




FISCAL REACTION FUNCTIONS AND PUBLIC DEBT SUSTAINABILITY IN NIGERIA: AN ERROR CORRECTION MECHANISM APPROACH

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ABSTRACT

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The pervasiveness and persistent spiral of public debt in the country provide needed insights to determine the tendency for achieving sustainable debt. This, essentially, spurs the study to examine the responsiveness of Nigeria's fiscal authorities to rising debt accumulation. As such, the study employs conventional unit root and cointegration approaches to estimate the fiscal reaction functions used in the study. Findings suggest that the existence of equilibrium relationship, in the models estimated, signals the fulfillment of the necessary condition for achieving debt sustainability. However, the sufficient condition for a sustainable public debt could not be met; this is evident in the negative response of government primary balances to changes in public debt in the long run. These findings readily affirm that government's fiscal behaviour is not in tandem with the tenet of the intertemporal budget constraint as fiscal authorities could not generate enough surpluses in reaction to public debt increases. Therefore, there is threat to the feasibility of ensuring a sustainable public debt, importantly, as fiscal pressures and excesses still remain endemic issues. The study concludes that the fiscal operations of Nigerian government cannot sufficiently allow for a sustainable debt; hence, consistent running of this fiscal stance could either spur harsh adjustment measures in the long run or result to insolvency and default.

Contribution/Originality: This study is one of the sparse studies that elucidate the tendency for achieving public debt sustainability in Nigeria through the lens of fiscal reaction functions which are hinged on the government budget constraints.

1. INTRODUCTION

The question of what a sustainable fiscal operation is, in the literature, remained an essential discourse in the macroeconomic analysis of fiscal policy. This question became more topical as a result of persistent fiscal deficits and resurgence of government debts predicated on the 2008-2010 global economic and financial crises in world economies (Baharumshah and Lau, 2007; Afonso and Jalles, 2012; Baharumshah *et al.*, 2016). Nigeria, as a developing economy, has witnessed series of macroeconomic and fiscal imbalances despite various fiscal management and stabilization policies. The specifics of these imbalances, which are excessive debt, double-digit inflation, spotty investment and poor growth performance, have been attributed to the inability of fiscal authorities to persistently raise enough fiscal surpluses (Okunroumu, 1993; Chimobi and Igwe, 2010; Folorunso and Falade, 2013). In sequel, the Nigerian government has embarked on fiscal stabilization and management policies, among

which are the Structural Adjustment Programme, the Fiscal Responsibility Act, the Medium Term Expenditure Framework, the Public Procurement Act, the Petroleum Information Bill and the Sovereign Wealth Fund, in a bid to curb fiscal indiscipline and instill sanity in the fiscal space. Essentially, the [Fiscal Responsibility Act \(2007\)](#) as a fiscal rule, was enshrined to ensure that government held its deficit and debt at a sustainable level; at most 4 percent of deficit-to-GDP ratio and 40 percent of debt-to-GDP ratio as stipulated by the International Monetary Fund (IMF) for developing economies.

However, despite consolidated efforts, the oscillatory and volatile nature of the oil market persistently triggers fiscal imbalance vis-à-vis public debt increase. Specifically, reports from the National Bureau of Statistics (NBS) and the Debt Management Office (DMO) of Nigeria revealed that federal government debts profile uptick rapidly to the tune of \$60 billion in the mid 2017 (2nd Quarter). The external and domestic components of the debt accounted for a whopping \$15 billion and ₦14 trillion (\$45 billion) respectively. These figures were far beyond a relatively modest domestic (₦1 trillion) and external (\$3 billion) recorded immediately after the debt exit of 2006. Therefore, the issues of sustainable fiscal operations still border on the efficacy of servicing deficit by issuing new debt or limit has to be placed.

Conceptually, an economy operates a sustainable debt stance if its debt is not explosive. For debt to be non-explosive, its growth should be restricted below the growth rate of the economy (GDP) to avoid excess debt accumulation, to leverage on external borrowing without distorting macroeconomic fundamentals, to ensure smooth private sector operation and economic growth ([Baharumshah et al., 2016](#)). Furthermore, the working definition of debt sustainability is hinged on the satisfaction of the Intertemporal Budget Constraint (IBC) or the Intertemporal Solvency Condition ([Mahdavi and Westerlund, 2011](#); International Monetary Fund (IMF), [2013](#)). The tenet of the budget constraint explains that the present value of future primary surplus must suffice to offset outstanding debt; as such government should service its debt out of its future income or surplus. The budget constraint precludes the exercise of Ponzi game in which government debt is serviced through the issuance of new debt rather than serviced out of future income; the so called transversality condition. Hence, without the foregoing condition, government debts stance would be unsustainable and insolvency and default would be possible. However, without issues of debt magnitude, indiscriminate debt policies, and debt management problem, the issues bordering on debt sustainability would not be worthy of discourse.

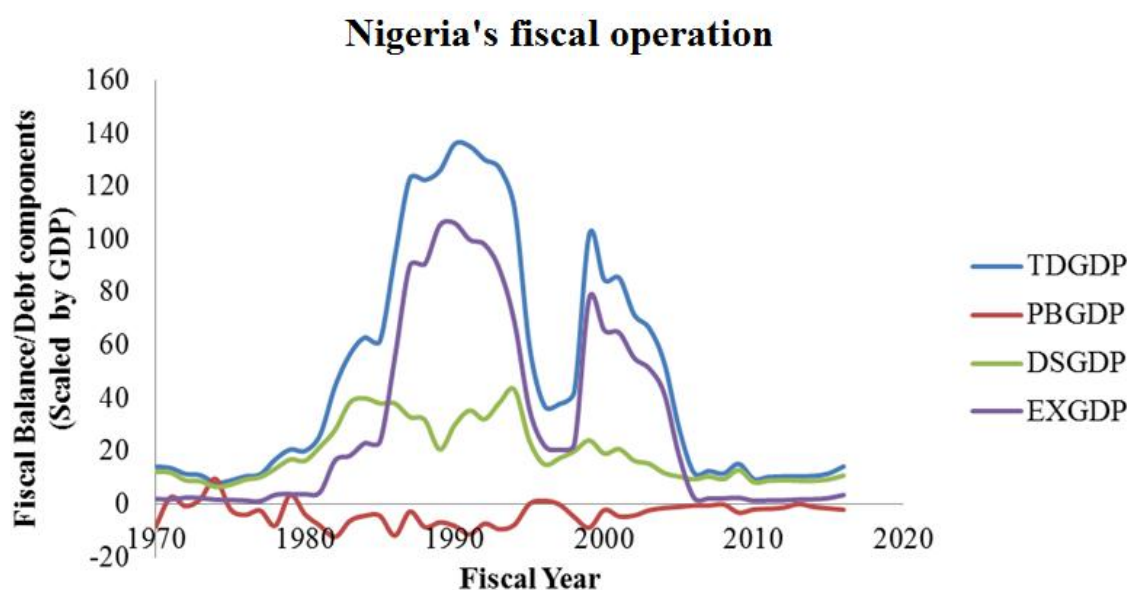
Therefore, amidst fiscal imbalances, rising debt stocks and slow economic growth rate, the feasibility of a sustainable debt stance of Nigeria (in the long and short run) remains a pressing issue of concern. The foregoing essentially surfaces as various stimuli packages and fiscal incentive efforts to ensure economic recovery being expedited has, in fact, resulted to the persistent running of deficits and debt accumulation in the country. Analysis of debt sustainability will provide the needed guide on whether the government can continuously sustain its running of deficits in the long run without running into risk of insolvency or default. This paper fills the void in literature by estimating a fiscal reaction function for Nigeria to ascertain the behaviour of Nigeria fiscal authorities in relation to rising public debt under the IBC framework.

