt service paid by government in 2018 amounted to US\$2,493.8 million, as opposed to an outstanding amount of US\$1,679.3 million in 2017. Principal payments dominated the servicing of debt by 68.7 percent in 2018(MOFEP, Ghana, 2019).

⁴ Ghana for the first time in 2017 issued a 10 year bond which was retired in 2017. As of end-December 2018, the outstanding balance

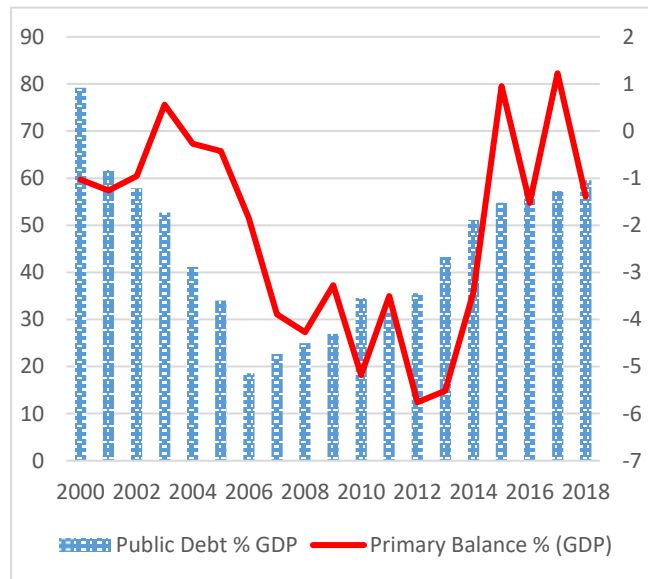
of Eurobonds reduced from US\$5,750.0 million to US\$4,978.1 million as a result of government liability management.

The domestic debt component of the debt stock increased by 30.2 percent to GH¢86,899.7 million in 2018, of which 73.4 percent was in marketable securities, 26.5 non-marketable securities and 0.1 percent of domestic standard loans. Domestic debt to GDP has been on the increase since 2015 and stands at 29.1 percent as at end-December 2018. The banking sector, which include the Bank of Ghana, held a significant portion of domestic debt of 44.7 percent, followed by foreign investors of 30.1 percent in 2018 (MOFEP-Ghana, 2019).

Ghana has a mixed profile of debt sustainability. In the Pre-HIPC era the debt service ratios soared above the sustainability thresholds (15-20 percent of exports) (WBG, 2001)⁵. In 2001, for instance, the debt service to exports was 24.3 percent, whilst the debt service to revenue was 60.5 percent. With the help of HIPC, these ratios improved as they got whittled down to acceptable levels. The debt service ratio declined to 13.3 percent, whereas the debt service to revenue fell to 24.6 percent. Improvement became incremental thereafter, and for the past two decades the best performance in Ghana’s ability to repay its debt was in 2012, where the debt service to export and debt service to revenue were 7.2 percent and 14.2 percent, respectively (Quartey, 2017). Post HIPC, fast

forward 2018, the ratios worsened and debt service became burdensome, accounting for over 40.0 percent of government revenue (AfDB, 2019).

Meanwhile, the country recorded primary deficits in most years during the last decade, and averaged 1.5 percent of GDP between 2000 and 2008, but worsened to 2.7 percent in the last decade. The highest deficit was recorded in the electioneering year of 2012 at 5.8 percent, while a primary surplus of 1.2 percent of GDP in 2017 was the best performance during the review period.



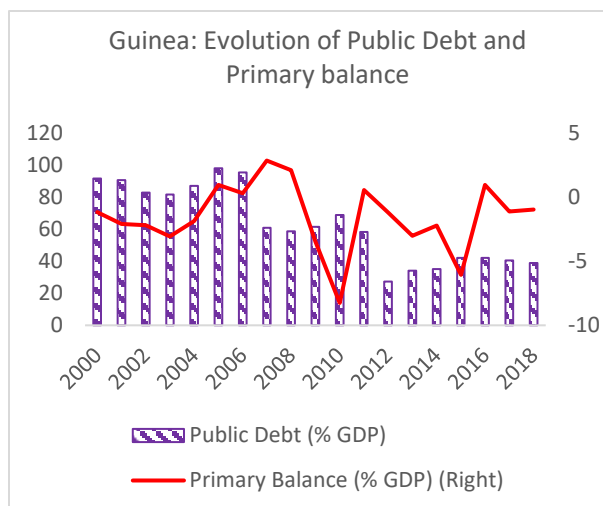
⁵ WBG sustainable thresholds under the enhanced HIPC Framework.

2.3 Guinea

Guinea's outstanding public debt rose above 90 percent of GDP in early 2000s and started to become a concern in terms of sustainability. The stock of public debt surged by 30.7 percent to GNF 6,140.7 billion in 1999, or 92.3 percent of GDP⁶, compared to 75.9 percent of GDP the preceding year. The upward trend continued the following years, as the country recorded several social and political crises, which transmitted to the real economic activity (low output, high inflation and exchange rate depreciation). Following the inauguration of a civil government in 2010, the country successfully reached the Heavily Indebted Poor Countries (HIPC) initiative completion point with the IMF in 2012, leading to a reduction in external debt by two-third (USD 2.1 billion). As a result, public debt dropped to GNF 14,029.0 billion (27.2 percent of GDP) in 2012, compared to GNF 26,239.2 billion (58.1 percent of GDP) in 2011. The stock of debt has remained within a sustainable level since 2012 (below 40 percent of GDP on average) given the country some space as compared to the 70 percent threshold of ECOWAS convergence criteria as well as the IMF debt burden thresholds and benchmarks, under the Debt Sustainability Framework (DSF), which ranged between 35 - 55 percent of GDP.

In terms of composition, external debt accounted for around 52 percent on average of total debt while domestic debt was 48 percent during the period 2010-2018. Most of the domestic debt was held by the Central Bank, following the securitization of claims to the Government by the Bank. Like many low-income countries, Guinea relies heavily on concessional debt, which represented 78.4 percent⁷ of total external debt on average

between 2000 and 2012, and 58.6 percent since the HIPC completion (2012-2018). Total debt service to exports ratio has significantly declined, from an average of 14.3 percent prior to HIPC to an average of 3.7 percent post HIPC.



Primary balance, on the other hand, was generally in deficit from 2000 to 2004, but turned surplus between 2005 and 2008. However, the fiscal position worsened during the political transition period (2009-2010) reaching a deficit of 8.3 percent of GDP in 2010, as the government engaged in public expenditures which were financed by only domestic resources as the country was suspended by multilateral agencies (World Bank and IMF). Despite some fiscal improvement in 2011, the country could not sustain it due to the outbreak of Ebola Virus Disease (2014-2015), which resulted in huge public expenditure and thus, higher fiscal deficit. Overall, fiscal performance remained a challenge as the country's primary balance stood at -1.6 percent on average between 2016-2018, indicating the need for fiscal reforms aiming at improving tax collection and giving priority to growth driven sectors in order to maintain the budget deficit and indebtedness at a reasonable level.

⁶ WEO (IMF) 2018

⁷ WDI (World Bank) 2019

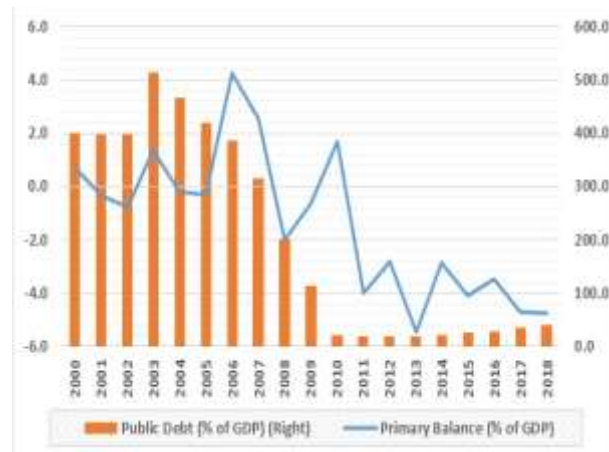
2.4 Liberia

In spite of the growth in the mining sector, real GDP growth for Liberia was revised downward to 1.2 percent from 2.5 percent in 2018. The sluggish growth performance of the economy affected the fiscal space of government creating a daunting task for government to pursue its development agenda: The Pro-poor Agenda for Prosperity and Development (PAPD).

