Public Debt Sustainability: Estimating the Fiscal Reaction Function for Uganda
(1981/82 – 2016/17)

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Abstract

This study examines the sustainability of Uganda’s public debt from 1981/82 to 2016/17 using the fiscal reaction function approach. This approach is used to find out whether the government’s reaction to the growing debt is responsive and systematic. The study used annual secondary time series data obtained from the Ministry of Finance, Planning and Economic Development, the Bank of Uganda and the World Bank database for World Development Indicators of 2018. The autoregressive distributed lag estimation approach was used based on the order of integration of the study variables and the presence of a long-run relationship. The results show that in the long run, the government has been able to respond to past debt build-up sustainably by improving the primary balance. However, in the short run, the government has been unresponsive to the debt bulge, which poses risks to debt sustainability. The study suggests that to guarantee debt sustainability in the future, the government should strengthen the primary balance by reducing wasteful expenditures through eliminating corruption, reducing fiscal slippages and supplementary budgets and curbing the creation of more administrative units, which increase the funding burden of the government.

JEL Classification: C22; H63; E62; E62
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I. Introduction

The inquiry about the sustainability of public debt is paramount in the macroeconomic analysis of fiscal policy and public finances. Governments and scholars examine whether the public debt and its projected path are consistent with those of the government’s revenues and expenditures (D'Erasmo, Mendoza, & Zhang, 2016). Bohn (1998) shows that the government is committed to debt sustainability if the primary balance is improved during or in anticipation of periods of increasing public debts.

The national debt stock in developed, emerging market and developing economies is growing at unprecedented levels in history. The developing economies’ debt is predominantly external whereas the developed and emerging market economies’ debt is largely domestic. Historically, the growing public debt in the 1970s and 1980s culminated in a debt crisis in several developing countries (Tanzi & Blejer, 1988; Kumar & Ter-Minassian, 2007).

Following the global financial crisis of 2007–2009, global interest in examining debt sustainability and its implications for macroeconomic stability was rekindled with the possibility of a future global debt crisis anticipated by Reinhart and Rogoff (2011). The European debt crisis, characterised by defaulting governments shows that sovereign debts are not inherently risk-free. The debt sustainability question re-emerged for most African countries after the completion of the Heavily Indebted Poor Countries (HIPC), enhanced HIPC and Multilateral Debt Relief (MDR) initiatives (Diogo, Birdsal, Okonjo-Iweala, Woods, & Robinson, 2017). This is partly attributed to rising debt levels fuelled by increasing domestic and non-concessional borrowing for financing infrastructure and human capital investments. The other factors include weak fiscal institutions, increasing interest payments on debts, decreasing donor support and a reduction in foreign direct investments to non-natural resource sectors (Diogo et al., 2017; Mustapha & Annalisa, 2018).

Uganda’s public debt creates reasonable doubts regarding the government’s solvency because of its bulge, the increasing interest payments and the deteriorating primary balance. The debt is growing at a rate obscuring the HIPC debt relief received from 1997/98, enhanced HIPC debt relief received in 2000/01 and MDR received in 2005/06 that significantly reduced the debt (Teunissen & Akkerman, 2004; Suruma, 2014; MoFPED, 2017b). Figure 1 (see page 29) in the appendix shows that public debt increased from UGX 4.6 trillion in 2006/07 to UGX 33.8 trillion in 2016/17. Of the total debt in 2016/17, the share of domestic debt is 34 percent and external debt is 66 percent (MoFPED, 2017a). The debt to GDP ratio is projected to rise to 47.8 percent in 2020/21 mainly driven by external borrowing to finance infrastructure projects enshrined in the ambitious Vision 2040 (MoFPED, 2018).

The increase in the public debt is explained by the widening fiscal deficit arising from the growing public sector expenditure due to the creation of more local government administrative units, salary increments for public servants in response to continued industrial action and the rampant corruption that has plagued government. Unfortunately, increases in public expenditures are not matched by increases in government revenues hence perpetuating borrowing.

In addition, Figure 2 (see page 29) in the appendix shows that the interest payments increased from UGX 236 billion in 2006/07 to UGX 2,360 billion in 2016/17 whereas the primary balance (government revenue minus noninterest government expenditure) deteriorated from UGX -162
billion to UGX -1181 billion over the same period. The deterioration in the primary balance could be explained by growth in government noninterest expenditure and the deterioration of the current account balance.

During the study period, the government has undertaken reforms and fiscal actions to promote fiscal discipline to ensure debt sustainability. The key reforms include (i) the merging of the Ministry of Finance and Ministry of Planning and Economic Development to integrate planning and budgeting (ii) the formation of Uganda Revenue Authority to improve revenue collection (iii) introduction of a cash flow management system to control government spending and borrowing and (iv) the introduction of the Medium Term Expenditure Framework to improve the allocative efficiency of limited budget resources (Kuteesa, Tumusiime-Mutebile, Whitworth, & Williamson, 2010). Other actions include the introduction of the commitment control system to address the problem of domestic expenditure arrears and the lobbying for and reception of debt relief (involving debt rescheduling, forgiveness and debt buyback) to reduce Uganda’s debt burden (Kuteesa et al., 2010). In addition, the government came up with strategies to improve debt management including the Debt Strategy (1991), the Enhanced Debt Strategy (1995), the Debt Strategy (2007) and the Public Debt Management Framework (2013) (MoFPED, 2007; Kuteesa et al., 2010; MoFPED, 2013). These actions have partly contributed to fiscal discipline and have also enabled the government to keep the debt within sustainable limits.

Previous studies argue that the growth of developing countries greatly depends on macroeconomic stability supported by country-specific policies (Azam, Fosu, & Ndung’u, 2002). Uganda’s fiscal policy aims at ensuring macroeconomic stability to support inclusive and sustainable economic growth and socio-economic transformation (MoFPED, 2017c). However, economic growth has slowed down since 2011/12, and the current expansionary fiscal policy characterised by the growing debt is yet to stimulate it. The growing debt levels are precursors to instability in key macroeconomic variables like inflation and exchange rates by straining foreign reserves and budget resources (Murandafu, 2007; MoFPED, 2016a).

Several studies assess the state of Uganda’s public finances and debt sustainability position. Some studies indicate that debt sustainability is compromised by large fiscal deficits (Wamala, 1994; Mugabi, 2004), the ever-increasing external debt (Muvawala, 1998) and the burgeoning domestic debt (Hisali & Guloba, 2013). Ejalu (2016) shows that Uganda’s fiscal policy is unsustainable because there is no cointegrating relationship between government expenditure and taxes. In contrast, Debt Sustainability Analysis (DSA) studies by the Ministry of Finance, Planning and Economic Development (MoFPED) and the International Monetary Fund (IMF) show that Uganda’s debt is sustainable (and is no cause for concern)1 in the medium term and long term (MoFPED, 2017a; IMF, 2016a). The MoFPED (2017a) study shows that Uganda moved from low to moderate risk of debt distress due to projection of a higher rate of debt accumulation in the medium term driven by borrowing for infrastructural development. It also highlights vulnerabilities and risks such as low domestic revenues, lower exports and real GDP growth, worsening borrowing terms and sustained exchange rate depreciation.

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1 The fiscal rules, particularly the ceiling of 50 percent of GDP on public debt in net present value (NPV) terms seems to weaken the governments’ response to the growing debt. This rule is meant to be achieved by 2020/21 and the debt-GDP (NPV terms) was 27.1 percent in 2016/17 (MoFPED, 2017a). The large gap between the target (fiscal rule) and the actual debt-GDP (NPV terms) might encourage increased borrowing with limited restraint.
Previous studies provide evidence on the state of Uganda’s public finances and debt sustainability, however, they overlook the role of fiscal policy responses in ensuring debt sustainability in the face of growing public debts. Given Uganda’s development aspirations and immense financing needs, borrowing remains inevitable (hence, the trend exhibited in Figure 1 is likely to continue) and yet the global development finance landscape has evolved with a reduction in Official Development Assistance. For example, from 2010/11 to 2016/17, International Development Association’s share in total public debt reduced from 61.9 percent to 45.2 percent while China’s share increased from 3.3 percent to 20.3 percent (MoFPED, 2017a). The changing economic and financing conditions raise concerns on how Uganda can finance its sustainable development aspirations and maintain debt sustainability.

The general objective of this study is to assess the extent to which fiscal policy has been instrumental in ensuring debt sustainability in Uganda. The key research question answered by this study is; is the Ugandan government systematically adjusting its primary balance in response to growing public debt?

The present study contributes to the existing literature on Uganda’s fiscal policy in the following ways. First, previous studies focused on how the growing fiscal deficits and debts compromise the sustainability of debt and public finances (Wamala, 1994; Mugabi, 2004; Muvawala, 1998; Hisali & Guloba, 2013). However, this study provides evidence on the government’s fiscal policy response (proxied by the primary balance) to increases in the public debt by adjusting the primary balance, despite the frequent primary budget deficits. Second, Ejalu (2016) focuses on fiscal sustainability by examining the presence of a cointegrating relationship between fiscal variables and fiscal policy adjustments to the output gap and deficits. This study uses the primary balance as the response variable and considers other independent variables like the temporary fluctuations in the noninterest government expenditures (expenditure gap), the current account balance, debt relief, fiscal rules and elections that influence the government’s fiscal policy actions. Third, this study uses the fiscal reaction function approach to identify the government’s reaction to debt accumulation. Earlier studies have employed approaches such as the IMF Debt Sustainability Framework [DSF] (MoFPED, 2017a; IMF, 2016a), present value budget constraint approach (Ejalu, 2016) and the accounting approach (Hisali & Guloba, 2013; Mugabi, 2004) to examine the sustainability of Uganda’s debt, fiscal policy and public finances. However, these approaches are unable to provide evidence on the government’s past response to growing public debts.