The remaining contents of the paper are partitioned as follows; section 2 provides a synopsis of literature reviews on public debt sustainability analysis in developed and developing countries, while empirical reviews in Nigeria are drawn separately. Section 3 provides the data and methods deployed in the study; Section 4 presents and interprets the results and findings. The last section draws conclusion on the paper.

1.1. Some Stylized Facts

Since the 70s, the surplus generating capacity and the expenditure stance of Nigeria government has been much prone to happenings inherent in the global oil market; essentially because oil has been a major driver of the economy. The specifics of government fiscal operations revealed persistent accumulation of deficits and public debt, while the pattern of government debt holdings varied. As such, series of oscillatory movements of government fiscal

balance (+surplus –deficit) and debt components was observed. Within the forty-six fiscal years, fiscal authorities accumulated more of deficits whilst surpluses were observed in 1971, 1973, 1974, 1979, 1995 and 1996. This is explicitly depicted in Figure 1. Specifically, the surplus observed in the 70s was predicated on the oil price boom in the international oil market which was occasioned by the Middle East crises. In addition, the surpluses of the mid-90s were occasioned on the non-oil revenue diversification measure of government through the promulgation of the Value Added Tax (VAT) revenue policy in 1994. However the pattern of debt holdings, in the 1970s, tilted more towards the domestic credit market with the domestic debt averaging 10.5 percent of GDP as against 2.1 percent recorded by the external debt holdings. In the 1980s the pattern of debt holdings changed in favour of the external financial market with the government external borrowings averaging 43 percent as against 30.54 percent sourced from the domestic financial market.



Source: Central Bank of Nigeria (CBN) (2016).

Interestingly, external debt persistently accounted for a large share of public debt holdings with average value of 63.95 percent of GDP recorded when compared to 27.86 percent of domestic debt stocks within 1990 and the inception of democratic regime in 1999. Furthermore, the debt holdings oscillated downwards after the debt rescheduling and debt forgiveness occasioned by the Paris and London clubs in 2005 and 2006. Therefore, domestic and external debt share of GDP nose-dived to 10.35 and 18.3 percent respectively. The aftermath of the debt restructuring, made the pattern of debt holding tilt towards the domestic market (as the 70s) in a bid to ease the country from the bottlenecks of external debt servicing. As such, concerns are raised as regard the sustainability of domestic debt due to the gradual resurgence of domestic debt burden in the country. Specifically, the domestic debt recorded an average of 9.5 percent which is much higher than 2 percent average value of the external debt holding during 2006 and 2016. A synopsis of the fiscal operations of Nigeria revealed that the country accumulated more deficits than surpluses; and it accumulated more of external debt than domestic debt during the period under review. Thus, the fiscal deficit persistence and the resultant public debt accumulation readily probe the feasibility of a sustainable public debt in Nigeria.

2. REVIEW OF LITERATURE

A large chunk of empirical works has been carried out on the sustainability of fiscal policy and public debt in an economy; however, there is no uniform consensus as regards the fiscal sustainability stance either on analytical or empirical grounds (Chibi *et al.*, 2015). Essentially, plausible reasons for this inconclusiveness are due to different

theoretical underpinnings, No-Ponzi-Game/transversality condition, methods and approaches, underlying assumptions etc. Despite the lack of compromise, the intertemporal budget constraint (IBC), hinged on the transversality condition, still forms the theoretical crust of most empirical analyses. As such, a sustainability criterion which was proposed by Bohn (1998) as a generalization of the traditional IBC is considered a better sustainability test (Sarvi, 2011).

The earlier studies on whether the fiscal operation is consistent with the intertemporal budget constraint have been controversial. For instance, in the developed economies, Hamilton and Flavin (1986) in their works on the U.S, argued that for the time series property of public debt to be sustainable it must exhibit mean reverting behavior in its level form. Their analysis was based on the unit root test. However, Hakkio and Rush (1991) also argued that the cointegration between real government revenue and real government spending (inclusive of real interest rate payment) is a necessary condition for the intertemporal budget constraint to be satisfied. On the contrary, Trehan and Walsh (1991) emphasized that under the assumption of constant expected real interest rates a necessary and sufficient test of the intertemporal budget constraint is the cointegration of debt and primary balance and a quasi-difference stationary primary balance. Also, Ahmed and Rogers (1995) considered the intertemporal budget constraint by examining a cointegration vector that includes government primary spending (inclusive of interest payment) and government tax revenue; they found that the budget constraint holds. Similarly, Quintos (1995) argued that the cointegration between the US revenue and expenditure (inclusive of debt payment) is not a necessary but rather a sufficient condition for deficit sustainability. A precursor for the necessary condition to be satisfied is structural changes involving shift in the rank of cointegrating matrix. However, his study submitted that deficits of the US government are unsustainable irrespective of the inclusion or non-inclusion of structural breaks. In a comparative study involving the US, the UK and Germany, Polito and Wickens (2005) made a case for the consequent fiscal sustainability position of countries using Taylor rule to set monetary policy. They argued that the policy implication of adopting the Taylor's rule improved the fiscal stances of the US and UK with the exception of Germany. Their findings conclusively revealed that the fiscal stances of all three countries under consideration are not sustainable.