Liberia's total debt stock stood at US\$3.68 billion (401.6 percent of GDP) in 2000. It surged to US\$4.1 billion (514.9 percent of GDP) and US\$4.6 billion (314.7 percent of GDP) in 2003 and 2008, respectively, on account of higher government outlays to finance post-war construction. This raised severe public debt sustainability concerns, and the country became eligible for debt relief under the Heavily Indebted Poor Countries (HIPC) initiative in 2008. Despite the challenging economic environment in the post-conflict era, the Government undertook critical reforms to reach the Completion Point under the HIPC Initiative. The government showed strong commitments in improving human security, supported by a stronger system of national integrity and justice, strengthened civil society engagement and establishment of the Liberia Anti-Corruption Commission. In 2010, the IMF and the World Bank declared Liberia eligible for debt relief, resulting in the cancellation of the country's debt amounting to \$4.6 billion in nominal terms. Consequently, the debt stock declined to US\$0.44 billion (21.8 percent of GDP) in 2010. However, the debt stock sharply increased to US\$1.32 billion (40.5 percent of GDP) in 2018, but remained within a sustainable threshold. The country's total debt service to export ratio declined significantly over time. Total debt service to export ratio reached an average of 117.0

percent during 2007 to 2008, but declined gradually between the period 2009 and 2017, averaging about 3.7 percent.

Liberia: Evolution of Public Debt and Primary Balance



Even though the country's debt stock has accelerated since 2010 due to higher spending on infrastructure and fiscal response due to some adverse shocks, the IMF debt sustainability analysis indicated that Liberia remains at moderate risk of debt distress. Like other low-income countries, the country relies on concessional borrowing to achieve its developmental agenda.

Liberia's primary balance was negative between 2001 and 2005, but improved significantly to a primary surplus of 4.3 percent of GDP in 2006. This was due to a number of fiscal reforms geared towards improving government revenues during the year. However, it has been in deficit since 2011, averaging 4.0 percent of GDP between 2011 and 2018. This was largely attributable to severe fiscal pressures owing to Government's attempt to meet its high spending need; meeting its developmental agenda and checking the 2014 Ebola epidemic. This came at the face of drop in international commodity prices and the withdrawal of United Nations Mission in Liberia (UNMIL) personnel from the country.

2.5 Nigeria

Nigeria witnessed a steady decline in debt to GDP ratio from 57.6 percent in 2000 to 7.3 percent 2008, which largely resulted from prudent debt management by the fiscal authorities as well as the debt cancellation. However, public debt to GDP ratio witnessed increases from 8.6 percent in 2009 to 28.4 percent in 2018.

Even though Nigeria's debt to GDP and other GDP based measures remained relatively low in the Zone, low revenue generation impacts negatively on liquidity based indicators. Revenue generation in Nigeria is at low levels, and debt service to revenue prior to the Paris Club Agreement averaged about 30 percent in 2001 to 2005 but declined significantly to about 10 percent between 2006 and 2010, after debt relief. Owing significant increases in public debt after 2010 and weak revenue mobilization, debt service to revenue rose to about 60 percent in 2018, which was well above the World Bank's threshold on debt service to revenue ratio of not more than 22.5 percent. This remained a constraint to the central government's fiscal space to spend on critical and priority sectors (BudgIT, 2019).

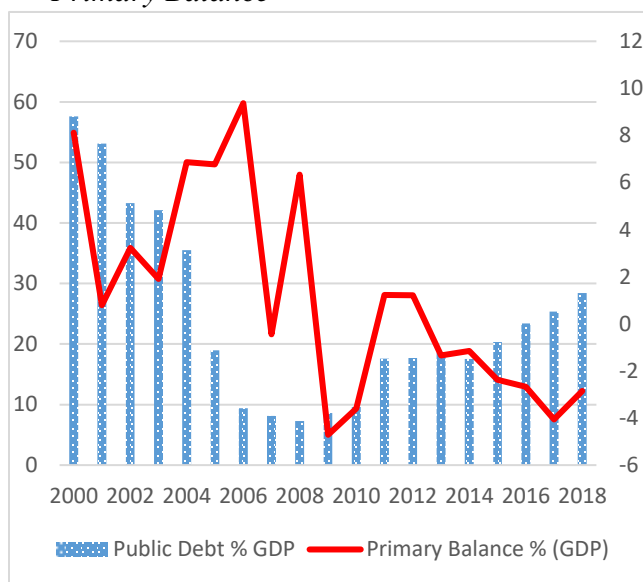
Nigerian's debt is burgeoned by rising domestic debt, even though it slightly receded to 10.0 percent of GDP at the end of 2018 from 11.0 percent recorded in the previous year. External debt rose marginally to 6.0 percent of GDP, from 5.0 percent in 2017.

Nigeria's primary balance was positive and averaged about 4.8 percent of GDP between 2000 and 2008. The country's best fiscal performance within that period was in 2006. It recorded a primary surplus of 9.4 percent, which was attributable to the debt relief that

served to reduce the amount of resources used to service public debt. The effects of global commodity price shocks beginning from 2014 impacted negatively on Nigeria's fiscal performance. The primary balance, although remaining in deficit, recorded a marginal improvement in 2018 to 2.9 percent of GDP, from 4.1 percent of GDP recorded in 2017.

In 2017, the Nigerian authorities initiated a medium term Economic Recovery and Growth Plan (ERGP) 2017-2020 on the backdrop of accelerating the pace of growth, strengthen economic diversification and social inclusion. The strategy's objective was to achieve macroeconomic stability and boost investment in social infrastructure through fiscal incentives (Diallo & Mendy, 2018).

Nigeria: Evolution of Public Debt and Primary Balance

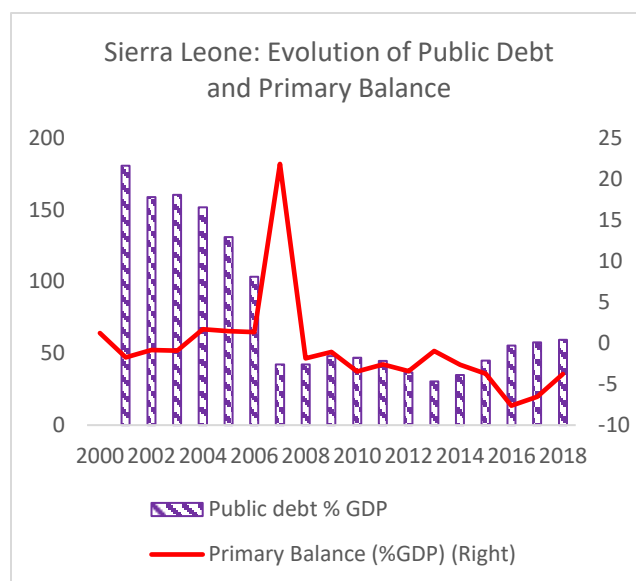


2.6 Sierra Leone

During 2000s, public debt sustainability remained a concern as it stood at 147.6 of GDP⁸, in average, between 2001 and 2006. The country's authorities, thus, considered debt forgiveness from foreign creditors, through the HIPC initiative, a priority since the country could face other macroeconomic imbalances due to the high level of public debt. The country successfully reached the HIPC initiative completion point, with the IMF in 2007, leading to significant reduction of its external debt. As a result, public debt dropped to SLL 2,717.2 billion (42.2 percent of GDP) in 2007, from SLL 5,764.3 billion (103.2 percent of GDP) in 2006. The country's public debt remained at a sustainable level at post HIPC, recording a downward trend until 2013. However, as the country suffered from the Ebola Virus Disease (EVD) in 2014, it significantly increased public expenditure financed through public debt, which stood at SLL 9,700.2 billion (44.9 percent of GDP) in 2015, compared to SLL 7,933.5 billion (34.9 percent of GDP) in 2014. Since then, a significant upward trend in public debt level was recorded, as total outstanding public debt in 2018 was SLL 18.9 billion in 2018 (59.5 percent of GDP), from SLL 15.9 billion (57.6 percent of GDP) in 2017.

The rapid accumulation of public debt over the last few years was accompanied by a speedy rise in debt servicing costs for the country as well. External debt service stood at USD 57.6 million in 2017⁹, corresponding an average increase of 33.03 percent between 2010 and 2017. This is on account of high level of interest costs, which reached 26.0 percent of tax revenue in 2018.

In terms of composition, external debt accounted for 73.0 percent (US\$ 1.64 billion) of the total public debt stock with domestic



debt accounting for 27.0 percent (US\$ 604.39 million). Multilateral debt was the leading debt source accounting for 73.2 percent (75.2 percent; 2017) in 2018, followed by commercial and bilateral debts of 15.7 and 11.1 percent respectively. Sierra Leone conducted a multi-pronged Debt Sustainability Analysis in 2018, and a new MTDS¹⁰ (2018-2022) was fashioned-out, following the expiry of MTDS (2013-2017). The new MTDS supported the extension of the maturity profile of treasury bills by the introduction of 2- 5 years marketable bonds and the pursuit of concessional external financing.