The rest of the study is organised as follows: chapter two provides the reviewed theoretical and empirical literature. Chapter three describes the methodology and the data used in the study. The fourth chapter presents the results, their interpretation and discussion. The study concludes with chapter five that presents a summary of the study, conclusion, policy recommendations, the study limitations and the areas for further research.
II. Literature Review

2.1 Theoretical Literature review

2.1.1 Present Value Budget Constraint
The present value budget constraint (PVBC) has been the starting point for the analysis of debt and fiscal sustainability in several country-specific and cross-country studies (Burnside, 2005). This approach uses econometric tests of stationarity of government debt and a cointegrating relationship between debt and primary balance to examine debt sustainability. Quintos (1995) argued that countries have limits to borrowing and face a present value borrowing constraint. Therefore, governments balance their budgets inter-temporarily by setting the current value of debt equal to the discounted summary of expected future surpluses. Fiscal policy and a country’s public debt are unsustainable if the intertemporal budget constraint is violated since the public debt growth rate exceeds the economic growth rate. Romer (1996) asserts that countries that embark on unsustainable fiscal policies have an ever-increasing debt to GDP ratio that violates their budget constraint. The PVBC approach has been criticised for estimating the transversality condition that involves discounting the government debt at a given interest rate (Bohn, 1998). Therefore, this test is sensitive to the choice of discount rates.

2.1.2 Debt stabilising primary balance
This approach focuses on the long run implications of a deterministic version of the intertemporal government budget constraint. It uses the government budget constraint evaluated at steady state as a condition relating the long run primary balance as a share of GDP and the debt to GDP ratio (Buiter, 1985; Mauro, Romeu, Binder, & Zaman, 2013). The two sustainability conditions are the No-Ponzi-Game and the intertemporal budget constraint where the present value of public debt must asymptotically converge to zero, which correspondingly means that the already existing debt amount must be paid off by future primary surpluses. This approach also requires the calculation of the primary balance required by the government to ensure that the debt remains sustainable. Ley (2010) argues that the larger the real interest – growth differential (the difference between real interest rate and real GDP growth rate), the larger the required debt stabilising primary balance. This approach is partly flawed since it only defines the long run debt for a given long run primary balance (or vice versa) if stationarity holds, or defines lower bounds on the short run dynamics of the primary balance. Secondly, this approach does not account for uncertainty and considerations about the asset market structure (D’Erasmo et al., 2016).

2.1.3 Fiscal reaction function
Sims (1994) makes a conceptual distinction between passive (Ricardian) fiscal policy and active (non-Ricardian) fiscal policy with the former not pragmatically stabilising government debt whereas the latter does. Bohn (1998) argues that earlier fiscal and debt sustainability tests are inconsistent and ambiguous because they do not adjust for temporary fluctuations in GDP and noninterest public expenditures. He proposed an approach that emphasises the role of stable fiscal policy reactions in dealing with accumulating debts. In this case, debt sustainability is a result of the revealed behaviour of the fiscal authorities. This approach entails estimating fiscal policy reaction functions that are similar to the Taylor reaction functions in monetary policy. The fundamental concern for this method is whether the primary balance is systematically raised when the debt level rises. Bohn (2011) further asserts that debt sustainability is achieved if the primary balance responds positively to changes in the debt to GDP ratio.
This approach has the following advantages (i) it does not estimate likely shocks and their respective probabilities, (ii) it makes no assumptions about interest rates, (iii) it does not determine the acceptable debt level thereby avoiding the contentious Country Policy Institutional Assessment process by the IMF-DSF and (iv) it identifies whether the debt is unsustainable because of undisciplined past policies or because of adverse shocks (Wyplosz, 2005). D’Erasmo et al. (2016) also commend this approach for providing a direct and powerful method for conducting non-structural empirical tests that are sufficient to satisfy fiscal solvency because they require data on the primary balance, outstanding debt and a few control variables. The main weakness of this approach is that it is backward-looking (Wyplosz, 2005; Baldi & Staehr, 2013). In other words, this approach uncovers the fiscal response to the debt within the estimation sample without indicating the fiscal reaction to debt in the future.

2.1.4 IMF Debt Sustainability Framework
The IMF uses different approaches to evaluate debt sustainability accounting for the country’s level of development, the burden of debt and the ability to borrow from different sources. The formal frameworks for conducting public and external debt sustainability analyses (DSAs) include the DSF for low-income countries and the DSF for market access countries. The DSF aims at assessing the country’s debt position, vulnerabilities in the debt structure and the alternative debt stabilising policy actions (IMF, 2017). While conducting DSAs, the framework considers a baseline scenario (based on macroeconomic projections of the government’s intended policies) and applies sensitivity tests to the baseline scenario. The country’s vulnerability to debt distress is assessed based on the projected paths of the various debt indicators under the baseline scenario and the stress. Uganda is assessed using the standardised joint World Bank/IMF DSF-LICs with independent DSAs carried out by MoFPED and IMF. This approach has been criticised by Wyplosz (2005) and Debrun, Celasun and Ostry (2006).

2.2 Empirical review

2.2.1 Present value budget constraint
Empirical evidence on the consistency of fiscal policy with the PVBC has generated different results. For example, Hamilton and Flavin (1986) examined the sustainability of fiscal policy in the United States (U.S) using data from 1960 to 1984. They sought to find out how long the government budget deficits could continue unchecked giving rise to issues about the desirability and feasibility of perpetual deficits. They tested for the presence of unit roots in the real deficit and the real debt to find out whether the PVBC was met. They found that the discounted debt was stationary (an indicator for sustainability), thus concluding that the fiscal policy was sustainable. However, they assert that, for government to continue issuing interest-bearing debt, it must promise to balance its budget in expected present value terms.

Trehan and Walsh (1988) examined the sustainability of fiscal policy in the U.S. using data from 1890 to 1896. Unlike, Hamilton and Flavin (1986) that focused on deficit exclusive of interest payments, they focused on the deficit inclusive of interest payments. They tested for cointegration between government expenditures inclusive of interest, tax revenues and revenues from seignorage to find out whether the government violated the intertemporal budget constraint and whether the deficit inclusive of the interest is stationary. They found that the government’s fiscal policy was consistent with the intertemporal budget balance and that government expenditure inclusive of interest is stationary. Therefore, they concluded that fiscal policy was sustainable. However, their results indicated that the tax-smoothing hypothesis does not hold.
Wilcox (1989) extended Hamilton and Flavin’s (1986) framework by allowing for stochastic real interest rates and non-stationarity in the noninterest surplus. He examined the sustainability of fiscal deficits in the U.S. and finds that the fiscal policy was not sustainable (if it was allowed to continue indefinitely) since it would not ensure that the forecast trajectory for the discounted value of the debt would converge to zero. This finding is contrary to Hamilton and Flavin’s (1986) and Trehan and Walsh’s (1988) findings.

Ejalu (2016) examined fiscal sustainability for Uganda, Kenya, Burundi, Rwanda and Tanzania using data from 1980 to 2016. She also examined the fiscal policy adjustments using both linear and nonlinear adjustments of fiscal variables. She found that there was no long run (cointegrating) relationship between taxes and expenditure for Uganda thus concluding that Uganda’s fiscal policy was not sustainable during that study period. Ejalu (2016) also finds no evidence of budgetary correction or tax response to the output gap and deficits. However, she does not account for other economic shocks that the fiscal reaction function accounts for.

2.2.2 Fiscal Reaction Function Approach

Bohn’s (1998) seminal paper addresses the question about fiscal and debt sustainability by examining the reaction of primary balance to debt accumulation. He examined the behaviour of U.S. public debt and deficits using data covering the period from 1916 to 1995. He sought to find out the government’s response to debt accumulation basing on Barro’s (1979) tax smoothing theory. He estimated the fiscal reaction function and found that the government responded to the increasing debt to GDP ratio by raising the primary surplus (or reducing the primary deficit). He thus concluded that the U.S. fiscal policy was sustainable.

Studies extend Bohn’s approach to developed and emerging market economies. For example, Mendoza and Ostry (2008) examine fiscal solvency and public debt sustainability in both using data from 1970 to 2005. They find that the primary balance response was positive in both industrial and emerging market economies. Similarly, Ghosh, Kim, Mendoza, Ostry and Qureshi (2013) study the extent to which public debt in 23 advanced economies over the period of 1970 to 2007 can increase without compromising fiscal solvency. They extend Bohn’s approach by including a nonlinear stochastic model specification allowing for sovereign default risk. They find a strong positive response of the primary balance to lagged debt at moderate levels but the response is weaker at high debt levels especially around 90-100 percent of GDP.

The other studies considering developed and emerging market economies focused on the long run and short run response of the primary balance to changes in the debt. These include Jeong (2014) for U.S., United Kingdom and South Korea; Berti, Colesnic, Desponts, Pamies and Sail (2016) for Finland and Belgium; Pamungkas (2016) for Indonesia; Shastri, Giri and Mohapatra (2017) for Bangladesh, Pakistan, India and Sri Lanka and Barbier-Gauchard and Mazuy (2018) for European Union countries. These studies provide mixed evidence concerning the sustainability of public debts in the different countries in the short and long run.

For example, Barbier-Gauchard and Mazuy (2018) estimate the fiscal reaction functions using data from 1990:Q1 to 2017:Q2. First, they observed that Austria, Belgium, Germany and Finland responded positively to increases in debt in both the short and long run. Second, they find that Lithuania, Malta, Slovakia and Slovenia positively responded to debt in the long run but with a negative response in the short run. Third, they find that Greece and Italy’s primary balances
responded negatively to the growing debts in the long run but with a positive response to debt in the short run. Lastly, they find that the primary balance of Portugal and Spain negatively responded to public debt growth in both the short and long run.