Bohn (1998) argued that the previous empirical findings (Hamilton and Flavin, 1986; Hakkio and Rush, 1991; Ahmed and Rogers, 1995) do not adequately deal with stochastic nature of uncertainty and risk aversion; as such made the mean reversion process difficult to detect. Therefore, to salvage this problem, a fiscal reaction function (that is devoid of interest rate dynamic assumptions and suitable for economies with indiscriminate and haphazard debt management policies, uncertainty, and risk aversion) was estimated. Importantly, the sustainability test involved data on primary balance, public debt and other control variables. The theoretical backdrop here for debt to be sustainable is that past debt must be offset by current primary balance; this is indicated by a positive and significant response of the primary balance to public debt. He found that the U.S debt was still sustainable over the study period 1916 to 1995 despite running more deficits. Furthermore, making a case for fiscal rule and federal grant policies, Mahdavi and Westerlund (2011) in a panel analysis capture for serial and cross sectional dependence by considering the fiscal policy sustainability of 47 state-local governments in the U.S over the period 1961 to 2006. Their findings suggest that the strong sufficiency condition is satisfied in the full sample and all subsamples in relation to balances that include special funds and federal grants. However, their findings further show that for the full sample and some regional subsample (with balances that exclude special funds and federal grants) there is evidence of weak sustainability. Accounting for endogenous breaks in the sustainability of fiscal policy for OECD countries, Afonso and Jalles (2012) study revealed that the fiscal operation of most selected countries is not sustainable. Employing the unit root and cointegration tests the study show uniform results for the time series and panel data used in the study. In Japan, Doi *et al.* (2011) estimated a fiscal and monetary policy function, using a Markov Switching model, to allow for fluctuations in the relationship between primary surplus and government debt between two regimes. Their study also calculated the minimum tax rate that could stabilize the government

debt given future expenditures of government. The response of the primary surplus to debt increases was also estimated. Their findings affirmed that the Japanese government fiscal stance under their approaches is not sustainable. Applying the dynamic stochastic general equilibrium (DSGE) framework to allow for simulation transition path between primary surplus and debt under various fiscal regimes, [Sakuragawa and Hosono \(2011\)](#) evaluated the fiscal sustainability of Japan by investigating whether the expected path of the government debt stabilizes or increases with bond. Based on the simulation results and given that government do not react to its fiscal crisis, they argued that debt-to-GDP will increase with bond and fiscal policy will be unsustainable.

In the developing and emerging economies, [De Mello \(2005\)](#) estimated a fiscal reaction function to examine the debt sustainability stance of Brazil over the period 1995 to 2004 using the standard unit root and cointegration test. Based on the observations of government revenue, expenditure, primary balance and public debt, output gap, institutional proxies and inflation, he found a strong and positive reaction from government towards public debt. Furthermore, in India, [Nguyen \(2013\)](#) could not draw firm conclusion on the sustainability of its fiscal policy; however, he established that India follows a reaction function that contains shocks that could mar economic growth. [Kunvoru \(2011\)](#) investigated the budget sustainability of Indonesia, over the sample period 1999q1 to 2009q4, by estimating a fiscal reaction function using the unit root, cointegration test and Vector Autoregressive techniques. The test revealed that the government budget is unsustainable within the sample period. In an analysis involving 5 East Asian countries, [Baharumshah and Lau \(2007\)](#) examine the nexus between fiscal regime changes and sustainability of fiscal imbalance. Using the VAR technique, their findings reveal that Thailand and South Korea fiscal policy is sustainable while the Philippines and Malaysia show weak sustainability. The causality test revealed unidirectional causality running from expenditure-revenue for Korea, Singapore and Thailand and revenue-expenditure for Malaysia and Singapore making a case for fiscal synchronization to moderate fiscal imbalance. In a somewhat recent work, [Baharumshah et al. \(2016\)](#) assessed the sustainability of fiscal policy in Malaysia using the Markov Switching approach. Their findings reveal that, except for period of economic downturn, the country's fiscal policy is sustainable. Their findings also show that public debt exceeding 55% threshold could truncate economic growth while a unidirectional causality runs from debt to growth.

Using the standard unit root test and the Ordinary Least Square (OLS) approach, [Deyshappriya \(2012\)](#) examined the debt and fiscal sustainability in Srilanka over the period 1990 to 2009 based on the intertemporal budget constraint. The finding revealed that the stance of fiscal policy is unsustainable during the period due to some factors that affected the net total debt of the country. [Chandia and Javid \(2013\)](#) estimated an extended fiscal reaction function of Pakistan that is hinged on the [Bohn \(1998\)](#) sustainability test over the period 1971 to 2008. The estimated results showed that the government debt stance aligned to the intertemporal budget constraint. However, the reaction function revealed weak debt sustainability stance of Pakistan as evident in the small coefficient of the public debt-to-GDP ratio. In recent study, [Waheed \(2016\)](#) examined the sustainability of government debt of Bahrain, by estimating a Fiscal Reaction Function through the ARDL bounds test over the period 1990 to 2014. Using annual observations of Fiscal balance, public debt, GDP, Population, financial deepening, inflation and trade openness, he confirmed that the necessary condition for achieving fiscal sustainability holds in Bahrain through the existence of co-integration between fiscal balance and public debt. In addition, the estimated results of the Fiscal Reaction function also showed that the sufficient condition for fiscal sustainability is satisfied; as evident in the long run and short run positive coefficient of the public debt-to-GDP ratio.

In another clime, [Burger et al. \(2011\)](#) investigated the fiscal sustainability of South Africa by estimating a fiscal reaction function with an extended model which added the lag value of primary balance, using various methods (OLS, VAR, TAR, GMM, State-Space and VECM), they found that the South African government react to rising public debt by increasing the surplus and by reducing the primary deficit. Similarly, [Asiama et al. \(2014\)](#) examined the sustainability of fiscal policy in Ghana to explore how the Ghanaian authorities have reacted to past debt accumulation via the estimation of a Fiscal Reaction Function between 2000:Q1 to 2014:Q1. The ARDL Bounds

test of co-integration revealed that the fiscal authorities' behaviors were coherent with the Intertemporal Budget constraint (IBC), although fiscal adjustments to public debt accumulation were low. As such, the Ghanaian fiscal operation was on a sustainable path since it reacts to increases in public debt by raising its surpluses in support of the IBC. More recently, [Ikikii \(2017\)](#) estimated a fiscal reaction function for Kenya, using monthly data, within the period 2000:07 and 2014:03. Using the quantile regression and the ARDL bounds test, the study revealed that the government response to public debt stocks contravenes the tenets of the intertemporal budget constraint; as such he affirmed that government may face a severe fiscal adjustment measures in the long run. The synopsis of the literature review showed that a large proportion of empirical work focused exclusively on the total public debt; as such there is need to examine if the response of government primary balance could vary depending on the type of public debt. This study incorporated the domestic, external and the total debt components of government debts in its analysis.

In reference to Nigeria, [Ariyo \(1993\)](#); [Oshikoya and Tarawalie \(2010\)](#); [Ayinde \(2014\)](#); [Oyeleke and Ajilore \(2014\)](#) could not reach a consensus on the fiscal sustainability stance of the country. [Ariyo \(1993\)](#) findings, based on the accounting approach and sustainability indicators, revealed that the country's fiscal operation was not coherent with the intertemporal budget constraint; as such it is not sustainable. The author argued that the surge in fiscal deficit occasioned by the post-civil war rehabilitation efforts made fiscal deficit not sustainable during the period. Similarly, [Ayinde \(2014\)](#) assessments based on the Present value budget constraint approach revealed that the fiscal operation of government was both strongly and weakly unsustainable. He argued that the enshrinement of fiscal rules do not guarantee that the fiscal policy stance of government would be sustainable. On the contrary, [Oshikoya and Tarawalie \(2010\)](#) and [Oyeleke and Ajilore \(2014\)](#) findings showed that the fiscal policy of Nigeria was weakly sustainable. The authors argued that the government fiscal deficit could explode over the long run. A caveat to these empirical works is that they focused extensively on the time series behavior of revenue and expenditure (devoid of public debt components of fiscal operation) by examining if their behavior is in line to the intertemporal budget constraint. The second level sustainability test that examines the nexus between primary balance and public debt is yet to be sufficiently addressed in the Nigerian debt sustainability literature. This paper fills this gap by estimating a fiscal reaction function to ascertain the responses of government to changes in its debt position whilst taking into cognizance some key determinants that could affect the surplus generating capacity in ensuring that the IBC is satisfied.

