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Can Corruption Explain Public Debt Accumulation in Nigeria?

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Abstract

This study examines the effect of corruption on public debt stock in Nigeria for the period 2010q1-2020q4. An ARDL bound test to cointegration, canonical cointegration regression (CCR), dynamic ordinary least squares (DOLS) and fully modified ordinary least square (FMOLS) techniques were used for the analysis. We find consistent evidences of a positive long-term relationship between the ratio of public debt to GDP and corruption alongside the ratio of government expenditure to GDP, and a negative relationship between the ratio of public debt to GDP and government revenue to GDP as well as logarithm of GDP per capita, GDP growth rate and unemployment rate. Overall, the evidence suggests that corruption has an increasing effect on public debt irrespective of the magnitude of government expenditure; on average a unit increase in corruption index increase public debt stock by about 14.88 percent. Further results show that, the adverse effect of corruption persists in foreign and domestic debt components, albeit, the effect on domestic debt components was statistically not significant. These findings imply that better control of corruption can be a potential instrument for taming the rising public debt stock in Nigeria.

Keywords: Corruption, Public Debt, Nigeria

JEL: H11; H63.

1. Introduction

Public debt stock represents the total accumulated past deficit minus past surpluses. It plays vital roles in filling the government expenditure-revenue gap in developed and developing countries (Ncanywa & Masoga, 2018). Prudent and disciplined utilisation of debt financing in developing countries can help narrow down infrastructural deficit; meet emergency financing needs such as the covid-19 and speed up the attainment of overall social and developmental goals (Abu, *et al*., 2022; Onyele & Nwadike, 2021; World Bank 2020). Notwithstanding, there is a general consensus in the literature on the downside of excessive and irresponsible debt accumulation. For instance, debt-overhang literature supports the decreasing effect of public debt on output growth (Jibir *et al*., 2017; Benayed *et al*., 2015; Afonso & Alves 2014; Reinhart *et al*., 2012; Reinhart & Rogoff 2010). Also, a strand of literature on the crowding-out hypothesis points to the substituting effect of debt servicing on other government expenditure components especially the social

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spending (Iliyasu & Gambo 2022; Picarelli*etal*., 2019; Ndour 2017; Shabbir & Yasin 2015).

In the early 2000s, Nigeria experienced a severe debt-trap problem as manifested in various debt sustainability measures. For example: total public debt stock reached about US$ 46,259.45 billion, the Net Present Value of debt/GDP was at 51.4 percent, the Net Present Value of debts/revenue stood at about 412 percent, the Net Present Value of debt to export revenue was 152 percent. As a result of these, the required yearly debt services stood at about US$ 3 billion. However, the country managed to afford an average of about US$1 billion debt servicing payment from 1999-2004 (Okonjo-Iweala, 2005; Debt Management Office, DMO 2006). Nigeria's fiscal space was squeezed, there were little resources left for public investment in key sectors (Okonjo-Iweala, 2005). It is worth noting that the historic Paris Club of creditors debt relief agreement that wrote off US$ 18 billion out of US$30 billion (about 60 percent) of Nigeria debt in lieu of an upfront payment of about US$12 billion provided an opportunity for a fresh start in Nigeria's public debt accumulation dynamics (Nwankwo, 2013).

Furthermore, the past decade set the tune for another public debt buildup in Nigeria due to the volatility in commodity price (2014-2016) and the Covid-19 health and economic crisis (Iliyasu& Gambo 2021; IMF, 2020; World Bank 2022). By the end of first quarter of 2022 the nominal public debt stock was about ($ 100,069.89 billion) higher than the pre debt-relief figures ($46,259.45 million) as in December 2004 (Debt Management Office, DMO 2006 & 2022). Consequently, the central government has been spending an average of US$5.52 billion to services its debt over the 2016-2021 period, this is equivalent to more than half of its retained revenue (CBN, 2021a).

A growing body of cross country level evidence indicates the existence of a positive association between public debt accumulation and the incidence of corruption especially in developed countries (Cooray *et al*, 2017; Benfratello *et al*, 2018). In addition, amid rising public debt stock, many scholars have suggested that corruption has eaten deep across every sector of the Nigerian economy (Rivi*et al*., 2020; Abu *et al*., 2015; Abu, Staniewski, 2019, Abu *et al*., 2022). A report by the Independent Corrupt Practices Commission (ICPC 2019b) indicted law makers for padding the budget and stealing the public fund through the guise of a constituency project usually tagged "capacity building and empowerment" beside the hasty approval given to a series of loan requests without clear information on the intended project cost-benefit analysis and the potential socio-economic impacts. Similarly, ICPC, (2019a) records revealed that the anti-graft agency had concluded investigation on 3,657 corruption cases and recovered the sum of N51.4 billion during 2006-2019. Furthermore, the Economic and Financial Crimes Commission (EFCC) has successfully secured about 2,544 convictions on various corruption cases from 2010-2019 involving former governors, ministers, advisers and head of government agencies.