Previous studies also estimated the fiscal reaction functions for developing countries. Ghatak and Sánchez-Fung (2007) estimated fiscal reaction functions for Peru, the Philippines, South Africa, Thailand and Venezuela with data from 1971 to 2000 using ordinary least squares (OLS). They found that fiscal policy for all countries was not sustainable since they did not increase their primary balance in response to the growing debt. Burger, Stuart, Jooste and Cuevas (2012) also estimate the fiscal reaction function for South Africa using OLS, Vector Autoregression (VAR), Threshold autoregressive (TAR), General method of moments (GMM), State-Space modelling and Vector error correction mechanism (VECM). The study estimates models using fixed parameters for the 1974-2008 period while only the state-space model is estimated for the 1946-2008 period. They find that the government implemented a sustainable fiscal policy guaranteeing debt sustainability. The differences in the study periods might explain the different results obtained by Ghatak and Sánchez-Fung (2007) and Burger et al. (2012) for South Africa. In addition, South Africa’s debt to GDP ratio reduced further from 2000 until 2008. This shows the sensitivity of results to the period, the estimation technique used and the evolution of debt.

Other developing country studies also focus on the short run and long run response of the primary balance to debt. These include Asiama, Akosah and Owusu-Afriyie (2014) for Ghana, Amankwah, Ofori-Abedrese and Kamas (2018) for Ghana and Makau, Ocharo, and Njuru (2018) for Kenya. The study by Amankwah et al (2018) estimated the fiscal reaction function for Ghana using the autoregressive distributed lag (ARDL) approach for the period covering 1990 to 2016. They find that there is a positive relationship between the primary balance and the growing public debt in the long run. However, the short run response to debt was negative in the long run.

2.2.3 Other Uganda specific studies
Wamala (1994) studied the sustainability of the public sector deficit in Uganda for the period covering 1970 to 1993 and he finds that the fiscal deficit was unsustainable. Mugabi (2004) used the accounting approach (based on solvency) to examine the sustainability of fiscal deficits in Uganda between 1988 and 2003. He observes that the level of public sector deficits, given the macroeconomic conditions at the time, was unsustainable and that this compromised the sustainability of the country’s public debt. Muvawala (1998) finds that the burgeoning external public debt compromised the sustainability of external debt. Hisali and Guloba (2013) employ the accounting approach to fiscal policy consistency to analyse the sustainability of fiscal policy. They observe that the consolidated deficits were consistent with the attainment of the inflation and GDP growth rate targets. However, they argue that the inflation target was achieved at the cost of an unsustainable domestic debt.

The IMF and MoFPED have also conducted separate DSAs for Uganda. The previous DSAs indicate that Uganda’s burgeoning public debt is sustainable in the medium and long term at low risk of debt distress (IMF, 2015; MoFPED, 2016b; IMF, 2016a). However, the recent DSA by the MoFPED shows that the debt has moved to moderate risk of debt distress, though still sustainable (MoFPED, 2017a). However, the rapidly rising debt justifies reasonable doubts about solvency and fiscal stability thereby undermining the fiscal strategy built on the perception that Ugandan debt is safe and no cause for concern.
III. Methodology

3.1 Theoretical Framework
The key aspects of assessing the sustainability of public debts are solvency and liquidity. The government is solvent if it satisfies the intertemporal budget constraint whereas it is liquid if the instantaneous budget constraint is met. This study follows the solvency aspect of debt sustainability based on the fiscal reaction function approach of assessing debt sustainability pioneered by Bohn (1998). This approach investigates the fiscal policy response of the government in coping with debt accumulation over time. The study assumes that the government increases the primary balance in response to rising debts to stabilise the public debt to GDP ratio.

Considering a real economy, the study postulates that the government cannot rely on money creation to reduce the value of its outstanding public debt. Following Bohn (1998), the starting point for the analysis of the sustainability of the public debt is the standard government budget constraint which describes the accumulation of public debt:

$$d_{t+1} - d_t = r_t d_t - s_t,$$  

where $d_{t+1} = \frac{D_{t+1}}{Y_{t+1}}$, is the debt to GDP ratio in period $t+1$, $Y_{t+1}$ is the real gross domestic product in period $t+1$, $d_t = \frac{D_t}{Y_t}$, is the debt to GDP ratio in period $t$, $D_t$ is the debt in period $t$, $Y_t$ is the real gross domestic product in period $t$, $s_t = \frac{S_t}{Y_t}$, is the primary balance to GDP ratio, $S_t$ is the primary balance (government revenue minus noninterest government expenditure) in period $t$ and $r_t$ is the real interest rate on debt contracted in period $t$. Therefore $r_t d_t$ is the real interest payment on government debt in period $t$. In other words, equation (1) means that the change in government debt (left-hand side of equation [1]) is equal to the real interest payment on debt minus the primary balance (right-hand side of equation [1]).

Theoretically and fundamentally, the government follows a sustainable debt policy when (i) the present value of the public debt converges to zero asymptotically (or the intertemporal budget constraint is satisfied), (ii) the government does not play a Ponzi game (government should not issue more debt without servicing the existing debt by rolling it over with interest) and (iii) the government should be able to service its debt even under adverse conditions (Bohn, 2011).

From equation (1), the study seeks to find a systematic relationship between the primary balance to GDP and the debt to GDP ratio. In line with Bohn (1998), the study assumes that the government chooses a primary balance to GDP ratio that is a positive linear function of the debt to GDP ratio and other non-debt determinants. Therefore, the governments’ fiscal reaction function (i.e. the response of primary balance to public debt) can be written as:

$$s_t = \alpha_d d_t + \mu_t + \varepsilon_t,$$  

where the coefficient $\alpha_d$ measures the responsiveness of the primary balance to changes in the debt ratio, $\mu_t$ captures all the systematic non-debt determinants of the primary balance and $\varepsilon_t$ is the independent and identically distributed error term. The first term on the right-hand side of
equation (2) indicates that the primary balance increases with an increase in the debt. The reaction function shows that the sufficient condition for debt sustainability is that the government reacts systematically to increases in government debt by adjusting the primary balance.

The choice of the non-debt determinants and other control variables is influenced by the existing theories. First, the study relies on tax smoothing theory which argues that fiscal deficits respond primarily to recessions, temporarily high government expenditures and anticipated inflation (Barro, 1979; Barro, 1986). The government is assumed to finance its expenditures either through current taxation or by issuing public debt. Therefore, the excess burden of taxation can be minimised, maintaining a relatively stable tax rate rather than raising it in one period or lowering it in another, by running budget deficits or surpluses. First, the tax smoothing theory proposes the use of budget deficits (surpluses) in case of temporary increases (decreases) in government spending. Second, budget deficits (surpluses) are feasible when the economy is contracting (expanding). This enables the government to avoid abnormally high tax rates during periods when its expenditures are unusually high or when output is low by borrowing. The non-debt determinants provided by this theory include the temporary fluctuations in noninterest government expenditure and the cyclical fluctuations in output or GDP. The proxy for temporary fluctuations in noninterest government expenditure is the expenditure gap to GDP (GVAR) and the proxy for the cyclical fluctuations in output is the output gap to GDP (YVAR).

The inclusion of tax smoothing theory variables (GVAR and YVAR) accounts for the potential impact of omitted variables hence ensuring that the model is correctly specified and consistent (Bohn, 1998). In line with Barro’s (1986) tax smoothing theory, $\mu_t$ is defined as,

$$\mu_t = \alpha_g GVAR_t + \alpha_y YVAR_t$$

(3)

where $GVAR_t = \frac{G_t - G_t^*}{Y_t}$ and $YVAR_t = \left[1 - \left(\frac{Y_t}{Y_t^*}\right) \cdot \left(\frac{G_t^*}{Y_t^*}\right)\right]$, where $G_t$ is the noninterest government expenditure (i.e. government expenditure exclusive of interest payments), $G_t^*$ is the trend noninterest government expenditure, and $Y_t^*$ is the trend GDP. The trend GDP and government expenditure are obtained by applying the Hodrick-Prescott filter. Substituting equation (3) into (2) yields the following equation:

$$s_t = \alpha_0 + \alpha_d d_t + \alpha_g GVAR_t + \alpha_y YVAR_t + \varepsilon_t$$

(4)

According to the tax smoothing theory, the term GVAR in equation (4) indicates that the primary balance decreases when the government expenditure is above potential (i.e. when $G_t > G_t^*$ ). Intuitively, for a developing country like Uganda, GVAR is important because financing key sectors (with temporarily high expenditures) like the security sector and the works and transport sector tend to increase the budget deficit, and, as long as insecurity or infrastructure gaps prevail, trigger high fiscal deficits which decrease the primary balance. On the other hand, the term YVAR indicates that the primary balance decreases when the output is below potential (i.e. when $\frac{Y_t}{Y_t^*} < 1$). The output gap also depends on the trend noninterest government expenditure $G^*$. Therefore the effect of cyclical fluctuations on the primary balance to GDP depends on the ratio,
The variable, YVAR, is equally important because the government undertakes actions to stimulate economic activity when the economy is contracting through deficit financing instead of raising taxes since the economy is not performing well.

Second, the study relies on the twin deficits hypothesis that argues that there is a strong positive relationship between the government’s fiscal balance and the current account balance. There is a debate in the empirical literature on the direction of causation with different studies providing inconclusive evidence. First, some studies indicate unidirectional causality from the fiscal deficit to the current account balance (Nickel & Vansteenkiste, 2008; Sakyi & Opoku, 2016). Second, others show unidirectional causality from the current account deficit to the budget deficit (Summers, 1988; Marinheiro, 2006; Sobrino, 2013). Third, studies show the existence of bidirectional causality (Mukhtar, Zakaria, & Ahmed, 2007; Bakarr, 2014). Lastly, some studies find no causality between the deficits in any direction (Ferda & Kasim, 2013). Therefore, the inclusion of the current account balance makes it possible to test, in particular, the hypothesis of twin deficits in the case of Uganda. Equation (4) is extended to include the current account balance as a component of \( \mu_t \).

\[
s_t = \alpha_0 + \alpha_g GVAR_t + \alpha_y YVAR_t + \alpha_c cab_t + \varepsilon_t
\]

where \( cab_t = \frac{CAB_t}{Y_t} \) is the current account balance to GDP ratio and CAB is the current account balance. The term \( cab_t \) in equation (5) indicates that the primary balance increases with an increase in the current account balance.