3. METHODOLOGY AND DATA

Typically, the fiscal reaction function is a rule tailored to ensure that government reacts appropriately to some macroeconomic changes ([Asiama et al., 2014](#)) as such it is incumbent for government to operate the right reaction function against harsh economic conditions. Essentially, the estimation of the fiscal reaction function is typically hinged on the Intertemporal Budget Constraint (IBC) framework. Following the works of [Bohn \(1998\)](#); [Burger et al. \(2011\)](#); [Chandia and Javid \(2013\)](#) the intertemporal budget constraint is expressed as:

$$B_t = (1+r_t)B_{t-1} - Pb_t \quad (1)$$

Where B_t denotes public debt, Pb_t is the primary balance (+ surplus -deficit) and r_t is the real interest rate.

Scaling [Equation 1](#) through by nominal GDP (Y), the solvency condition is derived while the contributory roles of macroeconomic factors to debt dynamics are accounted for. Thus, the change in the level of indebtedness when measured against the yardstick of GDP is considered; as such we derive [Equation 2](#):

$$\Delta \left(\frac{B}{Y} \right)_t = \left(\frac{1+r_t}{1+g_t} \right) \left(\frac{B}{Y} \right)_{t-1} - \left(\frac{Pb}{Y} \right)_t \quad (2)$$

Where in Equation 2, Y is the GDP, $\left(\frac{1+r_t}{1+g_t}\right)$ is the automatic debt dynamics, r is the real interest rate, g is the real growth rate of the economy. The implication of Equation 2 is that a higher primary balance leads to lower debt, and a higher initial debt results to a higher debt. In addition, a higher g leads to a lower debt while a higher r leads to a higher debt. If $\Delta\left(\frac{B}{Y}\right)_t = 0$, then Equation 2 becomes a conventional primary balance that ensures a stable debt target depicted in Equation 3:

$$\left(\frac{Pb}{Y}\right)_t = \left(\frac{1+r_t}{1+g_t}\right)\left(\frac{B}{Y}\right)_{t-1} \tag{3}$$

However, in Equation 3, when $r > g$ then a solvency condition given by $\lim_{n \rightarrow \infty} B_n \left(\frac{1+r}{1+g}\right)^n = 0$ is imposed to restrict public debt growth; a restriction that observes the absence of Ponzi game. As such, a simple reaction function that characterizes a rational and an ideal government behavior toward ensuring stable debt should be of the econometric form in Equation 4.

$$\left(\frac{Pb}{Y}\right)_t = \alpha_0 + \beta_1\left(\frac{B}{Y}\right)_{t-1} + \varepsilon_t \tag{4}$$

In Equation 4, the theoretical expectation is that $\beta_1 > 0$ is positive and significant against the alternative hypothesis ($\beta_1 < 0$) for an economy to be on the path of achieving debt sustainability in the long run. As such, for debt to be sufficiently sustainable, previous debt accumulation must be offset by surplus generated in the current period. Bohn (1998) called this condition the sufficient condition for achieving debt sustainability in the long run. Aside being positive and significant, Alfonso (2005) considered a beta coefficient closer to 1 as essential for fiscal solvency. However, it is argued that a detailed knowledge of the budgetary processes in the changes in government fiscal balance would not be effectively captured until other potential non-debt determinants are taken into consideration.

Therefore, an extended fiscal reaction function that incorporates some non-debt determinants of primary balance is depicted as:

$$\left(\frac{Pb}{Y}\right)_t = \alpha_0 + \beta_1\left(\frac{B}{Y}\right)_{t-1} + \beta_2 YGAP_t + \beta_3 EGAP_t + \beta_4 oilp + \beta_5 CPI_t + \beta_6 EXR_t + \beta_7 DUM_t + \varepsilon_t \tag{5}$$

We followed Bohn (1998) by incorporating YGAP (output gap/deviation) and EGAP (Expenditure gap/deviation) hinged on the Barro (1986) and Barro (1986) tax smoothing theory. The EGAP is included to account for shocks in expenditure needs of government and YGAP to account for the effect of business cycle fluctuation on the Nigerian fiscal operation. In addition, we followed the works of Abiad and Ostry (2005) and Asiama et al. (2014) by accounting for the influence of oil price movement on the Nigerian fiscal position since oil has been the economy mainstay; Consumer Price Index (CPI proxy of inflation) to capture inflation effect on the primary balance and exchange rate (EXR) to capture the effect of depreciation on fiscal stance regarding external debt services and the pass through effect on inflation. A structural dummy (DUM) was incorporated to account for the effect of breaks due to the various political regime changes which took toll on the modalities of fiscal operation

in Nigeria within the study period. We partitioned Equation 5 into total debt, domestic debt and external debt components to determine if the response of government primary balance varied depending on the components of debt. Thus, Equations 6, 7 and 8 are estimated.

$$\left(\frac{Pb}{Y}\right)_t = \alpha_0 + \beta_1 \left(\frac{Td}{Y}\right)_{t-1} + \beta_2 YGAP_t + \beta_3 EGAP_t + \beta_4 oilp + \beta_5 CPI_t + \beta_6 EXR_t + \beta_7 DUM_t + \varepsilon_t \quad (6)$$

$$\left(\frac{Pb}{Y}\right)_t = \alpha_0 + \beta_1 \left(\frac{Ds}{Y}\right)_{t-1} + \beta_2 YGAP_t + \beta_3 EGAP_t + \beta_4 oilp + \beta_5 CPI_t + \beta_6 EXR_t + \beta_7 DUM_t + \varepsilon_t \quad (7)$$

$$\left(\frac{Pb}{Y}\right)_t = \alpha_0 + \beta_1 \left(\frac{Ex}{Y}\right)_{t-1} + \beta_2 YGAP_t + \beta_3 EGAP_t + \beta_4 oilp + \beta_5 CPI_t + \beta_6 EXR_t + \beta_7 DUM_t + \varepsilon_t \quad (8)$$

A priori expectation: $\beta_{1\pm ve} \beta_{2-ve} \beta_{3-ve} \beta_{4+ve} \beta_{5+ve} \beta_{6-ve} \beta_{7\pm ve}$