In general, the literature on the public debt stock-corruption nexus was dominated by cross sectional and panel countries studies. The results and conclusions pointed to a positive relationship between corruption and public debt (Baklouti & Boujelbene, 2021; Del-Monte & Pennacchio, 2020; Benfratello *et al*., 2018; Cooray *et al*., 2017; Grechyna, 2012). At country level (especially in Nigeria),

few empirical studies existed on the causal link between corruption and public debt, in spite of the rising stock of public debt and high incidence of corruption. The few studies conducted on the effect of corruption on public debt include: Revi *et al*. (2020), Fagbemi and Olatunde (2019), and Matthew and Anda, (2016). Whereas, these attempts are acknowledged, there are a number of general and specific limitations in their methodology. For example, the sample size for all the three studies is less than 30, which is the recommended requirement for a robust time series analysis. Secondly, Matthew and Anda (2016) and Revi *et al*. (2020) were biased toward external debts; the former used external debt stocks and the latter used the ratio of debt services to export as their dependent variables. Thirdly, all the studies failed to check the possibility of structural breaks in the public debt series due to the 2006 debt-relief that drastically reduced the stock of Nigerian public debt.

From the foregoing, limited evidences existed on the nexus between public debt stock and corruption at country level (particularly in Nigeria). In addition, the observed deficiency in the existing studies left several pertinent research questions unanswered; (i) Can high corruption level induce public debt accumulation? (ii) Does corruption affect foreign and domestic debt stock differently? (iii) Does the effect of corruption on public debt hinge on the existing government expenditure regime?

This study addressed the above questions and specifically investigates the effect of corruption on public debt accumulation in Nigeria. In addition, we examined whether the overall effect of corruption depends on the level of government expenditure, and the specific components of public debt stock (foreign or domestic). The study differs from existing studies as follows: firstly, we employ quarterly data that gave a large amount of observations capable of generating reliable empirical results. Secondly, in addition to the ARDL techniques, a robustness test was conducted using alternative cointegration estimation techniques (FMOLS, DOLS and CCR). Thirdly, we captured a structural break in the model detected by the Zivot-Andrews (1992) and Bai-Perron (1998) tests. The rest of the study is organised as follows: Section 2 consists of the literature review; Section 3 explains the methodology employed in the study, Section 4 includes the results and discussion and Section 5 concludes and offers policy recommendations.

2. Empirical Literature Review

There is substantial literature on the public debt-corruption nexus. Many of the studies used cross-section or panel data on a group of countries or regions. For instance, Baklouti & Boujelbene (2021) investigated the effect of corruption on public debt through the mediating role of democracy for 16 Arab countries over the 2000-2016 period. Estimates from the general method of moments (GMM) show that corruption has an increasing effect on public debt. Also, Appiah-Kubi *et al*., (2022) examined the key drivers of public debt in 47 African countries between 2000-2018 using (GMM, FE, 2SLS and IV) estimation techniques. The results show that the increase in corruption raises the public debt stock in Africa. Further results indicate that government consumption and tax revenue have a significant decreasing effect on the public debt stock in Africa.

In addition, Del Monte and Pennacchio (2020) examined the effect of corruption on public debt in OECD countries. They used annual data from 1995–2015, fixed effects

(FE), Arellano- Bond (AB) and Generalized Method of Moments (GMM). The study found that halving corruption could reduce public debt by 2 percent in the short-term. This effect extends to the long run when highly indebted countries (Greece and Italy) are considered. Likewise, Benfratello *et al*. (2018) examined the impact of corruption on public debt on a panel of developed and developing countries over the 1995-2015 period using the Arellano–Bond first difference generalized method of moments (GMM). Evidence suggested a heterogeneous increasing effect of corruption on public debt; "corruption has a strong positive effect on public debt in developed economies and low insignificant effect on less developed economies".

Similarly, Cooray *et al*., (2017) examined the link between public debt, corruption, the shadow economy and the interacting effect of the shadow economy on the public debt-corruption nexus. The study developed and tested a model for 126 countries between the 1996-2012 period using four alternative estimation techniques (OLS, FE, system GMM, and IV). Evidence suggested that corruption and the shadow economy have a significant positive impact on public debt. In addition, the effect of corruption on public debt is amplified by a larger shadow economy. In the same vain, Gonz´alez-Fern´andez, & Gonz´alez-Velasco (2014) examined the link between public debt, the shadow economy and corruption in the Spanish regional government. The study constructed a panel data set on the corruption index for the communities from 2000-2012 and applied fixed effect, random effects and instrumental variables panel estimation techniques. The findings indicate that the higher level of corruption and the higher shadow economy are significantly related to higher regional public debt, although the effect of corruption on public debt is lower in magnitude compared to that of the shadow economy.

Furthermore, Apergis and Apergis (2019) examined the relationship between corruption and government arrears in a panel of 120 countries from 1999 to 2015. The authors used Panel Smooth Transition Regression (PSTR) technique. Their results showed that higher corruption regimes are associated with higher public debt level and lower corruption regimes are related to lower public debt level. Also, Grechyna (2012) developed and tested a hypothesis on the link between corruption and public debt in a panel of OECD countries over the 1995-2010 period. Results from the OLS and System GMM techniques confirmed the role of public corruption in shaping the public debt profile of the studied countries.