Third, the study relies on debt relief literature. The provision of debt relief to heavily indebted poor countries is expected to reduce the respective countries’ debt burdens while ensuring debt sustainability. This would consequently enable them to improve their fiscal balances due to reductions in the debt servicing obligations and reception on debt relief funds that have been reallocated to social economic services thus relieving pressures on government expenditure. Uganda has benefited from debt relief initiatives including write-offs, new loans to service payments falling due, social infrastructure grants and contributions to HIPC trust fund to service payments falling due (BOU, 1999; Teunissen & Akkerman, 2004; Suruma, 2014; MoFPED, 2017b). The study includes a debt relief dummy to analyse its effect on the primary balance in the case of Uganda.

Fourth, according to fiscal rules literature, rules aim at influencing the fiscal administration of the government to ensure fiscal discipline and fiscal responsibility. Fiscal rules are long-lasting constraints on fiscal policy through numerical limits on budgetary aggregates (IMF, 2016b). In November 2013, Uganda consented to the East African Monetary Union (EAMU) convergence criteria. According to the criteria, countries should keep their gross public debt below 50 percent of GDP in net present value (NPV) terms and a budget balance rule (including grants) of 3 percent of GDP (United Nations Economic Commission for Africa, 2018). The fiscal rule dummy is used to study the influence of fiscal rules’ on the primary balance in the case of Uganda.

Lastly, the political business cycle theory posits that the incumbent government runs expansionary fiscal policy before an election to influence election outcomes in their favour.
(ensuring re-election). Previous studies argue that voters interpret this boom (due to expansionary fiscal policy) as an indicator of government competence hence reward it by voting them back into the office (Rogoff, 1990; Alesina, Roubini & Cohen 1997). This fiscal policy action tends to worsen the fiscal position by widening fiscal deficits. Therefore, this study considers an election dummy to examine the effect of elections on the primary balance.

3.2 Econometric Model Specification
The systematic empirical model applied to annual observations follows from equation (5). It is augmented by including the debt relief dummy, fiscal rules dummy and the elections dummy. The econometric model of this study is specified as:

\[ s_t = \alpha_0 + \alpha_d d_t + \alpha_g \text{GVAR}_t + \alpha_y \text{YVAR}_t + \alpha_c \text{cab}_t + \alpha_r \text{drelief}_t + \alpha_f \text{frule}_t + \alpha_e \text{elec}_t + \varepsilon_t \]  

(6)

The theory has the following expectations for the coefficients. (1) The coefficient \( \alpha_d \) is expected to be positive if the government is committed to reducing or maintaining a steady debt-GDP ratio conditional on non-debt determinants. Under weak conditions, this implies that fiscal policy is sustainable in the sense that maintaining such a policy for an indefinite period would satisfy a nation’s long run government intertemporal budget constraint. (2) The coefficient \( \alpha_c \) is expected to be negative since temporary increases in government expenditure would induce the government to decrease its primary balance due to increases in deficits financed by borrowing. (3) The coefficient \( \alpha_y \) is expected to carry a negative sign since the primary balance would decrease if the economy is contracting because the government would be expected to borrow to stimulate the economy through running deficits. (4) The coefficient \( \alpha_c \) is expected to be positive since an improvement in the current account balance leads to an improvement in the primary balance. (5) The coefficient \( \alpha_r \) is expected to be positive since debt relief is assumed to improve the primary balance. (6) The coefficient \( \alpha_f \) is expected to be positive since fiscal constraints aim at improving the fiscal behaviour of the government hence leading to improvements in the primary balance. (7) The coefficient \( \alpha_e \) is expected to be negative since using expansionary fiscal policy (through deficits) to influence elections worsens the primary balance.

3.3 Variables
This study chose these variables based on the theoretical relationship between the dependent variable and independent variables and their inclusion in earlier studies. The dependent variable is the primary balance to GDP \((s_t)\) and the independent variables are debt to GDP \((d_t)\), expenditure gap to GDP \((\text{GVAR}_t)\), output gap to GDP \((\text{YVAR}_t)\) and current account balance to GDP \((\text{cab}_t)\). The dummies include the debt relief \((\text{drelief}_t)\), fiscal rule \((\text{frule}_t)\) and election \((\text{elec}_t)\).

**Primary balance to GDP:** The primary balance is the fiscal balance exclusive of interest payments on public debt.² It is computed as the government revenue minus the noninterest government expenditure. The primary balance is scaled by real GDP. As a measure of

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² Uganda’s government revenue is equivalent to tax revenue plus grants since grants play a key role in financing government expenditure. Therefore, this study considers this definition of government revenue. The primary balance is therefore equivalent to government revenue minus government expenditure exclusive of interest payments.
government’s fiscal response, the primary balance is preferred to the cyclically adjusted primary balance because it shows the total fiscal impulse of the government to growing debts and it is observable hence making it less prone to ex-post revisions (Checherita-Westphal & Žďárek, 2017). Additionally, the government can easily control its primary expenditures. Lastly, the use of the primary balance helps to evaluate the impact of automatic stabilisers and discretionary policy action. Previous studies that used this variable include Bohn (1998), Baldi and Staehr (2013) and Checherita-Westphal and Žďárek (2017).

**Debt to GDP ratio:** The quantity of the total public debt is the outstanding stock of debt (both domestic and external) at the end of each fiscal year. The total public debt is scaled by real GDP. The inclusion of this variable facilitates the analysis of the primary balance’s reaction to the level of public debt, which signifies whether the government is responsible enough to guarantee debt sustainability. This variable has been used in studies such as Bohn (1998), Ghatak and Sánchez-Fung (2007), Burger et al. (2012), Mauro et al. (2013) and Amankwah et al. (2018).

**Expenditure gap to GDP:** This variable is a proxy for the temporary fluctuations in noninterest expenditures. The study uses the Hodrick-Prescott filter to obtain the trend component of noninterest government expenditure. The study calculates the expenditure gap by subtracting the trend of noninterest government expenditure from the realised values. This variable is then scaled by real GDP. Similar studies that use this variable include Bohn (2008), Jeong (2014) and Shastri et al. (2017).

**Output gap to GDP:** This variable is a proxy for the temporary fluctuations in real GDP over time and it represents the business cycle component. The study uses the Hodrick-Prescott filter to obtain the trend component of real GDP. The study calculates the output gap by subtracting the actual GDP values from the potential GDP. The difference is divided by the potential GDP. This variable has been used by Bohn (1998) and Ghatak and Sánchez-Fung (2007). The study uses the output gap to GDP to test the response of the primary balance to cyclical variations in GDP.

**Current account balance to GDP:** The current account balance is a component of the balance of payments. It consists of the trade balance, the net factor income and net cash transfers. In this study, the current account balance inclusive of grants is considered since Uganda is a recipient of grants which play a key role in its fiscal expenditure. The current account balance is expressed as a ratio of real output. Studies like Checherita-Westphal and Žďárek (2017) and Makau et al. (2018) have used this variable to test the twin deficits hypothesis.

**Debt relief dummy:** This is a binary variable capturing the effect of debt relief on the primary balance. This dummy is equal to one from 1997/98 to 2016/17 and zero from 1981/82 – 1996/97. Earlier studies that used this variable include Asiama et al. (2014).

**Election dummy:** This dummy captures the effect of the political budget cycle (proxied by the presidential and parliamentary elections) on the primary balance. This dummy is equal to one for the year preceding the election, the election year and the year after elections (1994/95 – 1996/97, 1999/00 – 2001/02, 2004/05 – 2006/07, 2009/10 – 2011/12 and 20014/15 – 2016/17) and zero for other years. This variable has been used by Galli and Padovano (2008), Asiama et al. (2014), Pamungkas (2016) and Checherita-Westphal and Žďárek (2017).
The fiscal rule dummy: This dummy captures the effect of the supranational fiscal rules on the primary balance. It is equal to one from 2013/14 to 2016/17 and zero for the other years. Previous studies using fiscal rules are Checherita-Westphal and Žďárek (2017) and Barbier-Gauchard and Mazuy (2018).

3.4 Estimation Procedure
3.4.1 Unit root tests
This study uses the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests which examine the null hypothesis of a unit root against the trend stationarity alternative (Dickey & Fuller, 1979; Phillips & Perron, 1988). The study accounts for the presence of structural breaks that bias the results of the ADF and PP tests. These tests include the Zivot and Andrews (1992) unit root test which deals with only one structural break and the Clemente, Montanes and Reyes (1998) test which allows for one or two structural breaks. The Zivot and Andrews (1992) endogenous structural break test utilises the full sample, using different dummy variables for each break date and it tests the joint hypothesis of a unit root with no break in the series. The Clemente et al. (1998) test treats the break dynamics in two ways. First, the innovation outlier (IO) model assumes that the structural break occurs gradually, with the breaks following the same dynamic path as the innovations. Second, the additive outlier (AO) model which assumes the structural break occurs immediately. This study used the additive outlier approach because it can detect a sudden change in a series over time.

3.4.2 Cointegration test
The standard economic theory suggests that some variables are linked by a long run relationship (are cointegrated). The presence of a cointegrating relationship between variables implies that they may drift away from each other in the short run. Therefore, it is expedient to examine the presence of a cointegrating relationship between the study variables. The key approaches to testing cointegration include the Engle and Granger (1987) two-step approach based on assessing whether the single-equation estimates of the equilibrium errors are stationary, the Johansen (1991) test is based on the VAR approach and the Pesaran, Shin and Smith (1996, 2001) Autoregressive Distributed Lag (ARDL) bounds test approach. The choice of the approach to use in testing for cointegration depends on the stationarity properties of the study variables.