Primary balance, on the other hand, remained generally in deficit in the 2000s despite an improvement between 2004 and 2007. The deficit worsened as the country was hit by the Ebola Virus Disease (EVD) in 2014-2015 and the decline in commodity prices during that period. A slight improvement was recorded in 2018 as primary balance stood in a deficit of 3.7 percent of GDP, as compared

⁸ WEO (IMF) 2019

⁹ WDI (World Bank) 2019

¹⁰ IMF, World Bank and WAIFEM.

to a deficit of 6.5 percent of GDP in 2017 and 7.6 percent of GDP in 2016.

Overall, most countries in the WAMZ have persistently recorded large primary deficits

over time. This pattern of fiscal behavior casts doubt that fiscal policy would be effective in preserving debt sustainability in the long run, as discussed in the literature.

3.0 LITERATURE REVIEW

The literature provides different practical approaches for assessing public debt sustainability, notably the debt sustainability analysis (DSA) framework, stress tests and fiscal reaction functions test (Jha, 2012). The DSA framework is mostly applied by international organizations such as the IMF, World Bank and regional Development Banks in their macroeconomic surveillance programmes to assess debt sustainability of countries in the medium term. This framework determines whether the debt would stabilize or grow rapidly in the medium term using forecast values of key macroeconomic variables such as debt/GDP ratio, primary balance/GDP ratio, price inflation, rate of growth of real GDP, interest rate on debt, nominal exchange rate and interest rate growth differential (see Jha, 2012). Similarly, these international organizations use a stress test framework to assess how the current fiscal policy would affect debt sustainability.

The empirical literature largely builds on the fiscal reaction function approach developed by Bohn (1998) to assess debt sustainability. This framework relies on the response of primary balance to the lagged public debt-to-GDP to assess debt sustainability. Using data on the United States over the period 1916 – 1995, Bohn (1998) predicts that a significant positive response of primary balance to rising debt-to-GDP ratio is an indication of public debt sustainability, while a negative response implies unsustainable debt levels. The literature provides mixed evidence of sustainability of public debt in the developed, emerging and developing economies. Utilizing this framework, Bolat et al. (2014) found a negative reaction of the primary surplus to increases in the debt to GDP ratio for the UK over the period 1970-2012. The finding suggests that fiscal policy in the UK

was not sustainable as it fell short of satisfying the intertemporal budget constraint during the period.

Using the dynamic panel data estimation techniques, Cristina and Vaclav (2017) estimated a fiscal reaction function for 18 Euro area countries and showed that the primary balance improves by about 0.3 – 0.5 percent for every 1 percentage point increase in the debt to GDP ratio. While this relationship was fragile after the commencement of the monetary union in 1999, the positive reaction of primary surpluses to higher debt strengthened after the global recession in 2008, which served to have acted as a disciplinary device. Beqiraj et al (2018) showed a negative relationship between structural primary balance and increases in public debt increases in the OECD.

In trying to explore a nonlinear approach to assessing debt sustainability in France, Aldama and Creel (2017) adopted a Regime-Switching sustainability framework to investigate fiscal sustainability in France. Results from the Markov-switching estimation identified two different fiscal regimes, with the first regime being sustainable, with a strong positive and significant feedback effect of public debt-to-GDP on primary surplus. The second regime was found to be unsustainable with no significant feedback effect.

Turning to emerging economies, there is empirical evidence in support of a positive response of primary balance to increases in the debt to GDP ratio in Pakistan and Brazil, indicating the sustainability of public debt in the two countries (Chandia and Javid, 2013; Luporini, 2015). However, Luporini (2015) discovered that primary surplus became less responsive to increases in the debt to GDP

after year 2000, and assumed a declining trend after 2006. Chua et al. (2018) employed both the linear and non-linear (regime-switching) models in evaluating fiscal sustainability in Sri Lanka. While results from the linear model indicated positive response of primary surplus to increases in public debt to GDP ratio, the regime-switching non-linear model, however, found evidence that fiscal regimes in two periods were not sustainable, thereby questioning the country's long-term fiscal sustainability.

Despite the growing concerns over the rapid increase in debt levels after the Highly Indebted Poor Countries (HIPC) and Multilateral Debt Relief Initiatives (MDRI) and its profound implications on sustainability, the empirical literature on debt sustainability is scant in African countries. Burger et al (2011) estimated fiscal reaction functions utilizing a variety of econometric techniques to investigate the reaction of South African government to increases in its public debt. The study reveals that South Africa has run a sustainable fiscal policy since 1946. Similarly, Liliame (2015) estimates a fiscal reaction function for ten African countries to assess how African governments react to increases in their public debt levels. Results from the analysis indicated that Algeria, Ghana, Rwanda and South Africa's debts were sustainable in line with Bohn (1998) assertions. Public debt in Cote d'Ivoire, Kenya and Nigeria also seemed sustainable given the positive sign of the primary balance – public debt coefficient, even though not significant. However, negative coefficients were discovered for Tunisia, Tanzania and Zambia, indicating that their debt were unsustainable during the study period.

Some empirical studies dwelt on assessing debt sustainability in the WAMZ, with findings providing direction for the present study on these countries. Nana (2015)

assesses Ghana's government reaction to rising public debt utilizing three decades of data. Empirical results from system iterative weighted least squares (SIWLS) analysis show that Ghana's public debt were sustainable when the full sample was utilized. Its primary balance responds positively to increase in public debt even though with delay. However, breaking the sample into two sub-samples indicates different results – the coefficient of public debt in the primary balance equation was negative and insignificant during 1990 – 2000, implying that Ghana's debt was unsustainable during the period. However, result from the second sub-sample (2001 – 2013) shows a net positive effect of public debt on the primary balance, suggesting that public debt was sustainable during the period. Alternative results from an ARDL analysis confirm the persistence of fiscal pressures in the 1990s and stability in fiscal policy from 2001 in line with the SIWLS results. However, the study observed that significant fiscal pressures persisted after 2006, exacerbated by the country's election cycle.

Corroborating Nana (2015), Amankwah (2018) finds that Ghana's debt is sustainable and its fiscal policy satisfies the intertemporal government budget constraint condition in spite of the surge in the debt profile in recent years. Empirical results from an Autoregressive Distributed Lag (ARDL) framework utilising data for the period 1990 to 2016 show that fiscal authorities react to rising debt levels through an increase in the primary balance by 0.087 percent when the debt profile rises by 1 percent.

The literature reveals mixed evidence on the response of fiscal policy to rising debt levels in Nigeria. Adeniyi (2018) estimated a fiscal reaction function using an error correction model. The results indicate that the primary balance exhibits a negative response to increase in public debt in the long run, while

the short-run response is positive, signaling that public debt is sustainable in the short run.

One issue overlooked in previous studies in the WAMZ is the possibility that the primary balance may not increase continuously in response to rising debt over the possible range of debt, as implicitly assumed by the application of the fiscal reaction function using linear estimation techniques. This issue has received considerable attention in recent years. The argument by Ostry et al. (2010) points towards the possibility that the response of primary balance to rising debt could vary at different levels of debt. It implies that the underlying relationship may be nonlinear, with this response varying across countries over time. One explanation for the existence of non-linearity in primary fiscal balance response to the lagged debt ratio is that the intensity of fiscal adjustment varies with the level of debt in a country (Sarangi and El-Ahmadieh, 2017). Depending on the debt-to-GDP ratio and compositional factors such as the proportion of external debt in total debt and the type of creditors (whether dominated by commercial creditors or multilateral partners), some countries could undertake forceful fiscal adjustments to reduce the debt, while others adopt moderate adjustment to tackle the debt problem. In response, a growing strand of literature has evolved overtime to explain the possible existence of nonlinearity in the underlying relationship. Adam et al. (2010) provide useful insights into the possible forms of the primary balance function, which could either take the form of u-shaped or n-shaped, reflecting the differences in the nature of fiscal adjustments over the range of debt. The u-shaped function refers to the case of moderate fiscal adjustment efforts at low debt-to-GDP ratio until it reaches a critical point beyond which fiscal adjustments are strengthened to contain rising debt levels. Regarding the n-shaped function, the literature points to the possibility of the onset

of an adjustment ‘fatigue’, which reflects the weakening response of fiscal policy to rising debt beyond a very high threshold of debt-to-GDP ratio (Adams et al., 2010; Ghosh et al., 2013; Sarangi and El-Ahmadieh, 2017).