Liu and Mikesell (2017) developed and tested a hypothesis that US states and the local governments' public debt is positively associated with corruption level in the long run. The authors constructed a panel data set for the period 1997–2008 and applied the dynamic panel data estimation techniques. The findings show that decreasing state level corruption can significantly decrease state public debt stock, in particular if 10 most corrupt states reduced their average corruption level, their public debt will decrease by about 9 percentage points equivalent to an average state per capita debt of US$ 249.35.

In Nigeria Rivi *et al*., (2020) examined the link between corruption and debt sustainability over the 1996-2019 period. The authors used the Vector Error Correction Model (VECM) Technique. Evidence suggested that corruption is significantly inversely related to debt sustainability in Nigeria, implying that the higher level of public corruption threatens public debt sustainability. Relatedly, Fagbemi

and Olatunde (2019) investigated the long-run and short-run impact of corruption on public debt in Nigeria between the 1996-2017 period using the bound test approach to cointegration. The results indicated that corruption has a significant adverse effect on public debt in the short run, but not in the long run. Furthermore, a bi-directional causality between the corruption index and public debt was confirmed. Also, Matthew and Anda (2016) examined the effect of corruption on Nigeria's external debt stock during the 1996-2014 period using the Vector Error Correction Model (VECM). The findings show that corruption and government expenditure have a significant increasing effect on public debt in the long run. However, the Granger causality test failed to confirm the results from the VECM estimate.

Therefore, it is evident that the literature on the public debt-corruption nexus is just evolving in Nigeria. In addition, the few existing studies are marred with obvious deficiencies such as inadequate sample size, biased toward external debt stock and failure to account for structural breaks. The current study addressed these issues by; (i) using quarterly data that gave a larger number of observations capable of generating reliable empirical results (ii) modeled total, foreign and domestic debt stock separately (iii) examines the impact of corruption when interacted with government expenditure (iv) accounted for structural break(s) and (v) carried out robustness test using alternative cointegration techniques (FMOLS, DOLS and CCR).

2.1. Stylized Facts

The general government debt-to-GDP ratio in Nigeria has been on steady increase over the 2010q1-2020q4 period as shown in figure1. The average ratio increase by about 1000 basis points after every four quarters. For example, it was 33% in 2010 and rose to 80% by 2015; it then jumped to 120% during 2017, 130% in 2018 and to 190% in 2020. Overall, between 2010q1 and 2016q1 there was a modest quarterly rise in the ratio of public debt to GDP. However, we noticed a sharp rise over the 2016q2- 2020q4 period with a peak around 2020q2. This period corresponded with the covid-19 health and economic crisis that decreased government revenue and induced emergency health and economic stimulus spending. As a result, available data shows that Nigeria's central government expended more than 50 per cent of its accrued revenue on debt servicing over the 2016 to 2021 periods (CBN, 2021b).

Also, despite more than two decades of anti-corruption fight, corruption has remained high and pervasive in Nigeria (Abu *et al*., 2022). Furthermore, the Transparency International (TI, 2020) has consistently ranked Nigeria as one of the leading corrupt nations in the world, through its Corruption Perception Index which measures perceptions of corruption in the public sector across different countries globally, from 0 (highly corrupt) to 100 (highly clean)[1].

[1] This is an inverse measure of corruption, we re-scale the index to a direct measure using (100-CPI) in our estimation for easy interpretation such that 0 (highly clean) to 100 (highly corrupt).

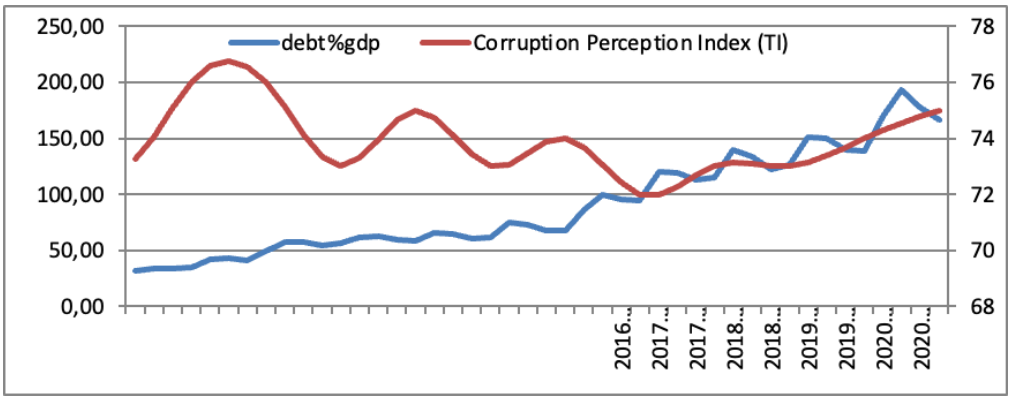

Figure 1. Plot of total public debt-to-GDP ratio and Transparency International TI Corruption Perception index. NB: The corruption perception index used was re-scale to a direct measure using (100-CPI), such that 0 (highly clean) to 100 (highly corrupt). Source: Authors' plotted based on data collected from (CBN, TI).