The Engle and Granger (1987) method is advantageous because it is economical and super-consistent. However it has the following limitations: (i) it is not applicable in case there is more than one cointegrating relationship since it assumes that there is a unique cointegrating variable, (ii) an error made in the first step will be carried in the second step since it is a two-step approach and (iii) it carries a finite sample bias which implies that superior estimates could be obtained by accounting for short run dynamics. The Johansen (1991) approach resolves the first limitation because it can be used in the presence of multiple cointegrating vectors. These two approaches are not applicable in case the study variables have different orders of integration (i.e. order one and order zero).

However, the Pesaran, Shin and Smith (1996, 2001) test is applicable in case variables have different orders of integration but not in the case of I (2) variables. It also has other advantages including: (i) it does not have an endogeneity problem; (ii) it can be used in small samples; (iii) the ARDL model is also suitable for forecasting and for disentangling long run relationships from short run dynamics. However, this approach can only be used in a single equation and on the assumption of one cointegration relationship which makes it less general than the Johansen approach (1991).
The ARDL Model
The study specifies the generalised ARDL Model \((p, q)\) as follows:
\[
y_t = c_0 + \sum_{i=1}^{p} \phi_i y_{t-i} + \sum_{i=0}^{q} \beta_i x_{t-i} + \varepsilon_t,
\]
where \(y_t\) is a vector and the variables in \(X_t\) are purely I (0) and I (1) or cointegrated; the coefficients are \(\phi_i\) and \(\beta_i\); the constant is \(c_0\); \(i=1,\ldots,k\) while \(p\) and \(q\) are the optimal lags. The study assumes that \(p \geq 1\) and \(q \geq 0\). For this study, the lag order \(q\) for all variables is chosen based on the Schwarz Bayesian information criterion (SBIC) which selects a more parsimonious model. The vector of error terms is \(\varepsilon_t\). The model shows that the dependent variable is a function of its lagged values, the current and lagged values of the exogenous variables.

Reparameterisation of model 7 in conditional error correction form gives rise to:
\[
\Delta y_t = c_0 - \lambda (y_{t-1} - \partial x_t) + \sum_{i=1}^{p-1} \alpha_i \Delta y_{t-i} + \sum_{i=0}^{q-1} \alpha_i \Delta x_{t-i} + \varepsilon_t.
\]
The speed of adjustment coefficient \(\lambda = 1 - \sum_{i=1}^{p} \phi_i\) measures the strength of the dependent variable’s response to a deviation from the equilibrium relationship in one period. The long run coefficients \(g = \sum_{i=0}^{p} \frac{\phi_i}{\lambda}\), show the equilibrium effects of the independent variables on the dependent variable. The short run coefficients \(\alpha_y, \alpha_x\) represent the short run fluctuations unaccounted for by distortions from the long run equilibrium. The equilibrium error correction term (ECT) is given by: \(ECT = y_{t-1} - \partial_{mf}\).

To test for the existence of cointegration among the variables included in the model, this study uses the critical values obtained by Kripfganz and Schneider (2019) because they are better than the near-asymptotic critical values by Pesaran et al. (2001) and the finite sample critical values by Narayan (2005). The null of no cointegration is not rejected if the F-statistic is closer to zero than the lower bound of the critical values. The null is rejected if the F-statistic is more extreme than the upper bound of the critical values.

In the presence of a long run relationship, the fiscal reaction function specified in an unrestricted error correction model form will be estimated to examine the long run and short run relationship. Similarly, the speed of adjustment from the short run disequilibrium toward the long run equilibrium is estimated. The estimated fiscal reaction function is specified as follows:
\[
\Delta s_t = \alpha_0 + \sum_{i=1}^{s} \alpha_i \Delta s_{t-i} + \sum_{i=1}^{d} \alpha_i \Delta d_{t-i} + \sum_{i=1}^{y} \alpha_i \Delta y_{t-i} + \sum_{i=1}^{g} \alpha_i \Delta g_{t-i} + \alpha_{i} \Delta ab_{t-i} + \alpha_{i} \Delta relief_{t-i} + \alpha_{i} \Delta flue_{t-i} + \alpha_{i} \Delta elec_{t-i} + \varepsilon_t
\]

3.4.3 Hodrick-Prescott filter
The Hodrick and Prescott (1997) filter is used to obtain the trend components of real GDP and the government’s noninterest expenditure. The Hodrick-Prescott (HP) filter is applied to data from various data generating processes to separate a time series into different trend and cyclical components. This approach specifies a trend in the data and then filters the data by removing a trend. The smoothing parameter determines the smoothness of the trend and different studies have set the smoothing parameter to 400, 100 and 25. However, Ravn and Uhlig (2002) conclude
that the smoothing parameter should be adjusted according to the fourth power of a change in the frequency of observations. Their value was close to that proposed by Baxter and King (1999). This study sets the smoothing parameter to 100 for annual fiscal year data.

3.4.4 Data and data sources
The data covers fiscal and other macroeconomic variables from 1981/82 to 2016/17. Data on total government revenue, government expenditure and interest payments were obtained from the Ministry of Finance, Planning and Economic Development background to the budget publications (MoFPED, 1983 – 2018). These data were used to compute the primary balance and expenditure gap. Data on domestic debt, external debt, end of the period exchange rate and the current account balance was collected from Bank of Uganda annual reports (BOU, 1983 – 2018). The end of the period exchange rate (UGX/USD) was used to convert the current account balance and external debt from United States dollars to Ugandan shillings. The data on domestic debt and external debt was used to compute the total public debt. Real gross domestic product data were obtained from the World Bank Database for World Development Indicators (World Bank, 2018).

The study wanted to preserve concept continuity and consistency by getting all variables from a single data source to minimise breaks in the data that would be attributed to changes in data sources. However, some variables were not available for the entire study period in one single source.

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3 The actual interest payments data for 1985/86 was missing so the study considered the preliminary value for that fiscal year.
4 The external debt data gaps for 1983/84 – 1988/89 were filled with data sourced from the World Bank Database for World Development Indicators for 2018.
5 No statistical agency in the country tracked the total public debt for the period under study. I considered Bank of Uganda data since it had tracked both domestic debt and external debt for the period under study.
IV. Presentation, interpretation and discussion of results

4.1 Data Description
Table 1 (see page 29) in the appendix provides a description of the main variables in this study. The data spans a period of 36 years. The mean and median value of each variable is a good measure of central tendency since the entire mean values lie between the minimum and maximum values of the series. The debt to GDP ratio has the highest value of 0.597 whereas the current account balance to GDP ratio has the smallest value (-0.115) in the sample. The standard deviations are reasonably small and concentrated around the mean implying that there are no outliers in the series. The debt to GDP averaged at 22 percent of real GDP while the primary balance averaged at -1.2 percent of real GDP over the study period.

4.2 Correlation between variables
The study explored the direction and strength of the linear relationship between pairs of variables used in the study. The results of the correlation analysis are displayed in Table 2 (see page 30) in the appendix. The results show that there is a strong negative linear relationship between the primary balance to GDP and the expenditure gap to GDP (-0.648). This suggests that the primary balance tends to decrease with an increase in the expenditure gap. The current account balance is significantly correlated with the primary balance (0.575), the debt to GDP ratio (-0.532) and the output gap (0.471). For instance, the linear relationship between the current account balance to GDP and primary balance to GDP is moderately positive which implies that the primary balance increases with an increase in the current account balance. There is a weak negative relationship between the primary balance to GDP and the debt to GDP which suggests that the primary balance tends to increase with decreases in the debt levels. The output gap is positively correlated with other variables albeit weakly.

4.3 Stationarity tests
The study conducts ADF and PP unit root tests at levels and at first difference with one lag to examine the stationarity properties of the data. The study also carries out structural breaks tests by Zivot and Andrews (1992) and Clemente et al. (1998). Table 3 (see page 30) in the appendix shows the results for the ADF and PP tests at level. The ADF and PP test results suggest that the primary balance to GDP and expenditure gap to GDP have no unit roots, hence stationary. On the other hand, debt to GDP and current account balance to GDP have unit roots.

This necessitates testing the presence of unit roots at first difference for debt to GDP and current account balance to GDP to find out whether they are difference stationary. Table 4 (see page 30) in the appendix shows the results for the ADF and PP tests at first difference. The unit root tests indicate that debt to GDP and current account balance to GDP are difference stationary.

The results for the unit root structural break tests based on the Zivot and Andrews (1992) test and the Clemente et al. (1998) test allowing for one structural break (reported as Clemao1) and two structural breaks (reported as Clemao2) are reported in Table 5 (see page 30) in the appendix. The results provide evidence of structural breaks for all the series albeit significant only for the primary balance to GDP, expenditure gap to GDP and output gap to GDP. The results indicate that the primary balance to GDP, expenditure gap to GDP and output gap to GDP have no unit roots. Despite the presence of structural breaks in the debt to GDP and current account balance to GDP series, the study cannot reject the null hypothesis of a unit root in the series. Therefore, since the variables are integrated of different orders [I(0) and I(1)], the preferred estimation technique is the ARDL approach.
4.4 Selection of optimal lags

The selection of the optimal lags for the different study variables is based on the two (2) regressions that this study estimates. Regression 1 considers the debt to GDP, expenditure gap to GDP, output gap to GDP and current account balance to GDP as independent variables. Regression 2 augments regression 1 with the debt relief, fiscal rule and election dummies as independent variables. The optimal lag orders for the variables included in the ARDL model are chosen based on Schwarz’s Bayesian information criterion (SBIC) using the maximum lag of three for the regression model 1. However, for regression model 2, the maximum lag of two is chosen instead of three due to multicollinearity between the study variables. The SBIC was chosen because it provides consistent and parsimonious estimates of the true lag order when compared to the Akaike’s information criterion and final prediction error that overestimate the true lag order. The SBIC lags specifications for the different variables are: Model 1: ARDL (1,1,1,0,0) and Model 2: ARDL (1,1,0,1,0,0,0).