Annual time series data, for the period 1970 to 2016 primary fiscal balance (PB), domestic debt (Dsgdp) and external debt (Exgdp) are sourced from the Central Bank of Nigeria (CBN) statistical bulletin 2016 edition; all fiscal variables are expressed as percentages of GDP. Also, data on consumer price index (CPI) and exchange rate (EXR) were sourced from the World Development Indicators (WDI) (2017) edition and data on oil price (oilp) were sourced from the World Bank commodity price database (the pink sheet). Proxies for output deviation (YGAP) and Expenditure deviation (EGAP) are percentages deviation from their respective trends. These are extracted from the Hodrick and Prescott filter using a conventional smoothing parameter of $\lambda=100$ in E-views 9 econometrics package. Dummies of 0 and 1 are used to represent period without break and period with break respectively. To avoid spurious estimates, the paper opts for the conventional unit root tests (Augmented Dickey Fuller ADF and Phillips Perron PP unit roots and unit root test with break point) to first ascertain the univariate properties of the data. Thereafter, the long run properties of the series are estimated through the Johansen cointegration tests. The error correction modeling is estimated for all models using optimal lag length of 3 as informed by the conventional Akaike Information Criteria (AIC).

4. PRESENTATION AND INTERPRETATION OF RESULTS

The unit root properties test result depicted in Table 1 exhibits high level of consistency since mixed results among the conventional tests could not be established. The ADF, PP and breakpoint unit root tests reveal that a large proportion of the series are not stationary in their level forms except primary balance, consumer price index and expenditure deviation. Essentially, the fact that all the debt components of fiscal operation could not exhibit mean reverting behaviours in their level forms casts doubt on their sustainability and give a signal of fiscal indiscipline (Wyplosz, 2012). Specifically the pioneer works of Hamilton and Flavin (1986) and Wilcox (1989) is based on the univariate properties of public debt whereby a case was made for a sustainable debt if its behaviour exhibits mean reversion at its levels form; otherwise it is not sustainable. Essentially, they argued that a case where levels form stationarity of government debts is rejected and primary balance is accepted, fiscal operation is still unsustainable. Therefore, the unit root property tests of the variables cannot sufficiently give a convincing conclusion as regards the sustainability of public debt and fiscal operation of Nigeria. The study further tests for the existence of cointegration based on the arguments of Trehan and Walsh (1991) which states that for there to be sustainability, the linear combination of primary balance and debt must be stationary, that is they must exhibit equilibrium or long run relationship. Of course, for stationarity to be restored the series may have to be differenced to avoid spurious regression. However, by differencing, only short run relationship is accounted for, hence it is important to establish if the linear combinations of the series are stationary in the long run. The study opts for the

Johansen cointegration test. To carry out the test appropriate lag length has to be chosen. The optimal lag length of three used in the study is informed by the conventional Akaike Information Criterion (AIC).

Table-1. Univariate properties of time series data and results for Nigeria (1970-2016).

Variable	Augmented Dickey Fuller			Phillips Perron			Break point test	
	Level	1 st Diff	Remark	Level	1 st Diff	Remark	Level	Remark
PB	-4.419***		I(0)	-4.579***		I(0)	-5.724*** (1974)	I(0)
DSGDP	-1.531	-5.929***	I(1)	-1.635	-5.908***	I(1)	-6.664***(1995)	I(1)
EXGDP	-1.859	-4.765***	I(1)	-1.719	-4.738***	I(1)	-6.301***(1999)	I(1)
TDGDP	-1.709	-4.796***	I(1)	-1.507	-4.796***	I(1)	-6.178***(1999)	I(1)
YGAP	-1.526	-5.952***	I(1)	-1.526	-5.914***	I(1)	-7.177***(1995)	I(1)
EGAP	-5.858***		I(0)	-6.857***		I(0)	-6.484***(1999)	I(0)
CPI	-3.352**		I(0)	-3.188**		I(0)	-5.801***(1995)	I(0)
EXR	2.024	-4.006***	I(1)	1.809	-4.006***	I(1)	-6.090***(2015)	I(1)
OILP	-1.841	-6.589***	I(1)	-1.883	-6.589***	I(1)	-8.160***(2014)	I(1)

Note: ***, **, * denotes 1%, 5% and 10% levels of significance respectively.

The Mackinnon critical values for the ADF and the PP tests with constant for 1%, 5%, and 10% levels of significance are -3.581, -2.927, and -2.601 respectively. -5.374, -4.859, -4.607 for break point critical values.

Source: Estimates are from E-views 9 Econometrics Package.

The Johansen cointegration tests reveal the existence of long run nexus among the variables used in the fiscal reaction functions as such the long run coefficients are presented in [Table 2](#). Specifically, the trace test revealed the existence of three cointegrating relationship in models 1 and 3 at 5 percent critical levels; while four cointegrating relationship was established for model 2 at 5 percent critical levels. The equilibrium relationships clarify that variables examined in the different reaction functions jointly exhibit mean reverting behaviours in their level forms. As such, the long run nexus gives evidence that the necessary condition for achieving debt sustainability in the long run is satisfied. However, [Bohn \(1998\)](#) argued that the cointegration of surplus and debt does not guarantee that debt would not explode in the long run. He therefore makes a case for a positive and significant coefficient of debt as a sufficient condition for debt sustainability. In view of the foregoing, having established equilibrium relationship, the study extracted the long run coefficients for different observations in the reaction functions estimated in order to test for the [Bohn \(1998\)](#) sufficiency condition. [Table 2](#) presents long run coefficients for the primary balance reaction function using external debt, domestic debt and total debt, as instruments among other control variables, as reported in models 1, 2 and 3 respectively. Specifically, the long run coefficients of debt components that capture the reaction of primary balance to public debts are statistically significant (at 5 percent for external debt and 1 percent for domestic and total debt) but negative against theoretical underpinning of a positive and significant response. This shows that the fiscal authorities do not operate a right reaction function against public debt dynamics. This negative response shows that Nigeria government is not able to run surpluses or to lower the primary deficits relative to increase in the public debt stocks. Additionally, the beta coefficient of the public debt stocks reveals that the unsustainability stance of the government debts is weak; although the magnitude of domestic debt tends to be stronger relative to the external debt component. Therefore, this negative response clearly violates the [Bohn \(1998\)](#) sufficient condition for achieving debt sustainability in that, government fails to react systematically to increase in public debt by generating surpluses to fulfill the solvency condition and be coherent with the tenet of the intertemporal budget constraint. These findings align with that of [Ariyo \(1993\)](#) and [Ayinde \(2014\)](#) but go contrary to that of [Oshikoya and Tarawalie \(2010\)](#) and [Oyeleke and Ajilore \(2014\)](#) on Nigeria.