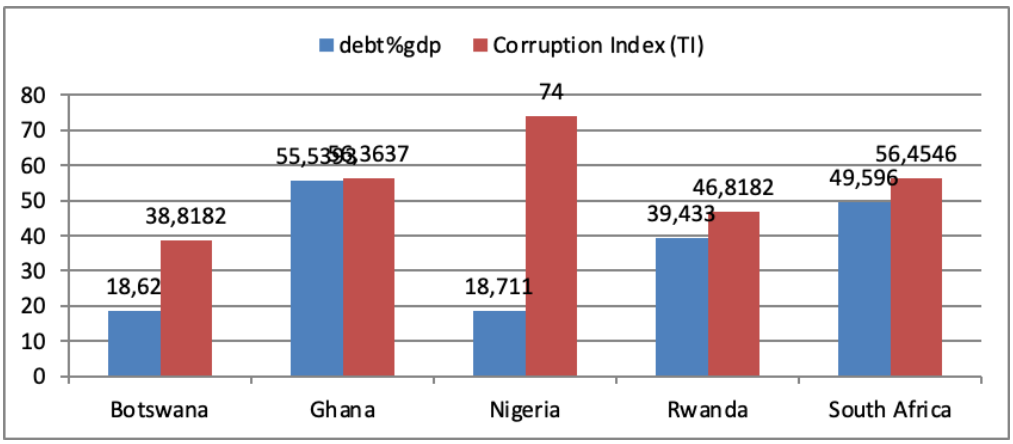

Figure 2. Plot of average public debt-to-GDP ratio (2010-2022) and Transparency International TI Corruption Perception index (2012-2022). NB: The corruption perception index used was rescaled to 0 (highly clean) to 100 (highly corrupt). Source: Authors' plotted based on data collected from (IMF, TI).

These assertions are buttressed by the trajectory of the country corruption perception index score shown in figure 1. For instance the index was 76.768 in 2011q2; it dropped to 73 in 2012q4, increased to 75 in 2012q4, and dropped again to 73.42 in 2014q3, rose to 74 in 2015q4, and dropped to 72 in 2016q4 and rose again to 75 in 2020q4.

Moreover, figure 2 indicated that among five African countries compared, Botswana (18.62) had the lowest average ratio of public debt-to-GDP ratio followed by Nigeria (18.71). The Nigerian case reflected the 2006 Paris club of creditors' debt cancellation. However, appreciable public debt accumulation resumed after the 2008 global financial crisis. Ghana (55.54) and South Africa (49.60) recorded the

highest average, then followed by Rwanda (39.433). In terms of incidence of corruption Nigeria (74) has the highest incidence of corruption; Botswana (38.82) and Rwanda (46.82) are less corrupt compared to Ghana (56.36) and South Africa (56.45).

3. Data and Methodology

3.1. Data

Table 1 presents the description of the variables, a priori expectation and data sources. The study covered two decades, 2010Q1 to 2020Q4. The choice of the period was conditioned by two reasons (i) Nigeria enjoyed clean slate in public debt accumulation after the 2006 Paris club of creditors debt cancellation. Thus, a significant upward trend of public debt appeared after the 2008 global financial crisis and (ii) the availability of quarterly data on the majority of our variables except corruption Perception Index (CORR) and per-capita GDP (LYP) from the year 2010 and beyond. Importantly, the evidence over the sample period can enhance our understanding on the post debt-relief period public debt accumulation dynamics in Nigeria.

Similar to (Abu & Karim 2021; Abu *et al.,* 2019; Baharumshah *et al*., 2006; Baharumshah & Rashid, 1999; Tang, 2008), we generated quarterly from yearly data frequency on corruption Perception Index (CORR) and per-capita GDP (LYP) using Gandolfo's (1981) interpolation technique from the 2008-2020 period. The process of interpolation eliminates data for the first two years leaving us with a quarterly data set over 2010Q1-2020Q4 (44 observations). The interpolation enabled us to have enough observations without creating bias in the cointergrating vectors (Abu & Karim 2021; Tang, 2008).

In addition, due to rampant incidence of corruption across every level of government in Nigeria (see Abu *et al*., 2015), the concept of general rather than central government was preferred. We therefore, aggregated actual expenditure and revenue of the three tiers of government (federal, state and LGAs) as well as expressed them as a ratio of the 2010 constant GDP alongside public debt. Also, for easy interpretation the corruption index was re-scaled to a direct measure of corruption (100-CPI) such that 0 stands for corruption free and100 highly corrupt, the strategy was also used by several authors (Cooray, *et al*., 2017; Benfratello *et al*., 2018; Del Monte & Pennacchio 2020).