Recent empirical works have adopted three main approaches to explore the nonlinearities between primary balances and public debt. These are the inclusion of explanatory variable spline in linear regression, allowing for quadratic terms in linear specifications and estimation of non-linear regression models. In a seminal work, Bohn (1998) finds strong response of primary balance to debt at higher levels of debt. Mendoza and Ostry (2008) have applied explanatory variable splines to test for nonlinearities beyond a threshold level of debt, and the squared and cubic terms of the deviation of debt from within country means. For a group of advanced economies, this study finds a weaker response of primary balance to debt at high debt-to-GDP than when it is at moderate levels. This finding is in line with the outcome of a closely related work (Ostry et al, 2010), which shows an increasing response of primary balance to rising levels of debt which eventually declines at high debt-to-GDP ratio. In a similar vein, Ghosh et al. (2013) introduced the squared and cubic terms of the lagged debt-to-GDP ratio to explore non-linearities in the underlying relationship. The findings indicate that the response of primary balance begins to decline at debt-to-GDP ratio of 90-100 percent for advanced economies and turns negative as the debt ratio approaches 150 percent of GDP. These findings support the “fiscal fatigue” hypothesis. Likewise, Sarangi and El-Ahmadieh (2017) allowed for nonlinearities in the model through the inclusion of squared and cubic terms of the lagged debt-to-GDP ratio in the regression. This study establishes a threshold of 90 percent of GDP, beyond which the response of primary balance to debt increases but

eventually declines at the debt-to-GDP ratio of 150 percent.

There is, however, scant evidence on the nonlinear response of primary balance to lagged debt-to-GDP on developing economies. A few studies have illustrated the non-linear relationship between primary balances and lagged public debt. Small, Brown and Canavire-Bacarreza (2019) examines the response of fiscal policy to debt in 53 developing countries using different measures of fiscal response, such as primary balance, general revenue, tax revenue and primary spending. By estimating a spline regression using a threshold of debt-to-GDP ratio of 90 percent, the study finds evidence in support of the nonlinear fiscal response to debt. The findings show that the responses of primary balance and revenues to rising debt ratio increase when debt is above the threshold of 90 percent of GDP and the response of private spending to debt decreases when debt is above this threshold. To account for possible heterogeneity in these fiscal responses to debt, the study further divided the sample into high/upper-middle-income and low/lower-middle-income countries. The results reveal some differences in the response parameters, with primary balance responding positively to rising public debt in high/upper-middle-income countries. The findings further point to the fact that the high/upper-middle-income developing countries undertake significant adjustments in both revenues and primary spending to reduce debt levels.

While the above studies provide valuable information about the nonlinearities in the response of primary balance to the lagged debt-to-GDP ratio, they are not without caveats. Studies that have employed a regression spline arbitrarily determine a threshold level of debt ratio to assess the possible existence of a nonlinear relationship between the variables. Similarly, the inclusion of quadratic terms in the linear specification assumes beforehand that there exists a nonlinear relationship rather than allowing nonlinearities to be determined endogenously. Addressing these weaknesses requires the estimation of nonlinear model that allows for the gradual variation in the response of fiscal policy to public debt over time, such as the panel smooth transition regression (PSTR) approach, as discussed in section 4.

In sum, the literature clearly provides evidence of a nonlinear response of primary balance to increasing public debt levels. It suggests that the underlying relationship may not be captured through assessment of a linear fiscal reaction function. The review points to the fact that there may be differences in the response of fiscal policy to rising debt across countries over time, which suggests the possible existence of threshold effects of debt. This study complements the insights on public debt sustainability in the WAMZ by exploring non-linearities in determining the threshold level of public debt that ensures the sustainability of fiscal policy in the WAMZ.

4.0 MODEL, DATA AND RESULTS

Previous empirical studies have largely adopted a fiscal policy reaction function developed by Bohn (1998) to assess the sustainability of public debt both at the country level and panel data setting. This framework expresses the primary balance ¹¹ (as a share of GDP) as a function of the ratio of the lagged public debt to GDP and other variables, such as government spending relative to its trend and the output gap, which is a proxy for business cycle fluctuations. Both output gap and government spending gap variables are included in the model to capture temporary influences on primary fiscal balances (Bohn, 1998; Adams, Ferrarini and Park, 2010; Debrun et al., 2018; Ghosh et al., 2013; Sarangi and El-Ahmadieh, 2017). Building on this approach, the linear fiscal reaction function is specified as:

$$PB_{it} = \beta_0 + \beta_1 PD_{i,t-1} + \beta_2 YGAP_{it} + \beta_3 GEGAP_{it} + \gamma' X_{it} + \mu_i + \varepsilon_{it} \quad (1)$$

where PB_{it} is the ratio of primary balance to GDP; $PD_{i,t-1}$ is lagged public debt to GDP ratio, $YGAP_{it}$ is output gap and $GEGAP_{it}$ is government expenditure gap. X_{it} is a vector of additional control variables that influence primary balance such as oil price, exchange rate, a proxy for the quality of institutions (political stability) and a dummy variable to control for the influence of the debt relief initiatives on fiscal policy, which comprises the Heavily Indebted Poor Countries (HIPC) and Multilateral Debt Relief Initiatives (MDRI). μ_i denotes country-specific fixed

effects and ε_{it} is an error term assumed to follow a white-noise process.¹²

The coefficient (β_1) is of interest in assessing public debt sustainability within this framework, which reflects the fiscal response behaviour i.e. the response of the primary balance to debt after a lag of one year. The value of this response parameter should be positive and lie within the range of zero and unity, which is a sufficient condition to achieve public debt sustainability. This allows the public debt variable to be stationary (follow a mean-reverting process) and hence non-explosive. A positive and strongly significant coefficient of the lagged public debt ratio with magnitude within the range ($0 < \beta_1 < 1$) is an indication that Member States are satisfying the intertemporal budget constraint. This implies that the primary balances are responding to rising debt levels to ensure sustainability of public debt. The response of fiscal policy to increases in debt levels is stronger when the coefficient β_1 is positive and close to unity. In contrast, a negative sign on this coefficient is an indication that the primary balance is not increasing in response to increases in the public debt ratio, which suggests that the fiscal policy stance may lead to an explosive debt to GDP ratio.

Equation (1) is estimated over the period 2000 to 2018, covering a panel of all member states of the WAMZ (The Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone). The choice of the study period was driven by data availability considerations, especially for Liberia before 2000. Data on primary

¹¹ The International Monetary Fund defines the domestic primary balance as the "Central Government revenue less expenditures and net lending adjusted for interest payments and foreign financed capital spending" (IMF, 2019: P.63).

¹² It is worth noting that the specification (Eq. 3) does not control for the persistence of primary balance in explaining the underlying relationship. While it is reasonable to assume that the fiscal policy

stance in the previous year can potentially influence the contemporaneous response of primary balance to rising debt levels, the inclusion of the lagged primary balance in the model will cause the problem of endogeneity bias. This requires the estimation of dynamic panel threshold models. However, these models were not estimated given the limited size of cross-sectional units (six countries) used in the study.

balances, public debt and oil price are obtained from the World Economic Outlook (WEO) database, while real GDP, government final consumption expenditure, trade openness, inflation and exchange rate variables are sourced from the World Development Indicators (WDI). The output gap is measured by the difference between the real GDP and its long-run trend (potential GDP), expressed as percentage of potential GDP. Similarly, government expenditure gap is generated as the difference between general government final consumption expenditure and its long-run trend, as a percentage of the long-run trend. This variable captures the impact of temporary components of government expenditure on primary fiscal balance such as electoral

spending. Because annual series are used, a smoothing parameter of 6.25 is applied in generating the long-run trend of both real GDP and government final consumption expenditure using the Hodrick-Prescott (HP) filter. While a smoothing parameter value of 100 has been used by some studies in the empirical literature, Ravn and Uhlig (2002) have shown that a smoothing parameter of 6.25 is appropriate for annual data. The debt relief dummy captures the completion period of the debt relief initiatives of the respective Member States in the WAMZ. The inclusion of this dummy variable in the regression allows us to control for structural breaks in the series on public debt, owing to successful implementation of the debt relief initiatives.

4.1 Results and Interpretations

A useful starting point of the discussion of the empirical results is to undertake a preliminary assessment of the variables. Tables 1 presents the descriptive statistics of the key variables used in the model estimation. It reveals considerable variation in lagged public debt ratio, with a standard deviation of 102.4, ranging from 7.28 percent

of GDP in Nigeria in 2009 to 514.9 percent of GDP in Liberia in 2004. Similarly, a standard deviation of 3.68 for primary balance relative to GDP reveals significant differences in the primary balance across Member States, which ranges from a deficit of 8.26 percent of GDP in Guinea in 2010 to a primary surplus of 21.83 percent of GDP in Sierra Leone in 2007.