Consistent with [Asiama et al. \(2014\)](#) on Ghana and [Abiad and Ostry \(2005\)](#) on emerging economies, the coefficients of output deviation (YGAP) are negative in signs but insignificant indicating a weak pro cyclical reaction of fiscal policy to output fluctuation. The pro cyclical reaction of government confirms the vulnerability of Nigeria fiscal policy to output shocks. Therefore, constraint is imposed on fiscal authorities in generating surpluses in the event of economic downturn. This finding lends credence to [Abiad and Ostry \(2005\)](#) findings that developing

economies tend to be pro cyclical to output fluctuations as against counter cyclical behaviour exhibited by developed economies.

Also, long run responses of Expenditure deviation (EGAP) are negative and statistically significant at 1 percent critical level in line to theoretical underpinning in the reaction functions. These findings readily align to Bohn (1998) prediction based on Barro (1979;1986) tax smoothing theory, that temporary government expenditures (as a result of shocks to expenditure needs) spur increase in primary deficit which invariably implies a decline in primary surplus. Therefore, shocks to expenditure needs could trigger the government debt stance not to be sustainable. Furthermore, the evidence of cointegration is also affirmed by the stationary status of the residual terms for the various reaction functions estimated. This is carried out by the ADF and PP tests as indicated on the last row of Table 2. The results are obtained by extracting the residuals obtained from the estimated models and by performing unit root tests on the residuals. The null hypothesis of unit root problem is rejected for all residuals in the models estimated.

Table-2. Long run relationship of the primary balance (PB) Reaction functions in Nigeria (1970-2016).

Series	Model 1 PB	Model 2 PB	Model 3 PB
c	-2.072 (-1.443)	0.603 (0.403)	-1.131 (-0.777)
Exgdp	-0.049** (-2.415)		
Dsgdp		-0.241*** (-4.309)	
Tdgdg			-0.052*** (-3.183)
YGAP	-0.012 (-0.904)	-0.005 (-0.429)	-0.006 (-0.425)
EGAP	-0.081*** (-3.163)	-0.081*** (-3.682)	-0.075*** (-3.074)
OILP	-0.018 (-0.618)	0.010 (0.418)	-0.019 (-0.704)
CPI	0.013 (0.337)	0.010 (0.270)	0.012 (0.310)
EXR	0.010 (0.892)	-0.010 (-0.617)	0.009 (0.852)
DUMMY	2.890* (1.889)	2.436* (1.795)	2.710* (1.850)
Rsquare	0.50	0.61	0.54
F-statistic	5.562***	8.724***	6.629***
ECM:ADF	-6.487	-7.474	-6.956
PP	-6.486	-7.622	-6.941

Source: Figures in parenthesis denote t-statistics while *** 1% **5% *10% represent levels of significance. The Mackinnon critical values for ADF and PP are 1% -3.581 5% -2.927 10% -2.601 respectively. Estimates are computed in E-views 9 econometrics package.

By applying general to specific approach we expunge some insignificant observations in the overparametrized models to obtain models that are parsimonious. Therefore, the results of the parsimonious error correction models linked to the long run fiscal reaction functions are depicted in Table 3. Models 1, 2 and 3 include external debt, domestic debt and total public debt components of fiscal operation. The results explicitly show that the error correction terms (which lies between 0.87 and 1.08) is negatively and significantly signed at 1% critical level for all models; therefore, conforming to a priori expectation. This implies that more than 96 percent (on average) of the disequilibrium caused by previous years shock is corrected for in the current period in all models. Also, the significance of the error correction term portends that the explanatory variables estimated in the fiscal reaction function granger-cause primary balance in the long run (Asiama et al., 2014). The models all exhibit relatively high coefficient of determination and adjusted coefficient of determination. For instance, the coefficient of determination

in model 1 shows that about 81 percent of variation of government primary balance is explained within the model; while about 83 percent and 84 percent variation of government primary balance are explained within models 2 and 3 respectively. The foregoing readily shows that all models are good fitted and variables included can indeed explain the government primary balance. In addition, the Durbin Watson statistic, which is close to 2 in all models, shows that all models estimated are free from first order serial correlation in their residuals.

The response of government primary balance to the contemporaneous values of external, domestic and total debt is negative and significant at 1 percent critical levels for all models. This negative response readily indicates that fiscal authorities run high deficit and low surplus relative to public debt increases contrary to the tenet of the intertemporal budget constraint. However, government primary balance to the first lagged value of external debt $\Delta(\text{Exgdp}(-1))$ and third lagged value of domestic debt $\Delta(\text{Dsgdp}(-3))$ as well as the first lagged value of total debt $\Delta(\text{Tdgdgdp}(-1))$ is positive and significant effect thereby satisfying the tenet of the intertemporal budget constraint. This suggests that past government debts are sustainable in the short run. Furthermore, the primary balance could not give a significant response to the contemporaneous value of the output deviation. However, the significant negative values of output deviation $\Delta(\text{YGAP}(-2))$, $\Delta(\text{YGAP}(-3))$, are reported in model 1 and 3; while $\Delta(\text{YGAP}(-1))$ and $\Delta(\text{YGAP}(-2))$ are reported in model 2. The negative response of primary balance to output deviation depicts a pro cyclical reaction of fiscal policy to cyclical fluctuations in the short run; thereby corroborating [Abiad and Ostry \(2005\)](#) findings of pro cyclical reaction peculiar to developing and emerging economies. The government primary balance reaction to expenditure deviation $\Delta(\text{EGAP})$ and third lagged $\Delta(\text{EGAP}(-3))$ aligns to its negative and significant long run signs in model 1. In addition, the government primary balance reaction to expenditure deviation $\Delta(\text{EGAP})$ and $\Delta(\text{EGAP}(-2))$ as well as third lagged $\Delta(\text{EGAP}(-3))$ aligns to its negative and significant long run signs in model 2; third lagged value $\Delta(\text{EGAP}(-3))$ in model 3. This sign conforms to a priori expectations by aligning to the Barro tax smoothing theory, in that temporary government expenditure readily lowers surpluses and increases deficits.

Furthermore, the response of primary balance to contemporaneous value of oil price is positive and significant (models 1) at 1 percent critical level and (models 2 and 3) at 5 percent critical levels; this is an indication that increases in oil price could help increase surplus in dampening down increase debt dynamics. As expected, increase in the oil price, being a commodity dependent economy, should spur the surplus generating capacity of government. This finding is consistent with [Asiama et al. \(2014\)](#) on Ghana. However, the primary balance exhibits negative response to the first lagged value of oil price $\Delta(\text{oilp}(-1))$ in model 1 and the first $\Delta(\text{oilp}(-1))$ and third $\Delta(\text{oilp}(-3))$ lagged value of oil price in model 3. This is only significant at 10 percent critical level. The negative response, therefore, implies that in the event of increases in oil price, deficits are rather generated rather than surpluses. As such increases in oil price which invariably should attenuate the burden of debt explosion through surplus generation rather exacerbate deficits accumulation. The foregoing could make a case for the Dutch disease phenomenon peculiar to developing countries that are resource dependent and the evident threat oil price could pose on achieving debt sustainability.