3.2. Theoretical Framework

Similar to Benfratello *et al.* (2018) and Grechyna (2012) the inter-temporal budget constraint provides the framework for the empirical analysis. The framework formally defines government inter-temporal budget constraints as follows:

$$B_t = (1 + r)B_{t-1} + G_t - T_t \quad (1)$$

Where B_t represent public debt, G_t is government expenditure, r is the interest rate and T_t is tax revenue. To express public debt stock as a share of Gross Domestic Product (Y_t), equation one is divided by Y_t ; assuming g to be the growth rate of GDP, this leads to:

$$\frac{B_t}{Y_t} = \left(\frac{1+r}{1+g}\right)\frac{B_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \quad (2)$$

Equation (2) implies that debt-to-GDP ratio at time *t* depends on debt ratio at *t-1* and on primary deficit ($G_t - T_t$). Moreover, extant literature postulates that corruption can affect public debt through at least three channels. Firstly, corruption can affect the country's Debt-to-GDP ratio by decreasing growth. The "sand in the wheels of commerce" literature

Table 1. Data Description and Sources

Variables	Description	Selection Justification	Expected Sign	Sources
DEBT	Total public debt stock constituting the total domestic and external debt stock of the federal government, the 36 state of the federation plus the FCT expressed as a ratio of GDP	Cooray, et al., (2017); Benfratello *et al*., (2018)		CBN
CORR	Transparency international corruption perception index originally measure corruption inversely between 100 corruptions free and 0 highly corrupt countries. But re-scale to a direct measure between 0 corruption-free to 100 totally corrupt countries	Cooray, et al., (2017); Benfratello *et al*., (2018)	+	TI
GX	Actual aggregate expenditure of federal government, the 36 state and FCT plus the 774 LGAs expressed as a ratio of GDP	Cooray, et al., (2017); Benfratello *et al*., (2018)	+	CBN
CORR_GX	Interaction of corruption index and government expenditure	Del Monte and Pennacchio (2020)	±	Authors' construction
REV	Actual revenue shared of federal government, the 36 state and FCT plus the 774 LGAs expressed as a ratio of GDP	Cooray, et al., (2017)	-	CBN
LYP	Logarithm of the per-capita GDP i.e GDP divided by the population	Cooray, et al., (2017); Benfratello *et al*., (2018)	-	WDI
GDPGR	Growth rate of real GDP, which measures increase in the productive capacity of a country.	Grechyna, (2012)	-	WDI
UNEM	The Rate of unemployment reported by National Bureau of Statistics was calculated by dividing the number of unemployed persons by labour force times 100	Grechyna, (2012)	+	NBS
D16[1]	Dummy variable constructed to account for the structural breaks observed around 2016Q1. 0 prior to 2016Q1 and 1 onward	Structural break		Authors' Construction

Sources: Authors' Summary from Various Sources

argued that corruption breeds distortion and inefficiency that hamper growth and development (Iliyasu & Muhammed, 2023; Alfada, 2019; Mauro, 1995; Schleifer & Vishny, 1993). Hence, a lower GDP growth rate is associated with low tax revenue, higher fiscal deficit and public debt (Benfratello *et al.,* 2018; Cooray, *et al*; 2017; Tanzi & Davoodi 2002; Mo 2001; Del Monte & Papagni 2001; Mauro 1995). Secondly, Corruption can also affect public debt by dwindling government revenue; inability to raise tax revenue increases the fiscal deficit and public debt (*Abu et al.,* 2022; Kaufmann, 2010; Micah *et al*., 2012; Momoh, 2018; Salami, 2011; Imam and Jacobs 2007). Thirdly, corruption affects public debt through inflated government expenditure thereby widening government deficit financing requirement (Delavallade 2006; Del Monte & Papagni 2001; Shleifer & Vishny 1993; Gupta *et al*., 2001; Tanzi & Davoodi 2002; Mauro 1998).

[1] The Bai-Perron model parameter instability test results reported in Table 5 suggested the existences of structural break around 2016Q1.

3.3. Model Specification

A simple model is drawn from the foregoing theoretical framework in which the ratio of public debt to GDP (DEBT) is dependent on Corruption (CORR), alongside the ratio of government expenditure to GDP (GX), the ratio of revenue to GDP (REV), the logarithm of Per capita GDP (LYP), the growth rate of GDP (GDPGR) and unemployment (UNEM). Similar to Del Monte and Pennacchio (2020) Primary deficit was excluded to guard against possible multicollinearity, the adapted model becomes:

$$DEBT = C + \gamma_1 CORR + \gamma_2 GX + \gamma_3 REV + \gamma_4 LYP + \gamma_5 GDPGR + \gamma_6 UNEM + e_t \quad (3)$$

Where c, γ_i, and e_t are the constant, slope of the explanatory variables and the error term respectively. Again, in line with the strategy of Del Monte and Pennacchio (2020) equation (3) was modified to include the interaction term of corruption and government expenditure to check if the link between corruption and public debt was contingent on the level of government expenditure as follows:

$$DEBT = C + \gamma_1 CORR + \gamma_2 GX + \gamma_3 CORR\_GX + \gamma_4 REV + \gamma_5 LYP + \gamma_6 GDPGR + \gamma_7 UNEM + e_t \quad (4)$$

We hypothesized that corruption contributes to public debt accumulation in Nigeria through reckless debt acquisition, increase in government expenditure and tax revenue reduction. Elsewhere, cross country evidence suggested that corruption is responsible for many episodes of high public debt stock (Benfratello *et al*, 2018; Cooray *et al*, 2017). Also, government expenditure and revenue can affect the level of public debt for instance higher expenditure and lower revenue create fiscal deficit that generate public debt stock (Amarcher & Ulbrich (1986). In addition, higher government expenditure translates to higher public debt (Cooray *et al*, 2017; Tanzi & Davoodi, 2002; Gupta et al., 2001). Little theory exists to guide a priori expectation on the interaction term. However, Del Monte and Pennacchio (2020) argued that the sign can be positive in the context of a low government expenditure regime and negative in a high expenditure regime. Likewise, Appiah-Kubi (2022) suggested that government revenue has a decreasing effect on public debt stock.