Table 1: Descriptive statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Primary balance to GDP ratio	114	-0.774	3.684	-8.258	21.83
Lagged public debt ratio	108	82.62	102.4	7.276	514.9
Real GDP gap	114	-0.0444	3.704	-13.57	15.84
Government expenditure gap	114	-0.368	15.09	-65.37	56.72

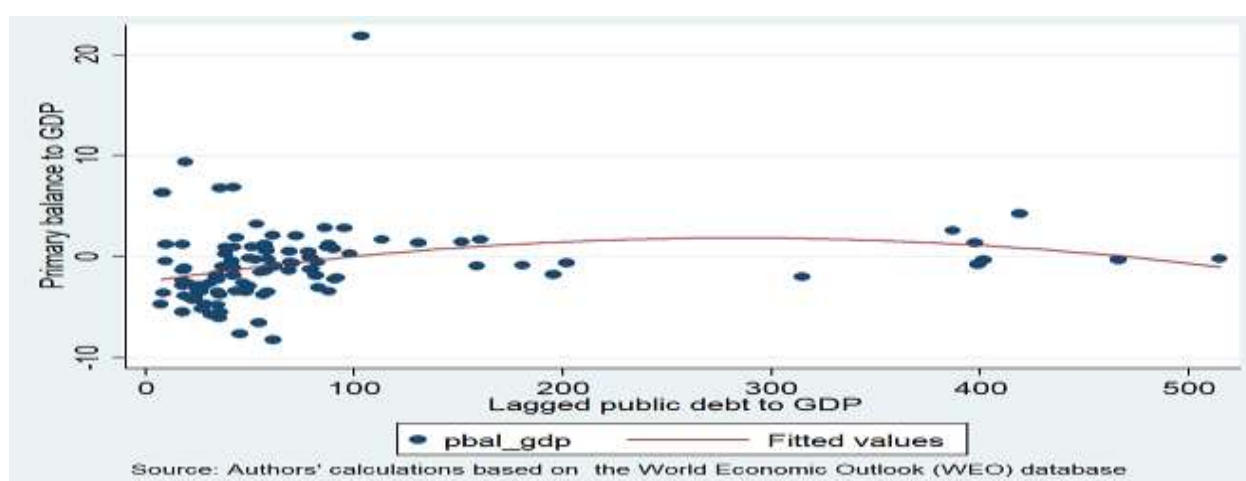
The extent of variation in both primary balances and public debt across the WAMZ countries is further assessed using a scatter plot of these variables. Figure 1 shows the association between primary balance relative to GDP and the lagged public debt ratio. The

graph is fitted using quadratic predictions, which allows us to assess beforehand, whether there is potential nonlinearity in the relationship between primary balance and public debt as predicted in the economic literature. Consistent with the description

above, this plot reveals significant variations in the primary balance and public debt ratio across countries in the WAMZ. The existence of such variations in the data is helpful to determine whether there are potential nonlinearities between primary fiscal balances and public debt ratio. Looking at figure 1 shows a positive association between primary balance and the lagged public debt ratio up to a given level of public debt ratio,

beyond which the primary balance tends to deteriorate as public debt ratio increases. This is an indication that the response of fiscal policy to increases in public debt is not likely to be positive throughout the period under consideration. It provides a signal of possible nonlinearities in the underlying relationship, which requires further empirical investigation.

Figure 1: WAMZ primary balance and lagged public debt ratio (2000-2018)



To assess public debt sustainability, we begin the empirical analysis by estimating the baseline equation, which considers only government expenditure gap and output gap as control variables. Table 2 presents the results of both the OLS and panel fixed effects estimation techniques, showing the response of primary balance to public debt, after controlling for the effects of other factors. Robust standard errors are applied in the estimation to address potential heteroscedasticity problem. Column (1) of table 2 displays the results of the baseline regression, which shows a clear positive response of primary balance to increases in public debt. Government expenditure gap affects primary balance negatively. In column (2), the coefficient of the primary

balance response parameter (lagged public debt ratio) remains positive and statistically significant at the 10 percent level, after controlling for the influences of other macroeconomic factors. The magnitude of the coefficient lies within the admissible range of zero to unity that would ensure the sustainability of public debt. This finding provides evidence of public debt sustainability in the WAMZ, suggesting that policymakers respond positively to rising public debt levels by reducing the primary deficit.

The results show remarkably consistent positive sign and statistically significant response parameter even after controlling for the influences of some macroeconomic

factors and the debt relief initiatives dummy on fiscal policy stance in the fixed effects estimation (column 3). The size of the coefficient of the lagged debt-to-GDP ratio in column (2) suggests that on average, WAMZ member countries would improve their primary balances by 0.005 percent, in response to a percentage increase in the ratio of public debt to GDP. The magnitude of this coefficient, however, shows sluggish response of fiscal policy to rising levels of public debt in member countries. It suggests that policymakers achieve moderate improvements in primary fiscal balances in response to increasing public debt.

The coefficient on output gap, however, is not statistically significant across all three models presented in table 2 (columns 1-3). This may be due to potential endogeneity problem, given that the output gap does not only influence fiscal policy, but also the fiscal policy stance of government determines the cyclical position of the economy (see e.g. Checherita-Westphal and Zdarek, 2017). Therefore, there is a potential feedback effect, which is not addressed in the OLS estimation.

Table 2: Pooled OLS and fixed effects estimations (2000-2018)

Variables	(1) Pooled OLS	(2) Pooled OLS	(3) Fixed effects
Lagged public debt to GDP ratio	0.007*** (0.002)	0.005* (0.003)	0.012** (0.005)
Output gap	0.022 (0.071)	0.031 (0.074)	0.037 (0.081)
Government expenditure gap	-0.048* (0.024)	-0.043* (0.026)	-0.039* (0.022)
Oil price index		-0.010 (0.010)	-0.006 (0.013)
Log of exchange rate		-0.016 (0.161)	-1.361* (0.769)
Political stability		-0.403 (0.634)	1.255 (1.025)
Debt relief dummy			4.823*** (1.085)
Constant	-1.517*** (0.414)	-0.987 (0.908)	5.713 (3.924)
Observations	108	108	108
R-squared	0.074	0.085	0.342
Number of countries			6

Note: Dependent variable-primary balance (% of GDP). '***', '**', '*' denote significant at 1, 5 and 10% respectively.

Standard errors in parentheses are corrected for heteroscedasticity.

While the OLS estimation provides a useful approach to analyzing the underlying relationship, the technique is, however

confronted with some estimation problems. One of such problems is its inherent weakness to address potential endogeneity

issues that may arise from the estimation of equation (3) as discussed above. In trying to mitigate potential endogeneity bias in the parameters, we estimate an alternative model, panel fixed effects model, which captures the effects of factors not included in the model, as well as unobserved country-fixed effects. Column 3 of table 2 reports the results of the panel fixed effects approach, which further confirms the positive response of primary balance to rising public debt. The response parameter is positive and statistically significant at the 5 percent level, and the value of this coefficient lies within the (0,1) range. This corroborates our evidence on the sustainability of public debt in the WAMZ region.

The fixed effects model addresses the problem of omitted variable bias that arises from unobservable factors that affect the primary balance in each country. Ghosh et al. (2013) argues that the lagged public debt ratio is correlated with unobserved country-specific factors driving the primary balance. These unobserved factors may induce countries to achieve relatively large primary surplus and low debt levels. There is, therefore some heterogeneity in the response of primary balance to rising debt levels across countries, with some countries showing stronger response and achieving lower levels of public debt due to the existence of favourable fixed effects. Along this argument, a few authors have predicted that the coefficient on the lagged public debt would reveal a downward bias if the estimation technique does not control for country-fixed effects in the fiscal reaction function (see Ghosh et al., 2013; Small et al., 2019). In this respect, the panel fixed effects model is estimated and results are reported in column (3). Looking at the magnitude of the response parameter across the models (columns 1-3) shows that an increase in the response parameter by 0.005 from 0.007 (column 1) to 0.012 (column 3) after the

inclusion of country-fixed effects and the dummy to proxy the effects of the debt relief initiatives. The results indicate that on average, an increase of 1 percentage point in the ratio of public debt to GDP improves the primary balance by about 0.007-0.012 percent. The result suggests that policymakers in the WAMZ respond systematically to rising public debt by reducing primary deficits, reflecting the debt stabilizing behaviour of the various national governments. This finding is in tune with the recent fiscal reforms initiated by policymakers in the region to improve public finances and ensure public debt sustainability, including the adoption and strengthening of fiscal consolidation measures to shore-up domestic revenues and rationalize government expenditures. Our findings are in line with a number of empirical studies that show a positive and significant response of primary balance to rising public debt ratio undertaken at both country-level and within a panel framework (e.g. Bohn 1998; Mondoza and Ostry, 2008; Asiama et al., 2014; Weichenrieder and Zimmer, 2014; Nana, 2015; Amankwah et al., 2018; Chua et al., 2018).