4.5 Long run relationship

The bounds test for cointegration was conducted to examine the existence of the long run relationship between the variables in the model as shown in Table 6 (see page 31) in the appendix. For model 1, the Pesaran et al. (2001) bounds test considered 4 long run variables, 33 observations and 2 short run coefficients. For model 2, the bounds test considered 7 long run variables, 34 observations, 2 short run coefficients. The bounds test used the Kripfganz and Schneider (2019) critical values and approximate p-values. The null hypothesis of no level relationship is rejected for all models since the F statistic values are more extreme than critical values for I (1) variables at the 5 percent level of significance. In this case, the study estimates the ARDL in error correction form.

4.6 Regression Estimates

Regression 1 presents the results of the regression model that excludes the debt relief, fiscal rules and election dummies. Regression 2 augments regression 1 by accounting for the effects of debt relief, fiscal rules and election dummies. The estimation results are presented in Table 7 (see page 31).

Interpretation and discussion of results

4.6.1 Diagnostic tests

The study presents the diagnostic tests results in Table 8 (see page 32) in the appendix. The residuals are not serially correlated as indicated by the p-value from the Breusch-Godfrey test for all the models indicating the failure to reject the null hypothesis of “no serial correlation.” The models do not suffer from heteroskedasticity since the results of the Breusch-Pagan test have p-values of 0.7511 and 0.5723 that are higher than the usual threshold of 0.05 (indicating the failure to reject the null hypothesis of constant variance). The results for the ARCH effects test indicate the failure to reject the null hypothesis that the errors are not autoregressive conditional heteroskedastic for all the models since the p-values are significant at the 5 percent level of significance.

The study fails to reject the null hypothesis that the error term is normally distributed, at the usual 5 percent threshold level for all models. The study provides more evidence for normality.

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6 The Durbin Watson test is not valid in ARDL models because the lagged dependent variable is not strictly exogenous by construction (Kripfganz & Schneider, 2018).
using Kernel density graphs (see page 32) in the appendix. The study also fails to reject the Ramsey RESET test of “no omitted variables” at 5 percent since the p-values for all the variables are higher than the conventional threshold. There is no multicollinearity in the models since the mean variance inflation factor (VIF) for all the different models is 3.27 and 2.62 respectively. Similarly, the individual variable VIF’s are less than 10 as shown in the appendix (see page 32). The study fails to reject the null hypothesis that “all parameters are stable or constant overtime” for parameter stability since the test statistic values for both the recursive CUSUM and OLS CUSUM tests do not exceed the 5 percent critical levels. The recursive CUSUM and OLS CUSUM plots also show that the parameters for the various models are stable since the CUSUM plots do not move out of the critical lines at the 5 percent level of significance as shown in the appendix (see page 33).

4.6.2 Regression results
The previous subsection provides the diagnostic test results that provide evidence that the estimated models meet the linear regression assumptions to ensure that the results are meaningful and reliable. It is against that evidence that this subsection presents the interpretation and discussion of the study findings presented in Table 7 in the appendix.

Debt to GDP
In the long run, debt to GDP has a small and significant positive effect on the primary balance in all regressions. In all the regressions, the debt to GDP coefficient has the expected sign that is in line with the a priori hypothesis that an increase in the public debt increases the primary balance. The coefficients for the debt to GDP ratio are 0.0480 and 0.0526 for models 1 and 2 respectively. On average, the government has positively adjusted the primary balance to GDP by 0.05 percent in response to a one percent increase in the debt-GDP ratio, holding other factors constant.

This finding suggests that the government’s reaction to past debt build-up has been responsive and systematic after controlling for other non-debt determinants of the primary balance in the long run. In other words, the government is raising the primary surplus or reducing the primary deficit to guarantee debt sustainability. This finding is consistent with Amankwah et al. (2018) for Ghana, Berti et al. (2016) for Finland and Belgium and Burger et al. (2012) for South Africa, who found a positive relationship between the primary balance to GDP and debt to GDP.

The short run coefficient on the debt to GDP ratio is significantly negative at 10 percent for model 1 but significant at 1 percent for model 2. The coefficients are -0.0454 and -0.0568 for models 1 and 2 respectively. This implies that a one percent increase in the government debt-GDP ratio leads to a 0.05 percent reduction in the primary balance on average, holding other factors constant. This suggests that the government’s policy actions are not sufficient to ensure debt sustainability in the short run. This could be explained by the government’s preoccupation with short-term macroeconomic priorities such as stabilising the economy or stimulating economic growth. In most cases, meeting these priorities may necessitate borrowing because of limited domestic resources hence leading to larger unsustainable debt levels in the short run. This result is consistent with Amankwah et al. (2018) and Asiama et al. (2014) for Ghana. However, this result differs from Asiama et al. (2014) who controlled for debt level beyond 80 percent of GDP in their study which influenced the short run coefficient for the debt to GDP ratio.
Expenditure gap to GDP
The long run coefficients of the expenditure gap to GDP are significantly negative at 1 percent for all regressions and in line with the *a priori* hypothesis based on the tax smoothing theory. The parameter estimates are between -0.650 and -0.584 for models 1 and 2 respectively. On average, a one percent increase in the expenditure gap leads to a 0.6 percent decrease in the primary balance, holding other factors constant in the long run. This implies that an increase in the noninterest spending above the normal level (trend level) reduces the primary balance. The government responds to temporarily high noninterest expenditures by borrowing to finance deficits as opposed to adjusting current tax levels.\(^7\) On the other hand, the short run coefficient is also significantly negative at 10 percent. For model 1, this suggests that a 1 percent increase in the expenditure gap to GDP decreases the primary balance by 0.2 percent.

This result also signifies the government’s commitment to meet temporary increases in noninterest expenditures to guarantee security and economic growth (through increased spending on security and infrastructure) by running deficits to finance these expenses. This finding is consistent with Jeong (2014) for U.S., United Kingdom and South Korea and Shastri et al. (2017) for Bangladesh, India, Pakistan and Sri Lanka. However, it is inconsistent with Amankwah et al. (2018) who find a positive relationship between the primary balance to GDP ratio and the expenditure gap in Ghana (though not statistically significant).

Output gap to GDP
In the long run, the output gap to GDP has a large and significant negative effect on the primary balance in all regressions. The parameter estimates are -4.161 and -2.353 for models 1 and 2 respectively. This indicates that on average, a one percent increase in the output gap leads to a 3.3 percent decrease in the primary balance, holding other factors constant. Therefore, a contraction (expansion) of the economy causes a negative (positive) effect on the primary balance. This suggests that fiscal policy is countercyclical in the sense that the government responds to a recession through expansionary fiscal policy (which in this case implies running budget deficits) to jumpstart the economy out of the slump or contraction.

This result is in line with the tax smoothing theory by Barro (1979) and with other studies. For instance, Amankwah et al. (2018) found a negative relationship between the primary balance and the output gap in Ghana. However, the finding is inconsistent with Shastri et al. (2017) who find that the coefficient on the output gap is positive in the case of India, Bangladesh and Sri Lanka. Pamungkas (2016) also observes that the primary balance positively responds to the output gap in Indonesia, though with a very small magnitude. The difference in the results of this study (concerning the output gap) with those of Pamungkas (2016) could be explained by the differences in specification of the output gap. Pamungkas (2016) considered the nominal GDP whereas this study used the real GDP to compute the output gap.

Current account balance to GDP
The current account balance to GDP has a significantly positive effect on the primary balance in the long run for all the models. The parameter estimates are 0.447 and 0.325 for models 1 and 2 respectively. On average, a marginal improvement in the current account balance leads to a 0.4 percent increase in the primary balance, holding other factors constant. The positive coefficient

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\(^7\) The government is assumed to finance its expenditures through current taxation and public debt issue. This analysis ignores currency issuance. For example, to finance the unusually high expenditures on infrastructure projects such as roads and dams, the government has resorted to borrowing to fund their construction, thereby avoiding abnormally high tax rates.
of the current account balance supports the twin deficit hypothesis for Uganda. This finding suggests that improvements in the current account balance could lead to improvements in the primary balance. In other words, the government can increase its fiscal space by undertaking policies to improve the current account balance. This result is consistent with Makau et al. (2018) who find the current account balance to be positively related to the primary balance in Kenya. It is also in line with Checherita-Westphal and Žďárek (2017) who found evidence in favour of the twin deficit hypothesis in a panel of European Union countries.

However, in the short run, the current account balance coefficient is significantly negative at 5 percent in model 2, which is inconsistent with the twin deficit hypothesis. On average, this implies that a 1 percent increase in the current account balance results in a 0.15 deterioration in the primary balance, holding other factors constant. The deterioration in the current account balance could reduce economic growth thereby encouraging the government to stimulate the economy through running budget deficits. This result is consistent with Makau et al. (2018) who find that the current account balance is negatively related to the primary balance in Kenya.

The fiscal rule
The coefficient of the fiscal rule dummy is negative and statistically significant at 1 percent in model 2, albeit with the unexpected sign. This suggests that the fiscal rules lead to deterioration in the primary balance to GDP. Since assenting to the EAMU convergence criteria, Uganda’s fiscal policy is yet to be constrained by the budget balance rule (including grants) of 3 percent of GDP for the fiscal deficit. In addition, the gross public debt ceiling of 50 percent of GDP in NPV terms is also not strongly binding the government as observed by the drive to incur more debt as long as it is below this ceiling. This compromises efforts to ensure a decline in deficits and the debt to GDP ratio in the run-up to the East African Monetary Union by 2024. This result is inconsistent with Barbier-Gauchard and Mazuy (2018) who found that fiscal rules tend to improve the primary balance in some European countries. This difference may be because fiscal rules in these European countries are more binding therefore promoting stronger fiscal discipline.