The effect of Per capita GDP on public debt can either be positive or negative, higher per capita GDP is associated with a greater demand for better social and welfare services. To provide these services governments resort to more debt (Liu *et al*, 2017; Temple 1994; Del Monte & Pennacchio, 2020). Again, an increase in per capita GDP expands an economy tax base that can be converted to additional revenue thereby decreasing public debt. The effect of GDP growth and unemployment rates on public debt mirror cyclicality of economic activities. Higher growth rate decreases the stock of public debt (Grechyna, 2012; Del Monte & Pennacchio, 2020; Doğan & Bilgili, 2014); while, higher unemployment rate can increase public debt if the government issues more debt to finance public works (Grechyna, 2012; Wassmer and Fisher 2011; Liu *et al*, 2017).

3.4. Estimation Procedure

The empirical strategy starts with an exploration of the characteristics and association among the variables using descriptive statistics and correlation analysis. Granger and Newbold (1977) emphasized the need to ascertain the stationarity status of the

series in order to guard against generating misleading results. In this regard, traditional Augmented Dicker-Fuller ADF (1979) and Phillips-Perron PP (1988) unit root tests were employed. However, the ADF/PP tests tend to be biased towards the non-rejection of the null hypothesis in the presence of structural breaks (Perron 1989, Ling *et al*., 2013). Also, the sharp rise of the ratio of public debt to GDP over the 2016Q2- 2020Q4 period in figure 1 elevates the possibility of a structural break. Consequently, Zivot-Andrews (1992), Bai and Perron (1998) structural break tests were used to complement the traditional unit root tests. Results in table 4 and 5 reveal that our series are a combination of *I*(0) and *I*(1) and at least one break is present around 2016Q1.

The long run relationship among the variables was tested using the Auto Regressive Distributive Lag (ARDL) Bound Testing approach to cointegration developed by (Pesaran *et al*., 2001). The technique received wide applications in empirical studies due to its ability to handle a combination of *I*(0) and *I*(1) series. Other attractive advantages are: it allows different optimal lags for each variable; the long and short-run coefficients are estimated using a single reduced form equation; and it provides robust results even with a finite sample (Abu, 2017; Abu *et al*., 2019; Abu & Staniewski, 2019). Hence, after accounting for the detected structural break with a dummy variable (d16), equation (3) was converted into an ARDL (p, qi) model as follows[2]:

$$\Delta DEBT_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta DEBT_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\, \Delta CORR_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\, \Delta GX_{t-i} + \sum_{i=0}^{n} \alpha_{4i}\, \Delta REV_{t-i} + \sum_{i=0}^{n} \alpha_{5i}\, \Delta LYP_{t-i} + \sum_{i=0}^{n} \alpha_{6i}\, \Delta GDPGR_{t-i} + \sum_{i=0}^{n} \alpha_{7i}\, \Delta UNEM_{t-i} + \emptyset_1 DEBT_{t-1} + \emptyset_2 CORR_{t-1} + \emptyset_3 GX_{t-1} + \emptyset_4 REV_{t-1} + \emptyset_5 LYP_{t-1} + \emptyset_6 GDPGR_{t-1} + \emptyset_7 UNEM_{t-1} + \emptyset_8 D16 + \mu_t \quad (5)$$

The bounds test to cointegration was carried out by testing the null hypothesis of no cointegration (H0) against the alternative hypothesis (H1) using the following formulation:

$$\text{H0: } \emptyset 1 = \emptyset 2 = \emptyset 3 = \emptyset 4 = \emptyset 5 = \emptyset 6 = \emptyset 7 = 0, \text{ and H1: } \emptyset 1 \neq \emptyset 2 \neq \emptyset 3 \neq \emptyset 4 \neq \emptyset 5 \neq \emptyset 6 \neq \emptyset 7 \neq 0$$

The computed F-statistic (i.e. Wald test) was used to test the joint significance of the coefficients, and its value compared with the lower and upper critical bounds values. If the F-statistic is higher than the upper critical bound, the H0 is not accepted. However, if the F-statistic is less than the lower bound, the H0 is not rejected. But if the F-statistic falls between the upper and lower bounds, then the decision will be inconclusive. If cointegration is found among the variables, both the long-run and the short-run coefficients would be estimated using the following models:

$$DEBT_t = \emptyset_0 + \emptyset_1 CORR_t + \emptyset_2 GX_t + \emptyset_3 REV_t + \emptyset_4 LYP_t + \emptyset_5 GDPGR_t + \emptyset_6 UNEM_t + \varepsilon 1_t \quad (6)$$

and

$$\Delta DEBT = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i}\, \Delta DEBT_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta CORR_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\, \Delta GX_{t-i} + \sum_{i=0}^{n} \alpha_{4i}\, \Delta REV_{t-i} + \sum_{i=0}^{n} \alpha_{5i} \Delta LYP_{t-i} + \sum_{i=0}^{n} \alpha_{6i}\, \Delta GDPGR_{t-i} + \sum_{i=0}^{n} \alpha_{7i} \Delta\, UNEM_t + \pi 1 ECT_{t-1} + \varepsilon_t \quad (7)$$