One problem inherent in the evaluation of the primary fiscal balance-public debt relationship in the estimation methods used (pooled OLS and panel fixed effects) is the assumption that the underlying relationship is linear. The positive and statistically significant response parameter generated by these estimation techniques assumes implicitly that Fiscal Authorities in the WAMZ would continue to respond positively to increases in public debt over the range of debt to preserve debt sustainability. As shown in the scatter plots (figure 2), the relationship between the primary balance and public debt is likely to be non-linear in the region. As noted above, a plausible explanation for the existence of nonlinearities in primary balance response to the lagged

debt ratio is the likely variation in intensity of fiscal adjustment with the level of debt across countries overtime. The literature reveals that there are potential threshold effects of public debt. One possibility points to the existence of a certain debt threshold level beyond which primary balances may respond strongly to rising debt stock. Alternatively, countries could experience declining response of primary balance to increases in public debt above a certain threshold, due to the onset of an adjustment or fiscal fatigue (Adams et al., 2010; Ghosh et al., 2013). Besides, all member countries of the WAMZ have benefited from debt relief over the years, which has introduced some structural breaks that could possibly influence the response of primary balances to increases in public debt. As analysed above, the descriptive statistics reveals considerable heterogeneity in public debt and primary balance across countries in the WAMZ. Such heterogeneity may have been partly driven by the differences in the composition of public debt, the varying capacity of countries to absorb high levels of debt and differences in institutional quality across countries.

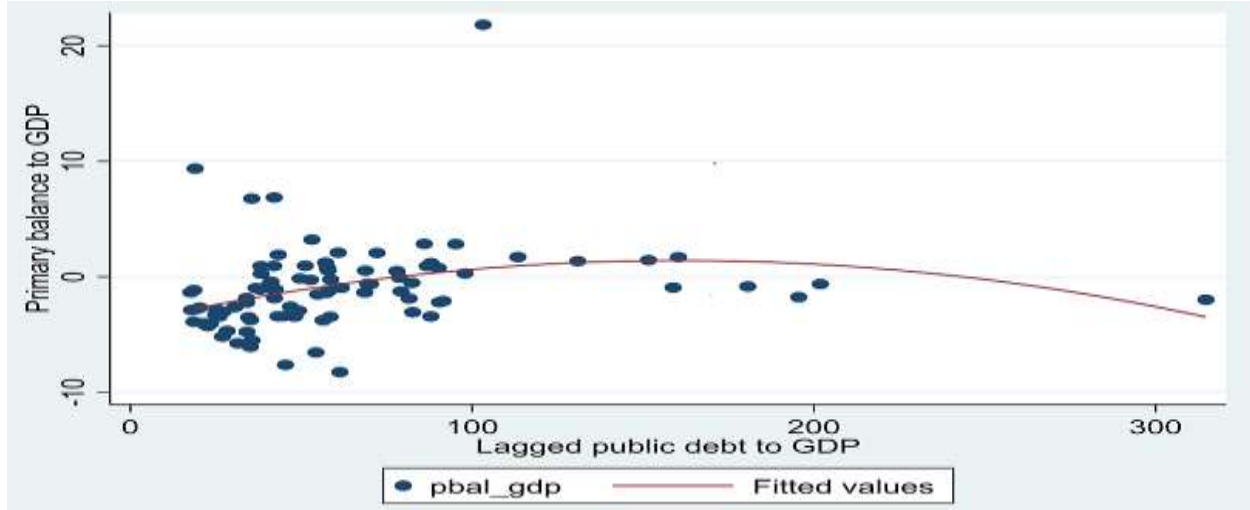
In trying to address the above issues, we estimate a panel smooth transition regression (PSTR) model, which allows us to capture country-heterogeneity through the variation in the lagged public debt, and explore the nonlinearities between primary balance and public debt. This model offers a novel approach to determining the threshold effects of public debt on primary balance, unlike other methods, such as the inclusion of a quadratic term of lagged public debt as an additional explanatory variable in the fiscal reaction function, or through arbitrary selection of a threshold to generate a spline for public debt. The PSTR approach provides a convenient way of assessing nonlinearities through formal tests and allows the threshold parameter to be determined endogenously. This approach was developed by Gonzalez

and van Dijk (2005) and Fok, van Dijk and Franses (2005), and widely applied in empirical research to assess potential nonlinearities in economic relationships (e.g. Colletaz and Hurlin, 2006). A notable advantage of the PSTR model is that it allows the parameters of the model to vary across countries and over time. In other words, the coefficients on the variables change smoothly between one regime (lower bound) to the next (upper bound), based on the different values of an observable variable known as transition function. In doing so, the PSTR approach allows for the effect of the threshold variable (public debt ratio) on primary balance to vary smoothly across countries over time, thereby exploiting country heterogeneity in public debt in explaining the underlying nonlinear relationship.

Prior to the estimation of the PSTR model, the data on the threshold variable (lagged public debt ratio) was carefully assessed to eliminate outliers while ensuring that there is significant heterogeneity to allow for the estimation of the threshold value of public debt and the slope parameters. As argued by Colletaz and Hurlin (2006), it is not appropriate to eliminate entirely the country with the highest values of the threshold variable (lagged public debt in this case) as it would lead to loss of important information that allows for heterogeneity across countries. As noted above, Liberia has the highest values of the threshold variable (lagged public debt ratio) and Nigeria recorded some of the lowest values of this variable. Following the approach by Colletaz and Hurlin (2006), we eliminate $T/2$ observations on the smallest and largest values of the lagged public debt ratio to remove some outliers and allow the estimation of threshold value of public debt and the slope parameters. Figure 2 displays the scatter plot of primary balance and lagged

public debt after eliminating some outliers of lagged public debt.¹³

Figure 2: WAMZ primary balance and lagged public debt ratio (2001-2018)



As a first step in the estimation of the PSTR, we conduct a test for homogeneity between the lagged public debt and primary balance against the alternative hypothesis of the PSTR model. This test determines whether the underlying relationship is linear, which would suggest that the impact of public debt on primary fiscal balance is homogenous across countries and does not vary over time. Rejection of the null hypothesis implies that there exists a nonlinear relationship between primary balance and its determinants. In this case, the PSTR model will be estimated, which allows for variation in the response of primary balance to changes in public debt. Consistent with this literature, we specify a fiscal reaction function with one threshold or two regimes as:

$$PB_{it} = \alpha_i + \beta'_0 F_{it} + \beta'_1 F_{it} \theta(PD_{i,t-1}; \gamma, \vartheta) + \varepsilon_{it} \quad (2)$$

Where $i = 1, \dots, N$, and $t = 1, \dots, T$; N and T denote cross-section units (6 member states) and time dimension of the panel respectively. α_i is the country fixed effects and ε_{it} is an error term. PB_{it} is primary balance as a share of GDP. F_{it} is a vector of time varying explanatory variables used in the regression which comprises public debt-to-GDP ratio, output gap, expenditure gap, oil price, exchange rate and a proxy for political stability.¹⁴ Consistent with Gonzalez and van Dijk (2005), we allow for one period lag of debt-to-GDP ratio, output gap and expenditure gap to mitigate any potential endogeneity issues, while primary balance responds contemporaneously to oil price,

¹³ To eliminate the outliers on public debt ratio, in addition to the elimination of observations for the year 2000, due to the use of one period lagged ratio of public debt to GDP, we further eliminated eight smallest and seven largest observations of public debt from the data.

¹⁴ The debt relief dummy is excluded from the estimation of the PSTR model, owing to limited variation across countries over time,

following the elimination of outliers on public debt ratio prior to estimation of the model. Nevertheless, the PSTR model allows for the structural breaks in the threshold variable (public debt to GDP ratio) induced by the adoption of the debt relief initiatives to be endogenously determined by the data, through the smooth variation in the coefficient of variable from a lower debt regime a higher debt regime.

exchange rate and political stability. The function $\theta(PD_{i,t-1}; \gamma, \vartheta)$ is a continuous function of the threshold variable, public debt ratio. γ is a slope parameter, which determines the smoothness of the transition function and ϑ is a location or threshold parameter. From the literature, this function is assumed be bounded between 0 and 1.

Gonzalez and van Dijk (2005) utilize a logistic transition function, which is specified as:

$$\theta(PD_{i,t-1}; \gamma, \vartheta) = \frac{1}{(1 + \exp(-\gamma \prod_{j=1}^m (PD_{i,t-1} - \vartheta_j)))}, \gamma > 0 \quad (3)$$

Where $\vartheta_1 \leq \vartheta_2 \leq \dots \leq \vartheta_m$ and $\vartheta = (\vartheta_1, \dots, \vartheta_m)'$ is an m-dimensional vector of threshold parameters. With one threshold parameter of public debt ratio ($m = 1$) or two regimes, the logistic transition function takes the form:

$$\theta(PD_{i,t-1}; \gamma, \vartheta) = \frac{1}{(1 + \exp(-\gamma(PD_{i,t-1} - \vartheta)))}, \gamma > 0 \quad (4)$$

The 2-regime PSTR regression is associated with low and high values of the threshold variable $pd_{i,t-1}$ and the regression parameters associated with low and high regimes are β_0 and $(\beta_0 + \beta_1)$ respectively. From equation (4), when $\gamma \rightarrow \infty$, the transition function $\theta(PD_{i,t-1}; \gamma, \vartheta)$ converges to an indicator function, depicting the Hansen (1999) panel transition regression (PTR) model. For $m = 2$, the transition function reaches its minimum at $(\vartheta_1 + \vartheta_2)/2$ and is associated with a value of 1 at both low and high values

of the threshold variable $PD_{i,t-1}$ (Gonzalez et al., 2005). As such, when $\gamma \rightarrow \infty$, the model becomes a three-regime threshold model. In general, for any value of m , the transition, function is constant when $\gamma \rightarrow 0$, and such a model will be estimated through a linear fixed effects panel regression.