4.6.3 Goodness of fit and overall significance of the model
The overall goodness of fit (R-squared) for models 1 and 2 is 0.92 and 0.95 respectively. For model 1, this implies that the independent variables explain about 92 percent of the variation in the dependent variable. The adjusted coefficient of determination of 0.89 also indicates a good fit. The overall F-statistic for models 1 and 2 is 38.5 and 43.30 respectively. The statistically significant probability values suggest the rejection of the null hypothesis that “all the regression coefficients are statistically equal to zero”. Therefore, the independent variables jointly influence the primary balance in Uganda.

4.6.4 Error Correction Term
The error correction term estimates the speed of adjustment of the primary balance towards the long run equilibrium following short run deviations from the long run relationship. The coefficient of the error correction term for regressions 1 and 2 is negative.\(^8\) For instance, the error correction term for regression 1 is -0.573 and it is statistically significant at 1 percent suggesting that about 57.3 percent of the adjustment towards long run equilibrium takes place within a year. This also indicates that the long run relationship between the primary balance and its determinants is stable.

\(^8\) It is expected to be negative in order to restore the equilibrium.
V. Summary, conclusion and policy recommendations

5.0 Summary
This study examined the extent to which fiscal policy has been instrumental in ensuring debt sustainability in Uganda by estimating the fiscal reaction function for Uganda using data for the period from 1981/82 to 2016/17. This is because the government has undertaken several fiscal actions to ensure that the growing debt remains sustainable yet there is limited empirical evidence for such actions. Drawing on the fiscal reaction approach advanced by Bohn (1998), this study uses the autoregressive distributed lag estimation technique to provide evidence on the short run and long run response of the primary balance to the growing debt. It also accounts for the other non-debt factors that influence the primary balance such as the expenditure gap, output gap, current account balance, debt relief, fiscal rules and elections. The results of this study indicate that the variables considered significantly influence the fiscal actions of the fiscal authorities.

5.1 Conclusion
An understanding of the government’s response to debt accumulation in the past is at the heart of assessing how it might react to the upward pressure on the public debt to GDP ratio that it is currently experiencing due to increased (and expected) investments in infrastructure. The key finding of this study is that on average, the Ugandan government has positively adjusted its primary balance (by raising the primary surplus or reducing the primary deficit) in response to increases in the debt to GDP ratio in the long run. The study accounts for the temporary fluctuations in government expenditures and cyclical fluctuations in output that would obscure the positive response of the primary balance.

The estimated positive response of the primary balance to the debt to GDP suggests that Uganda’s debt is sustainable in the long run in the sense that it satisfies the intertemporal budget constraint for the sample period from 1981/82 to 2016/17, despite frequent primary deficits. However, the response is still weak since it lies between 4.8 and 5.3 percent. The estimated negative primary balance response to debt to GDP in the short run indicates that the government is not sustainably responding to the growing debt and this poses risks to debt sustainability.

5.2 Policy recommendations
The study suggests that to guarantee debt sustainability in the future, the government should strengthen the primary balance by reducing wasteful expenditures through eliminating corruption, reducing fiscal slippages and supplementary budgets and curbing the creation of more administrative units which increase the funding burden of the government. Similarly, to check instances of perpetual borrowing, further increases in expenditures need to be matched by increases in revenues, thus the need to strengthen domestic revenue mobilisation by minimising tax exemptions and improving efficiency in tax collection.

The government should borrow smartly and invest in projects that are productive enough to enable the economy to achieve its growth potential thereby closing the output gap. Borrowing smartly entails ensuring that the government does not borrow funds beyond its capacity to repay. Investing borrowed funds in productive projects that spur economic growth would translate into increased government revenue to repay the debt. Similarly, to prevent prospective short run insolvency, more concessional borrowing is preferred to non-concessional borrowing since this poses serious implications for debt repayment in the short run.
Since the current account balance is positively associated with the primary balance in the long run, economic policies designed to improve the current account balance would lead to an improvement of the primary balance. Such policies might include increasing the volumes and improving the value of exports (through value addition) to improve the competitiveness of Uganda’s exports (especially agricultural and mineral exports). In addition, the government should promote the purchase of locally produced high-quality goods and services as opposed to buying similar goods and services from abroad.

The government should complement the current EAMU convergence criteria with a national debt rule (or limit). This is because the current debt limit (50 percent of debt-GDP in NPV terms) is not a strong constraint to governments’ borrowing strategy since it is too high. The adopted debt limit should be lower than the current debt limit but should be flexible enough to enable the country to undertake fiscal adjustments in response to exchange rate and interest rate shocks and natural disasters.

Lastly, because of the looming debt distress, the government should prioritise debt sustainability amidst growing concerns to stimulate the economy and to cater for temporarily high noninterest government expenditures. This would entail evaluating the necessity and immediacy of running perpetual deficits whenever there are temporary fluctuations in GDP or noninterest government expenditures because running perpetual deficits worsens debt sustainability prospects. A select committee of parliamentarians and technocrats can carry out such evaluations. A commitment to debt sustainability by fiscal authorities will guarantee that the current good fiscal record suggested by this study is maintained in the future.

5.3 Limitations of the study and caveats

The study acknowledges the limitations encountered that must be considered when interpreting and making inferences based on the results. The fiscal reaction function approach provides more meaningful policy evaluations when applied to annual data spanning a long period. The data from various government sources (particularly MoFPED and BOU) was inconsistent, missing or covering a short period for some study variables. For example, because data gaps for the external debt from 1983/84 – 1988/89 (six years) would not be filled by data from a domestic source, they were filled with data from the World Development Indicators database of 2018.

This study considered the total public debt (domestic and public and publically guaranteed external debt) that has been disbursed and is outstanding. It does not consider the undisbursed external debt and domestic expenditure arrears. This study could not use data on domestic expenditure arrears because of data gaps.

The fiscal reaction function approach used in this study is backward-looking and it examines debt sustainability based on historical or past fiscal behaviour. Therefore, the results should not be interpreted to mean that Uganda’s debt will be sustainable in the future based on the behaviour of past governments. It provides lessons from the past policymakers’ behaviour so that current policymakers can better react to the future fiscal policy challenges such as the anticipated risk of moderate debt distress.

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9 Due to data scarcity, most studies have used panel data methods, monthly or quarterly data. High frequency data obscures fiscal policy adjustments because of their noisy nature which is mostly used for cash management purposes rather than policy evaluation (Celasun, Debrun, & Ostry, 2006).
10 External debt data were sourced from BOU annual yearbooks, but between 1984 and 1989 only two annual yearbooks were published. One for 1984 and the other covering the 1986 – 1991 periods.
5.4 Areas for further research
Future research examining the East African Community country government’s responses to growing public debt would be ideal. This is because these countries intend to fulfil the East African Monetary Union convergence criteria in the run-up to the EAMU by 2024 through the implementation of fiscal rules. This detailed analysis could consider examining the effect of the fiscal rules on fiscal policy actions. Fiscal reaction functions have been estimated for individual countries like Kenya and Rwanda while some East African countries have been included in other panel regressions but to the best of my knowledge, none has considered all the East African community countries in one panel.

Future studies can examine the relationship between the fiscal or primary balance and the current account balance (twin deficit hypothesis) in depth. Such studies could provide evidence on: (i) the various channels through which the current account balance affects the fiscal or primary balance (ii) the various channels through which the fiscal or primary balance affects the current account balance and (iii) the contribution of fiscal policy adjustments to resolving external imbalances.

To better capture fiscal behaviour such as fiscal effort, some studies have filtered out the impact of automatic stabilisers on the primary balance by using the cyclically adjusted primary balance (CAPB) as the dependent variable. Future studies could specify the cyclically adjusted primary balance as the dependent variable in fiscal reaction studies for Uganda.

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11 This includes a ceiling of 50 percent of GDP on gross public debt in NPV terms and a budget balance rule (including grants) of 3 percent of GDP to be achieved by 2020/21.
REFERENCES


APPENDIX

Figure 1: Evolution of Uganda's public debt (UGX Billion)

![Graph showing the evolution of Uganda's debt from 1981/82 to 2016/17. The x-axis represents the years and the y-axis represents billions of UGX. The line shows a steady increase in debt over time.]

Source: Data from Bank of Uganda Annual Reports (various years) and World Development Indicators (2018)

Figure 2: Evolution of Uganda's interest payments and the primary balance (UGX Billion)

![Graph showing the evolution of interest payments and primary balance from 1981/82 to 2016/17. The x-axis represents the years and the y-axis represents billions of UGX. The line for interest payments shows a decrease over time, while the line for primary balance shows an increase.]