The error correction term lagged one period (ECT_{t-1}) measures the speed of

[2] For brevity the ARDL versions of the alternative models were not specified, but can be made available on request

adjustment required to restore equilibrium after any short term deviation/shock from the long-run equilibrium. Its coefficients $(\pi 1)$ is expected to be less than one and statistically significant. Serial-correlation, heteroscedasticity, normality and functional form diagnostic tests were carried out to validate the results. The Breusch-Godfrey serial-correlation LM (Breusch, 1978; Godfrey, 1978a) test was used for serial correlation; the Breusch-Pagan-Godfrey (Breusch & Pagan, 1979; Godfrey, 1978b) test for heteroscedasticity; the Jarque-Bera test for normality of residuals and the Ramsey Reset (Ramsey, 1969) test for model specification bias.

A sensitivity analysis was further carried out by re-estimating the long-run relationship using the Fully Modified Odinary Least Square (FMOLS) (Phillips & Hansen, 1990); the Dynamic Odinary Least Square (DOLS) (Stock & Watson, 1993) and the Canonical Cointegrating Regression (CCR: Park 1992). These techniques are effective in resolving the problems of endogeneity, serial-correlation and small sample bias thereby providing reliable and unbiased estimates of the cointegration coefficients (Abu, 2019; Abu & Gamal, 2020). The FMOLS procedure starts with the OLS estimation and then makes a non-parametric correction for any endogeneity and serial-correlation which might emanate from the OLS residuals (Phillips & Hansen 1990); it was implemented with the long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth. While, The DOLS approach regresses one of *I*(1) variables on other I(1) variables, I(0) variables, as well as the lags and leads of the first difference of the *I*(1) variables. The CCR transformed and removes second-order bias of the OLS estimator in the cointegration regression variables.

Table 2. Descriptive Statistics

Varaibles/Statistics	DEBT % GDP	DDEBT %GDP	FDEBT %GDP	CORR-(index)	GX% GDP	REV% GDP	YP (000)	GDPGR (rate)	UNEM (rate)
Mean	90.08	68.04	22.04	73.92	15.49	11.67	491.14	3.17	20.58
Median	70.39	58.53	11.50	73.68	15.52	12.72	513.64	2.70	21.74
Maximum	193.27	122.44	70.82	76.77	25.43	16.44	748.29	9.70	33.28
Minimum	32.14	27.10	4.59	71.99	5.33	4.49	49.37	-6.10	6.41
Std. Dev.	44.87	26.01	19.69	1.20	5.65	3.45	174.07	3.49	6.06
Skewness	0.60	0.22	1.05	0.73	-0.31	-0.71	-0.73	-0.25	-0.73
Kurtosis	2.18	1.91	2.86	2.95	2.44	2.28	3.56	3.06	2.96
Jarque-Bera	3.83	2.53	8.05	3.91	1.29	4.63	4.45	0.45	3.89
Probability	0.15	0.28	0.02	0.14	0.52	0.10	0.11	0.80	0.14
Observations	44	44	44	44	44	44	44	44	44

Source: Authors' Estimation based on data collected from (CBN, NBS, TI and WDI).

Note. YP values were divided by1000; DEBT%GDP= public debt stock as percent of GDP; DDEBT%GDP= domestic public debt stock as percent of GDP; FDEBT%GDP=foreign public debt stock as percent of GDP; CORR= transparency international corruption perception index; GX%GDP= government expenditure as percent of GDP; REV%GDP=government revenue as percent of GDP; YP i=per capita GDP; GDPGR =growth rate of GDP; UNEM=unemployment rate

4. Results and Discussion

4.1. Descriptive Statistics and Correlation Analysis

The descriptive statistics presented in Table 2 shows that the total debt ratio (DEBT%GDP) mean, minimum and maximum stand at 90.09, 32.14 and 193.27 respectively. Again, the mean (68.04), minimum (27.10) and maximum (122.44) of domestic debt ratio (DDEBT%GDP) are higher than the mean (22.04), minimum (4.59) and maximum (70.82) of foreign debt ratio (FDEBT%GDP), this reflected government bias toward domestic debt.

Also, the mean (73.92), minimum (71.99) and maximum (76.77) of corruption index (CORR) suggest persistent and less dispersion in the corruption index. Government expenditure as ratio of GDP (GX%GDP) has a mean (15.49), minimum (5.33) and maximum (25.43); these values are far below global average of about 30% which demonstrate a low level of public spending in Nigeria. Revenue as % of GDP (REV%GDP) has a mean (11.67), minimum (4.49), and maximum (16.44). However, the global average of tax revenue mobilization is put at 24%. Furthermore, within the sample period the mean of unemployment rate (UNEM), GDP growth rate and per capita GDP (YP) are 20.58, 3.17 and 491 respectively.