To determine the presence of nonlinearities between lagged public debt and primary fiscal balance, the null hypothesis of homogeneity, $H_0: \gamma = 0$ or $H_0: \beta_0 = \beta_1$, is tested against the alternative of the PSTR model from equation (4).¹⁵ As noted above, the test for nonlinearity involves testing a linear model ($r = 0$) against the PSTR model with one threshold ($H_0: r = 1$) or two regimes. Table 3 presents the linearity test from the estimated PSTR model (equation 4).¹⁶ The probability values associated with the tests statistics show strong rejection of the null hypothesis of linearity at the 1 percent level. This finding provides evidence of the existence of a nonlinear response of primary balance to increases in public debt ratio. A second step in the estimation procedure is to ascertain whether there is no remaining heterogeneity in the data. This implies testing the null hypothesis of the existence of a single threshold model ($H_0: r = 1$) or two regimes against a double threshold model ($H_1: r = 2$) or three regimes as shown in the second row in table 3. In this case, the probability values of the test statistics indicate that we fail to reject the null hypothesis of no remaining heterogeneity. It implies that cross-country heterogeneity in the response of primary balance to public debt would be completely captured by estimating a PSTR model with one threshold value of public debt or two regimes.

¹⁵ To conduct the test, an auxiliary regression is derived from equation (4) by replacing the transition with a first-order Taylor expression around $\gamma = 0$. For brevity of presentation, the auxiliary regression is not specified.

¹⁶ The PSTR regression results were obtained using the Matlab codes developed by Colletaz and Hurlin (2006) and Fouquau, Hurlin and Rabaud (2008).

Table 3: Test for nonlinearity

Hypothesis	Test	Statistics	P-value
$H_0: (r = 0); H_1: (r = 1)$	Wald Test (LM)	19.269	0.004
	Fisher Test (LMF)	3.542	0.004
	LRT Tests (LRT)	21.683	0.001
$H_0: (r = 1); H_1: (r = 2)$	Wald Test (LM)	9.665	0.139
	Fisher Test (LMF)	1.323	0.259
	LRT Tests (LRT)	10.225	0.116

Following the determination of the existence of nonlinear relationship between public debt and primary balance, equation (4) is estimated using nonlinear least squares. For clarity of presentation, the estimated PSTR model from equation (4) can be reformulated as equation (7):

$$PB_{it} = \alpha_i + \beta_0 PD_{i,t-1} + \beta_1 PD_{i,t-1} \theta(PD; \gamma, \vartheta) + \beta_{01} Z_{it} + \beta'_{11} Z_{it} \theta(PD_{i,t-1}; \gamma, \vartheta) + \varepsilon_{it} \quad (5)$$

where $PD_{i,t-1}$ is lagged public debt ratio and Z_{it} is a vector of control variables as defined above. It is worth noting that the estimated values of the parameters of the public debt to GDP ratio in the PSTR model corresponding to the two regimes (β_0 and β_1) cannot be interpreted directly as they do not directly reflect the direct impact of debt on primary balance (see Jude, 2010). Rather, the response of the primary balance to changes in the variables is interpreted by considering the direction of the signs of the coefficients. For instance, a positive (negative) sign on the coefficient of the lagged public debt ratio suggests that the elasticity of primary balance increases (decreases) as the debt ratio increases. As such, the parameter β_0 reflects

the response of primary balance to the debt ratio when the transition function $\theta(PD; \gamma, \vartheta)$ tends towards 0 and β_1 when it tends towards 1, depicting low and high debt regimes respectively.

Table 4 presents the results of the estimated parameters from the PSTR model with one threshold. The estimated PSTR model establishes a threshold of public debt of 90.2 percent of GDP for countries in the WAMZ, which is above the sample mean of the lagged debt-to-GDP ratio (82.62 percent of GDP) reported in table 1. This is an indication that the fiscal response function takes an n-shaped form, with the results showing a significant positive response of primary balance to increasing debt ratio below the threshold of 90 percent of GDP. However, the response of primary balance to rising debt ratio declines above this threshold, which suggests that the response of primary balance to public debt varies at different levels of debt. The results indicate that policymakers in the WAMZ undertake fiscal adjustments in response to increasing debt ratio to ensure debt sustainability when debt levels are below the threshold of 90 percent of GDP.

Table 4: PSTR model estimation

	β_0	β_1
Location (threshold) parameter (ϑ)	90.42	
Slope parameter (γ)	67.89	
Lagged public debt ratio	0.0576*** (0.0208)	-0.0894*** (0.0270)
Lagged real GDP gap	0.1149 (0.0705)	-0.2429 (0.1882)
Lagged government expenditure gap	-0.0170 (0.0234)	-0.1070 (0.1145)
Lagged oil price index	-0.0125 (0.0113)	0.1680*** (0.0609)
log of exchange rate	-0.3993* (0.2294)	1.2822*** (0.4751)
Lagged political stability	-1.0047 (0.9978)	5.6148** (2.6177)

Note: ***, **, * denote significant at 1%, 5% and 10 % respectively. Dependent variable-primary balance Standard errors in parentheses are corrected for heteroscedasticity.

Column (2) reveals that the response of primary balance to debt weakens at debt levels above the threshold. This finding suggests that member countries are at risk of slipping into a fiscal ‘fatigue’ position when debt ratios exceed 90 percent of GDP. It implies that the debt levels of member countries become increasingly explosive beyond this threshold, as countries would not be able to generate adequate primary balance to reduce the debt to sustainable levels. Therefore, there is an elevated risk of sovereign default when the debt-to-GDP ratio exceeds the threshold of 90 percent of GDP.

4.2 Robustness

To check the robustness of our results, we estimate an alternative model by further eliminating six observations from the lower end of the data, while retaining the three smallest and largest values of the lagged debt-to-GDP ratio to ensure that there is sufficient variation in the data. Tables (5) and (6) present the results of the nonlinearity tests and PSTR model after the elimination of these observations, respectively. The results

show remarkably consistent nonlinear response of primary balance to lagged debt-to-GDP ratio. Table 5 confirms the presence on nonlinear response of primary balance to increasing debt-to-GDP ratio, while table 6 reinforces our finding of a debt-to-GDP threshold at 90 percent. The results further confirm that the response of fiscal policy to increasing debt levels varies over time. These findings implies that while Fiscal Authorities undertake fiscal adjustments in response to increasing debt levels, such efforts appear to weaken when debt-to-GDP exceeds 90 percent. Thus, allowing debt ratios to exceed this threshold increases the likelihood of debt default. Our finding of declining response of primary balance to increasing debt-to-GDP ratio beyond a threshold is consistent with the findings in most empirical studies (Mendoza and Ostry, 2008; Ostry et al., 2010; Ghosh et al., 2013; Sarangi and El-Ahmadieh, 2017). In contrast, Small et al. (2019) employed an arbitrarily selected debt threshold of 90 percent of GDP in the spline regression and showed strong positive response of primary balance to increasing debt above this threshold in developing countries.

Table 5: Test for nonlinearity

Hypothesis	Test	Statistics	P-value
$H_0: (r = 0); H_1: (r = 1)$	Wald Test (LM)	19.925	0.003
	Fisher Test (LMF)	3.731	0.003
	LRT Tests (LRT)	22.744	0.001
$H_0: (r = 1); H_1: (r = 2)$	Wald Test (LM)	6.913	0.329
	Fisher Test (LMF)	0.897	0.503
	LRT Tests (LRT)	7.214	0.301

Table 6: PSTR model estimation

	β_0	β_1
Location (threshold) parameter (ϑ)	90.42	
Slope parameter (γ)	63.61	
Lagged public debt ratio	0.0444** (0.0203)	-0.0754*** (0.0257)
Lagged real GDP gap	0.1039 (0.0738)	-0.2349 (0.1842)
Lagged government expenditure gap	-0.0148 (0.0223)	-0.1205 (0.1045)
Lagged oil price index	-0.0137 (0.0118)	0.1793*** (0.0585)
Log of exchange rate	-0.3214 (0.2363)	1.1083** (0.5155)
Lagged political stability	-1.1123 (0.9848)	5.9563** (2.6593)

Note: ***, **, * denote significant at 1%, 5% and 10 % respectively. Dependent variable-primary balance
Standard errors in parentheses are corrected for heteroscedasticity.