Source: Data from Background to the budget reports (various years)

Table 1: Descriptive Statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary balance to GDP</td>
<td>36</td>
<td>-0.012</td>
<td>0.016</td>
<td>-0.064</td>
<td>0.005</td>
</tr>
<tr>
<td>Debt to GDP</td>
<td>36</td>
<td>0.228</td>
<td>0.148</td>
<td>0.011</td>
<td>0.597</td>
</tr>
<tr>
<td>Expenditure gap to GDP</td>
<td>36</td>
<td>0.00018</td>
<td>0.018</td>
<td>-0.032</td>
<td>0.085</td>
</tr>
<tr>
<td>Output gap to GDP</td>
<td>36</td>
<td>0.00014</td>
<td>0.002</td>
<td>-0.006</td>
<td>0.005</td>
</tr>
<tr>
<td>Current account balance to GDP</td>
<td>36</td>
<td>-0.031</td>
<td>0.036</td>
<td>-0.115</td>
<td>0.008</td>
</tr>
</tbody>
</table>
### Table 2: Correlation matrix

<table>
<thead>
<tr>
<th>Variables</th>
<th>$s_t$</th>
<th>$d_t$</th>
<th>$GVAR$</th>
<th>$YVAR$</th>
<th>$cab_t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary balance to GDP ($s_t$)</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt to GDP ($d_t$)</td>
<td>-0.304</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expenditure gap to GDP ($GVAR_t$)</td>
<td>-0.648**</td>
<td>0.016</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output gap to GDP ($YVAR_t$)</td>
<td>0.016</td>
<td>0.121</td>
<td>0.129</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Current account balance to GDP ($cab_t$)</td>
<td>0.575**</td>
<td>-0.532**</td>
<td>0.004</td>
<td>0.471**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. ** $p<0.05$

### Table 3: Unit root and Stationarity tests at level

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF (1)</th>
<th>PP (1)</th>
<th>Verdict</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary balance to GDP</td>
<td>-2.640*</td>
<td>-3.530**</td>
<td>No Unit root</td>
</tr>
<tr>
<td>Debt to GDP</td>
<td>-0.494</td>
<td>-0.210</td>
<td>Unit root</td>
</tr>
<tr>
<td>Expenditure gap to GDP</td>
<td>-5.632***</td>
<td>-6.215***</td>
<td>No Unit root</td>
</tr>
<tr>
<td>Output gap to GDP</td>
<td>-2.900*</td>
<td>-2.825*</td>
<td>No Unit root</td>
</tr>
<tr>
<td>Current account balance to GDP</td>
<td>-1.468</td>
<td>-1.413</td>
<td>Unit root</td>
</tr>
</tbody>
</table>

Critical values:

- 10%: -2.619
- 5%: -2.975
- 1%: -3.689

Note. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

### Table 4: Unit root and Stationarity tests at first difference

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF (1)</th>
<th>PP (1)</th>
<th>Verdict</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt to GDP</td>
<td>-3.038**</td>
<td>-4.381***</td>
<td>No Unit root</td>
</tr>
<tr>
<td>Current Account Balance/GDP</td>
<td>-4.367***</td>
<td>-5.220***</td>
<td>No Unit root</td>
</tr>
</tbody>
</table>

Critical values:

- 10%: -2.620
- 5%: -2.975
- 1%: -3.696

Note. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

### Table 5: Structural break unit root tests

<table>
<thead>
<tr>
<th>Variables</th>
<th>Zivot and Andrews</th>
<th>Clemao1</th>
<th>Clemao2</th>
<th>Verdict</th>
</tr>
</thead>
</table>

Critical values:

- 10%: -4.58
- 5%: -4.80
- 1%: -5.34

Note. (i) Break dates are in parentheses. (ii)*** $p<0.01$, ** $p<0.05$, * $p<0.1$
### Table 6: Long run relationship

<table>
<thead>
<tr>
<th>Significance level</th>
<th>F-stat</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration-order</td>
<td>F(crit)</td>
<td>F(crit)</td>
<td></td>
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<tr>
<td>10%</td>
<td>I(0)</td>
<td>2.713</td>
<td>2.344</td>
</tr>
<tr>
<td></td>
<td>I(1)</td>
<td>3.971</td>
<td>3.701</td>
</tr>
<tr>
<td>5%</td>
<td>I(0)</td>
<td>3.314</td>
<td>2.832</td>
</tr>
<tr>
<td></td>
<td>I(1)</td>
<td>4.750</td>
<td>4.387</td>
</tr>
<tr>
<td>1%</td>
<td>I(0)</td>
<td>4.772</td>
<td>4.038</td>
</tr>
<tr>
<td></td>
<td>I(1)</td>
<td>6.627</td>
<td>6.070</td>
</tr>
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</table>

### Table 7: Determinants of the primary balance

#### Dependent variable: Primary balance to GDP

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Error Correction Term</td>
<td>-0.573*** (0.120)</td>
<td>-0.944*** (0.0674)</td>
</tr>
</tbody>
</table>

#### LONG RUN

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt to GDP</td>
<td>0.0480** (0.0193)</td>
<td>0.0526*** (0.0128)</td>
</tr>
<tr>
<td>Expenditure gap to GDP</td>
<td>-0.650*** (0.142)</td>
<td>-0.584*** (0.0665)</td>
</tr>
<tr>
<td>Output gap to GDP</td>
<td>-4.161*** (1.299)</td>
<td>-2.353*** (0.629)</td>
</tr>
<tr>
<td>Current account balance to GDP</td>
<td>0.447*** (0.087)</td>
<td>0.325*** (0.0496)</td>
</tr>
<tr>
<td>Debt relief</td>
<td>0.000875 (0.00302)</td>
<td></td>
</tr>
<tr>
<td>Fiscal rule</td>
<td>-0.0165*** (0.00406)</td>
<td></td>
</tr>
<tr>
<td>Election</td>
<td>-0.000127 (0.00211)</td>
<td></td>
</tr>
</tbody>
</table>

#### SHORT RUN

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt to GDP</td>
<td>-0.0454* (0.0222)</td>
<td>-0.0568*** (0.0202)</td>
</tr>
<tr>
<td>Expenditure gap to GDP</td>
<td>-0.188* (0.0928)</td>
<td></td>
</tr>
<tr>
<td>Current account balance to GDP</td>
<td>-0.147** (0.0628)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.00409* (0.00207)</td>
<td>-0.0110*** (0.00200)</td>
</tr>
<tr>
<td>Observations</td>
<td>33</td>
<td>34</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.92</td>
<td>0.950</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.89</td>
<td>0.928</td>
</tr>
<tr>
<td>F-stat</td>
<td>38.5***</td>
<td>43.30***</td>
</tr>
<tr>
<td>F[7, 24]</td>
<td></td>
<td>F[10, 23]</td>
</tr>
</tbody>
</table>

**Note.** (i) Standard errors for coefficients are in parentheses. (ii) F-stat degrees of freedom are in the square brackets. (iii).*** $p<0.01$, ** $p<0.05$, * $p<0.1$. (iv). The output gap to GDP and the respective dummies are not included in the short run because they had zero (or no) lags based on the optimal lag orders selected by the Schwarz Bayesian Information Criterion. In other words, the results presented here are based on the optimal lags chosen by the SBIC.
Table 8: Diagnostic tests

<table>
<thead>
<tr>
<th>Diagnostic test</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial correlation</td>
<td>0.1805</td>
<td>0.1339</td>
</tr>
<tr>
<td>Heteroskedasticity</td>
<td>0.7511</td>
<td>0.5723</td>
</tr>
<tr>
<td>ARCH effect</td>
<td>0.1406</td>
<td>0.0557</td>
</tr>
<tr>
<td>Normality</td>
<td>0.2182</td>
<td>0.3387</td>
</tr>
<tr>
<td>Ramsey RESET</td>
<td>0.3833</td>
<td>0.3651</td>
</tr>
<tr>
<td>Multicollinearity (Mean VIF)</td>
<td>3.27</td>
<td>2.62</td>
</tr>
<tr>
<td>Parameter Stability - Recursive CUSUM</td>
<td>0.5625 (0.9479)</td>
<td>0.0841 (0.9479)</td>
</tr>
<tr>
<td>- OLS CUSUM</td>
<td>0.5432 (1.3581)</td>
<td>0.3853 (1.3581)</td>
</tr>
</tbody>
</table>

*Note: 5% critical values for the CUSUM tests are in parentheses*

**Kernel density graphs**

**Kernel Density graph (Model 1)**

![Kernel Density graph (Model 1)](image1)

**Kernel Density (Model 2)**

![Kernel Density (Model 2)](image2)

**Variance Inflation Factors**

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>GVAR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D1.</td>
<td>6.45</td>
<td>0.155131</td>
</tr>
<tr>
<td>d2</td>
<td>4.44</td>
<td>0.225332</td>
</tr>
<tr>
<td>st</td>
<td>3.73</td>
<td>0.268326</td>
</tr>
<tr>
<td>LI.</td>
<td>3.26</td>
<td>0.306294</td>
</tr>
<tr>
<td>cab</td>
<td>1.87</td>
<td>0.536013</td>
</tr>
<tr>
<td>VAR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d1</td>
<td>1.73</td>
<td>0.579415</td>
</tr>
<tr>
<td>D1.</td>
<td>1.41</td>
<td>0.711244</td>
</tr>
<tr>
<td>Mean VIF</td>
<td>3.27</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>cab</td>
<td>4.93</td>
<td>0.202891</td>
</tr>
<tr>
<td>dt</td>
<td>4.70</td>
<td>0.212863</td>
</tr>
<tr>
<td>btr</td>
<td>3.32</td>
<td>0.301302</td>
</tr>
<tr>
<td>sc</td>
<td>2.88</td>
<td>0.347030</td>
</tr>
<tr>
<td>YVAR</td>
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<tr>
<td>d1</td>
<td>1.85</td>
<td>0.539991</td>
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<td>dt</td>
<td>1.81</td>
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<tr>
<td>D1.</td>
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<td>0.606369</td>
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<tr>
<td>cab</td>
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<td>0.612183</td>
</tr>
<tr>
<td>D1.</td>
<td>1.22</td>
<td>0.852980</td>
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<tr>
<td>Mean VIF</td>
<td>2.62</td>
<td></td>
</tr>
</tbody>
</table>
### Recursive CUSUM plots and OLS CUSUM plots

<table>
<thead>
<tr>
<th>Recursive CUSUM plot (Model 1)</th>
<th>OLS CUSUM plot (Model 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Recursive cusum plot of D.st" /> with 95% confidence bands around the null</td>
<td><img src="image2" alt="OLS cusum plot of D.st" /> with 95% confidence bands around the null</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recursive CUSUM plot (Model 2)</th>
<th>OLS CUSUM plot (Model 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Recursive cusum plot of D.st" /> with 95% confidence bands around the null</td>
<td><img src="image4" alt="OLS cusum plot of D.st" /> with 95% confidence bands around the null</td>
</tr>
</tbody>
</table>