The primary balance responds to the first lagged value of exchange rate $\Delta(\text{EXR}(-1))$ was negative and significant in models 1, 2 and 3 respectively in the short run. This response gives an indication that exchange rate depreciation (the devaluation of the Naira against major currencies) could dampen the government surplus generating capacity in response to public debt increases. The depreciation effect of the Naira could also intensify the bottlenecks of government debt services thereby engendering fiscal imbalance through deficit generated via subsequent allocations earmark for debt servicing. This finding buttresses the significance of exchange rate stability in ensuring a sound fiscal policy system aimed at ensuring a sustainable debt.

Table-3. Error correction mechanism parsimonious fiscal reaction models results in Nigeria (1970-2016).

Series	Model 1 $\Delta(\text{PB})$	Model 2 $\Delta(\text{PB})$	Model 3 $\Delta(\text{PB})$
c	0.985* (1.934)	0.835* (1.773)	1.137** (2.213)
$\Delta(\text{Exgdp})$	-0.136*** (-2.318)		
$\Delta(\text{Exgdp}(-1))$	0.108** (2.402)		
$\Delta(\text{Exgdp}(-2))$	-0.051 (-1.472)		
$\Delta(\text{Dsgdp})$		-0.367*** (-4.345)	
$\Delta(\text{Dsgdp}(-1))$		-0.079 (-0.746)	
$\Delta(\text{Dsgdp}(-3))$		0.219** (2.153)	
$\Delta(\text{Tdgdgdp})$			-0.148*** (-3.474)
$\Delta(\text{Tdgdgdp}(-1))$			0.102** (2.429)
$\Delta(\text{Tdgdgdp}(-2))$			-0.041 (-1.216)
$\Delta(\text{YGAP})$			0.006 (0.334)
$\Delta(\text{YGA}(-1))$	-0.021 (-1.261)	-0.062** (-2.508)	
$\Delta(\text{YGAP}(-2))$	-0.038* (-1.989)	-0.040** (-2.149)	-0.047** (-2.332)
$\Delta(\text{YGAP}(-3))$	-0.037* (-1.960)		-0.040** (-2.107)
$\Delta(\text{EGAP})$	-0.038* (-1.908)	-0.071*** (-4.083)	-0.036 (-1.661)
$\Delta(\text{EGAP}(-2))$		-0.037* (-1.903)	
$\Delta(\text{EGA}(-3))$	-0.030* (-1.970)	-0.033** (-2.062)	-0.031** (-2.158)
$\Delta(\text{oilp})$	0.113*** (3.262)	0.087** (2.585)	0.096** (2.786)
$\Delta(\text{oilp}(-1))$	-0.084* (-1.763)		-0.097* (-1.966)
$\Delta(\text{oilp}(-2))$		-0.063 (-1.525)	
$\Delta(\text{oilp}(-3))$	-0.078 (-1.669)		-0.084* (-1.886)
$\Delta(\text{cpi})$	-0.038 (-1.11)		-0.046 (-1.362)
$\Delta(\text{cpi}(-1))$			-0.048 (-1.227)
$\Delta(\text{cpi}(-2))$		0.042 (1.350)	
$\Delta(\text{cpi}(-3))$			-0.033 (-0.794)
$\Delta(\text{EXR}(-1))$	-0.174*** (-2.874)	-0.094** (-2.308)	-0.195*** (-3.063)
$\Delta(\text{EXR}(-3))$		-0.065 (-1.519)	
$\text{ECM}(-1)$	-0.872*** (-5.652)	-1.083*** (-6.872)	-0.935*** (-2.242)
Rsquare	0.805	0.825	0.837
AdjRsquare	0.708	0.737	0.737
F-statistic	8.264***	9.398***	8.344***
DW-statistic	1.888	1.873	1.939

Source: Estimates were computed in E-views 9 econometric package. Note that values in parenthesis depict t-statistic; while '***' '**' '*' denote 1, 5 and 10 percent significance respectively. Δ is the difference operator. Optimal lag of 3 was informed by Akaike Information Criteria.

As a necessity, diagnostics tests depicted in Table 4 reveal that all models are robust since they passed all tests that befit a typically best regression model. Essentially, the null hypothesis of correct model specification of the

Ramsey Reset Test, normality of residuals of the Jacque-Bera test, no serial correlation of the Breusch-Godfrey Test and homoscedasticity of the Breusch-Pagan test cannot be rejected since the probability values assigned to each test are statistically insignificant in the models estimated. The cumulative sum and the cumulative sum of squares (provided in Figure 2 and Figure 3 respectively) that capture stability in mean and variance of the model parameters readily show that the residual of the model are statistically stable in their mean and variance values, as such the models are fit for policy inference. This is evident in the residuals whose movements fall within the confidence interval bounds.

Table-4. Model robustness check.

Diagnosis	Test statistic	Model 1 (Exgdp)		Model 2 (Dsgdp)		Model 3 (Tdgdp)	
		Test-Value	Probability	Test-Value	Probability	Test-value	Probability
Model specification ⁱ	Ramsey Reset test F-statistic	0.806	0.427	0.580	0.852	0.601	0.553
Normality ⁱⁱ	Jarque-Berra Test χ^2 -statistic	0.113	0.945	0.428	0.808	0.472	0.789
Serial correlation ⁱⁱⁱ	Breusch-Godfrey test F-statistic	0.389	0.762	0.494	0.689	0.488	0.694
	Obs*R-squared	1.917	0.589	2.405	0.493	2.575	0.462
Heteroskedasticity ^{iv}	Breusch-Pagan test F-statistic	0.881	0.586	0.998	0.481	0.599	0.856
	Obs*R-squared	13.149	0.515	14.310	0.427	11.586	0.772

Note: I Ramsey's RESET test uses the square of the fitted values.
 II Based on a test of skewness and kurtosis of residuals.
 III Lagrange multiplier test of residual serial correlation.
 IV Derived from the regression of squared residuals on squared fitted values.

Source: Estimates are from the E-views 9 Econometrics package.