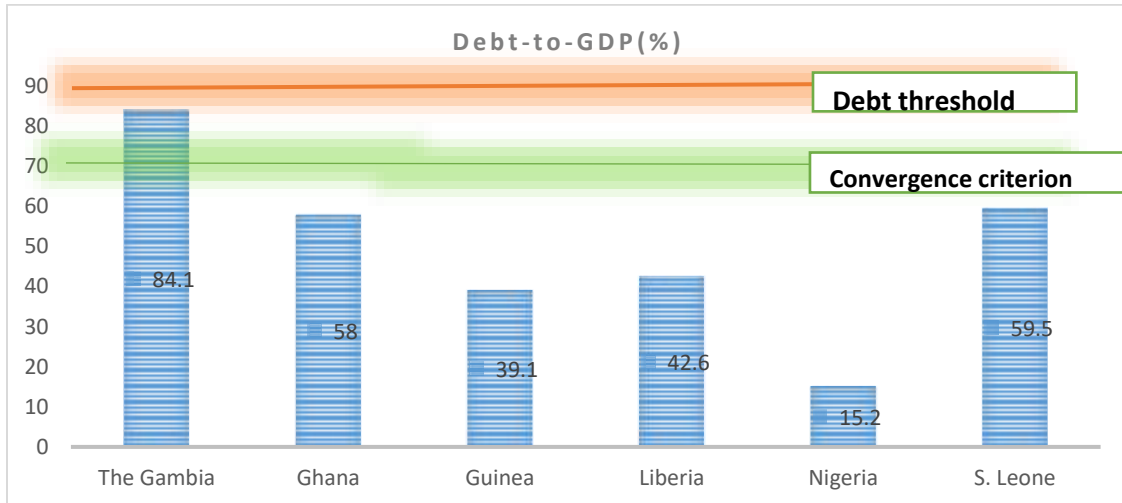
Figure 3 displays the debt ratios of WAMZ member states in 2018, which are compared with the established threshold of 90 percent of GDP and the macroeconomic convergence criterion of 70 percent of GDP. Looking at the debt ratios shows that all Member States

are below the threshold of 90 percent of GDP. This suggests that the fiscal stance of these countries appears to be sustainable. However, The Gambia is at high risk of slipping into fiscal fatigue, given its relatively high debt ratio as it approaches the threshold level

(84.1 percent of GDP) in 2018, compared to Ghana (58 percent), Guinea (39.1 percent), Liberia (42.6 percent), Nigeria (15.2 percent) and Sierra Leone (59.5 percent). Given these debt levels, further increases in the debt-to-GDP ratio in countries with relatively high

debt levels may erode investor confidence, as governments may only be able to borrow in future at high risk premium on debt (see World Bank, 2019a). This can potentially trigger a debt crisis if investors are convinced that the debt is no longer sustainable.¹⁷

Figure 3: WAMZ Debt-to-GDP ratio in 2018



Source: WAMI database

¹⁷ While the established debt threshold of 90 percent of GDP exceeds the secondary convergence target of 70 percent of GDP, Member States would still achieve sustainable debt levels if additional resources generated from borrowing are directed towards promoting investments in key sectors, including addressing infrastructural gaps, which would facilitate economic

diversification, promote sustainable growth, enhance the repayment capacity of countries in the medium to long-term, thereby allowing WAMZ countries to reduce dependence on commodity exports and build economic resilience.

5.0 CONCLUSION AND POLICY IMPLICATIONS

Debt levels have been increasing in the WAMZ in recent years, which has spurred a growing debate over debt sustainability in the region. This paper examined the sustainability of public debt levels in the Zone. It explored the existence of threshold effects of public debt and its implications on current debt levels for debt sustainability in the Zone.

Findings indicate a nonlinear response of fiscal policy to rising public debt, showing clearly significant variations in the response of primary fiscal balance to rising debt at different debt levels. The study presents strong evidence of the existence of a debt threshold of 90 percent of GDP for member countries in the WAMZ, which is determined through the estimation of a Panel Smooth Transition Regression (PSTR) model. The results indicate significant positive response of primary fiscal balance to increasing debt ratio at debt levels below the threshold of 90 percent of GDP, but turns negative above this threshold. This provides evidence of responsible fiscal behaviour in the WAMZ at moderate debt levels, pointing to strong fiscal adjustments undertaken by policymakers in recent years to stabilize the debt. However, the response of fiscal policy to rising debt declines above the debt-to-GDP ratio of 90 percent, which suggests weaker fiscal policy adjustment efforts beyond this threshold. It implies that above the threshold, member countries would not be able to achieve sufficient improvements in primary balances to service the debt and ensure debt sustainability.

A look at the established debt threshold suggests that none of the Member States of the WAMZ has slipped into a ‘fiscal fatigue’ position. However, there is an elevated risk to debt unsustainability in The Gambia, with a

relatively high debt level of 84.1 percent of GDP in 2018, compared to other countries in the WAMZ. There is also the risk of debt distress in countries such as Ghana, Guinea, Liberia and Sierra Leone, in the light of greater share of external debt in total debt, while Nigeria is heavily leveraged on domestic residents’ debt.

Although debt settles at a relatively high threshold, this finding does not suggest that Member States could increase debt ratios to the threshold of 90 percent of GDP. Rather, it points to a high risk of countries slipping into unsustainable debt levels if debt is not contained to a level below this threshold. In this respect, Fiscal Authorities should ensure that appropriate fiscal adjustments are made to reduce debt levels below this threshold and ensure adherence to the convergence threshold of 70 percent of GDP to preserve debt sustainability. This underscores the need for policymakers to pursue strong fiscal consolidation, aimed at enhancing revenue mobilization and rationalizing government expenditures.

The adoption of fiscal consolidation requires an appropriate mix of revenue and expenditure measures to ensure that adequate resources are devoted to supporting inclusive growth and alleviating poverty. It is important that government expenditure is not significantly reduced on productive investments that would accelerate growth in the medium to long term and enhance the repayment capacity of countries. It is worthwhile to note that countries in the WAMZ are characterized by limited degree of economic diversification and therefore exposed to external shocks. As such, there is need for Member States to invest in critical infrastructure to promote economic diversification for sustainable economic

growth and build economic resilience. Such measures could be complemented by the development of medium-term fiscal frameworks and aligning government policies to these frameworks to ensure fiscal prudence. Equally, government expenditures components, especially those components that are driven by political considerations, pose significant risks to debt sustainability in the WAMZ. This calls for the adoption of measures to increase the role of the private sector in these economies to enhance revenue generation, reduce the size of the government and associated employment related costs.

In Nigeria, additional reforms would be required to improve domestic revenue mobilization and administration to reduce inefficiencies in revenue collection and ultimately mitigate the huge burden of servicing domestic debt. These measures would help reduce dependence on resources generated from the oil and gas sector which is vulnerable to external shocks. Fiscal authorities in Ghana are urged to reduce reliance on commercial debt and enhance capacity to mobilize domestic revenue by issuing domestic bonds of long-term maturity.

Bond markets in The Gambia, Guinea, Liberia and Sierra Leone are underdeveloped, causing governments to depend heavily on borrowing through short-term instruments. This pattern of borrowing raises the risks to debt sustainability through increases in the interest rate. To minimize the cost of debt and ensure fiscal sustainability, it is helpful for policymakers in these countries to facilitate the development of the debt

market and introduce domestic debt instruments with long time horizon. It is imperative to also enhance capacity for effective management of debt in these countries. This would allow countries to strengthen capacity to manage risk exposure and mitigate mismatches between assets and liabilities of governments to stabilize the debt and reduce the risk of debt distress. The Authorities in these countries are further encouraged to establish independent Debt Management Offices to ensure effective management and reduce the risk to debt sustainability.

It is, however, worthwhile to note a few limitations to the analysis. The PSTR estimation technique applied does not capture the persistence of primary fiscal balances (lagged primary balance) in establishing the debt threshold. It is reasonable to assume that the fiscal policy stance in the previous year can potentially influence the contemporaneous response of primary fiscal balance to rising debt levels. Allowing for such dynamic effects in the response of primary fiscal balance to debt requires the estimation of a dynamic panel threshold model, which was not explored due to the small number of cross-sectional units (six countries) in the sub-region.

Finally, it may be helpful in future research to decompose the fiscal response function into revenue and expenditure to determine the pattern of adjustments along these components to ensure debt sustainability in the WAMZ.

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