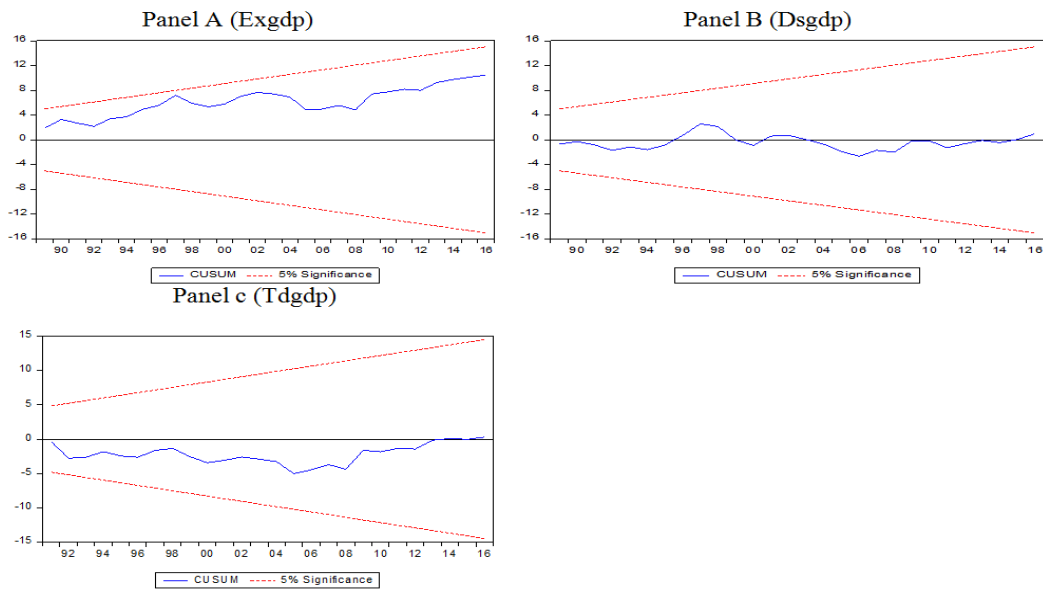


Figure-2. CUSUM (mean) test.

Source: Authors' Computation in E-views 9.

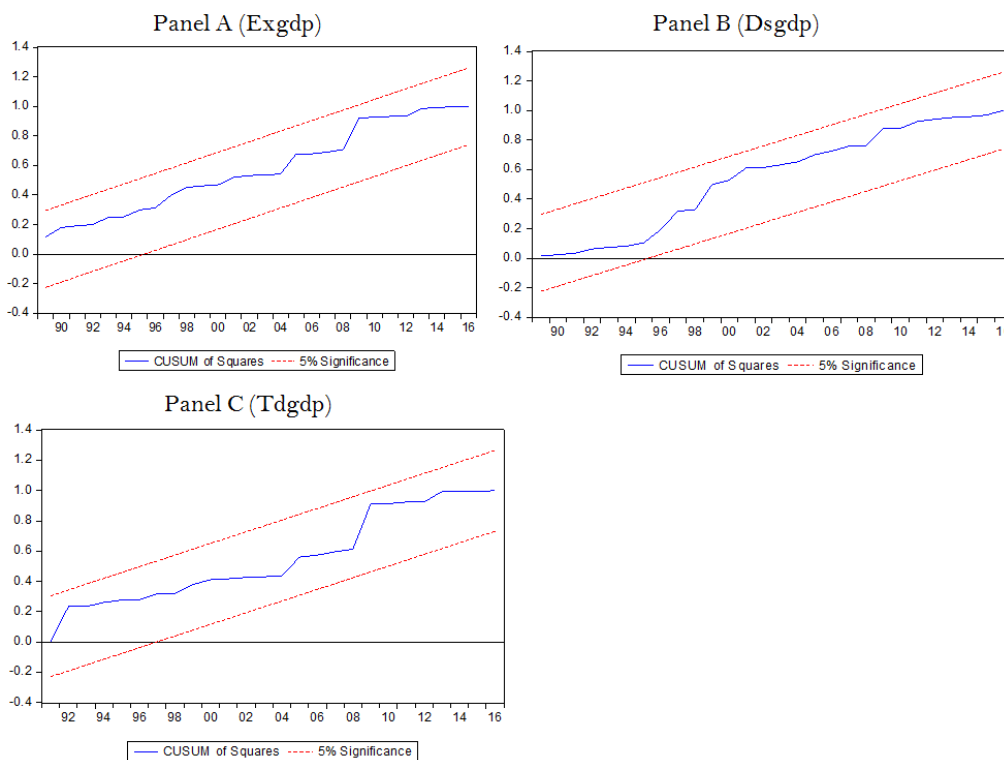


Figure-3. CUSUM of squares (Variance) test.

5. CONCLUSION

The study determines the tendency for public debt sustainability in Nigeria by estimating fiscal reaction functions hinged on the intertemporal budget constraint. The fiscal reaction functions are partitioned into three models based on the debt components of fiscal operation; domestic debt, external debt and total debt among other control variables. The study reveals the existence of long run relationship between primary balance and public debt in conjunction with other fiscal and non-fiscal variables in all the models estimated. The equilibrium nexus among the variables shows that government primary balance in response to public debt (domestic, external and total debt) accumulation satisfies the necessary condition for achieving debt sustainability in the long run. However, the coefficients of debt components are negative and significant going against theoretical underpinning of a positive and significant coefficient for an economy to be on the path of achieving debt sustainability. The study also observes that the negative responses of government to debts remain the same irrespective of the debt holdings. This negative response shows that fiscal authorities violate the [Bohn \(1998\)](#) sufficient condition for achieving debt sustainability in the long run. The finding rather suggests that fiscal authorities in response to rising public debts operation could not generate primary surpluses but rather accumulate primary deficit. This readily affirms the unsustainability of government debt in Nigeria. The implication of the unsustainability of government debt indicates that if government continues to run deficits in reaction to outstanding debts a case of harsh fiscal adjustment measure is eminent amidst debt explosion. The study also observes that government response in ensuring a sustainable debt stance is more vulnerable to swings inherent in the global oil market coupled with exchange rate depreciation. As such oil price and exchange rate movements could pose threat to sustainable debt operation. Furthermore, the study observes a pro-cyclical reaction of government to output fluctuations as such much constraint is imposed on the country's fiscal operation in events of economic downturn. However, in the short run, mixed results are established; in that, the reaction of government primary balance to the current value of debt is negative and significant confirming the long run findings. However, the primary balance response to the first lagged value of external debt is positive and significant in model 1; an indication that the immediate past external debt is sustainable in the short run. Similarly, government primary balance response to the third lagged value of domestic debt is positive and significant in model 2; while the government primary balance exhibits a positive and significant response to the first

lagged value of total debt (model 3) in line to the intertemporal budget constraint. This gives a signal of a sustainable previous government debt in the short run.

6. RECOMMENDATION

In view of the findings, there is need for government to reduce its borrowing excesses and to infuse some flexibility in its budget financing by pursuing aggressive non-oil revenue generation diversification as such widen its revenue base. This would make the economy less pro-cyclical to external shocks as enough buffers would be created to attenuate the effect of negative oil price shocks. The study reveals pro-cyclical reaction of government fiscal operations to output fluctuation. Therefore, there is need for strict adherence to fiscal rules; fiscal rules that improve the maneuvering ability of government towards output fluctuations, through policies that are counter-cyclical. Rules that instill fiscal discipline promote credible macroeconomic policies and reduce deficits. In addition, there is need for rules that guide against government spending excesses and promote spending that are growth enhancing. The study also reveals that exchange rate depreciation poses threat to debt sustainability, therefore there is need to pursue stringent management of exchange rate policies to cushion the transmission (pass through) effect of its depreciation on external debt service as such threat to debt solvency would be reduced.

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