The standard deviation shows that GDP per-capita (174) and the total debt ratio (44.87) have the highest variation/volatility while the corruption perception index (1.20) has the lowest variation. The skewness values indicate that, debt ratio (0.60) and corruption perception index (0.73) are mildly positively skewed while all the other variables are mildly negatively skewed. Finally, the Jacque-bera statistics and the associated p-values suggest that all the variables are normally distributed, except FDEBT%GDP.

The reported correlation coefficients in Table 3 indicate a strong association between the dependent variable(s) and majority of the explanatory variables for instance DEBT%GDP and GX%GDP (0.87); DEBT%GDP and REV%GDP (0.59);

Table 3. Correlation Analysis

Variables	DEBT % GDP	DDEBT %GDP	FDEBT %GDP	CORR-index	GX% GDP	REV% GDP	YP (000)	GDPGR (rate)	UNEM (rate)
DEBT%GDP	1.00								
DDEBT%GDP	0.99	1.00							
FDEBT %GDP	0.98	0.93	1.00						
CORR-(index)	-0.34	-0.43	-0.19	1.00					
GX %GDP	0.87	0.89	0.81	-0.45	1.00				
REV % GDP	0.59	0.63	0.51	-0.44	0.86	1.00			
YP (000)	0.67	0.66	0.66	-0.12	0.64	0.44	1.00		
GDPGR (rate)	-0.77	-0.81	-0.68	0.40	-0.66	-0.40	-0.49	1.00	
UNEM (rate)	0.03	-0.05	0.13	0.38	0.15	0.27	0.01	0.26	1.00

Source: Authors' Estimation based on data collected from CBN, NBS, TI and WDI)

Note: DEBT%GDP= public debt stock as percent of GDP; DDEBT%GDP= domestic public debt stock as percent of GDP; FDEBT%GDP=foreign public debt stock as percent of GDP; CORR= transparency international corruption perception index; GX%GDP= government expenditure as percent of GDP; REV%GDP=government revenue as percent of GDP; YP i=per capita GDP; GDPGR =growth rate of GDP; UNEM=unemployment rate

DEBT%GDP and YP (0.67); DEBT%GDP and GDPGR (-0.77). Additionally, DDEBT%GDP and GX%GDP (0.89); DDEBT%GDP and REV%GDP(0.63); DDEBT%GDP and YP(0.67); DDEBT%GDP and GDPGR(-0.81). Also, FDEBT%GDP and GX%GDP(0.81); FDEBT%GDP and REV%GDP(0.51); FDEBT%GDP and YP(0.66); FDEBT%GDP and GDPGR(-0.68). Furthermore, there is less worry on multicollinearity, since the correlation coefficients among the independent variables are all less than 80% except that of GX%GDP and REV%GDP (0.86). In any case, correlation among some independent variables does not affect the model best fit (Kutner *et al,* 2005).

4.2. Pre-Estimation Results

The unit root test results in Table 4 show that LYP and GDPGR are stationary. While, the other variables are integrated of order one. Noteworthy, is that the dependent variables in the base line model (DEBT) and other alternative specification (DDEBT) and (FDEBT) are all *I*(1). Overall, the series

Table 4. Results of Unit Root Tests

Series	ADF		PP		Zivot-Andrews				
	level	1st diff.	level	1st diff.	Level		1st diff.		
	t-stat	t-stat	t-stat	t-stat	t-stat	BD	t-stat	BD	Status
DEBT	-0.78	-2.42	-2.54	-7.32**	-3.57	2015Q2	-3.13**	2018Q2	I(1)
DDEBT	-2.78	-2.27	3.53**	-7.91**	-3.72	2013Q4	-2.98	2016Q1	I(1)
FDEBT	1.30	-13.11*	-1.02	-6.32	0.31	2012Q4	-13.54*	2016Q2	I(1)
CORR	-1.04	-3.20*	-2.29	-2.67*	-2.21	2019Q1	-6.03**	2015Q2	I(1)
GX	-2.73	-7.02**	-2.73	-7.38**	-4.09*	2014Q1	-8.19**	2012Q3	I(1)
REV	-1.90	-10.09**	-2.87	-10.20**	-3.39	2012Q1	-10.65**	2016Q3	I(1)
LYP	-6.90*	-7.44**	-7.46**	-43.65**	-7.53**	2018Q4	-5.95**	2014Q4	I(0)
GDPGR	-2.73	-6.09**	-2.73	-6.04**	-3.16**	2015Q1	-	-	I(0)
UNEM	-1.40	-6.68**	-1.41	-6.68**	-5.76	2015Q1	-7.35**	2015Q3	I(1)

Note: BD Breaks Date; ***, ** and * indicates significance at 1% level, 5% level and 10% level respectively.

Table 5. Bai-Perron Test Result

DV: Debt; Breaking Variables: C@TREND		
Break dates:	**Sequential**	**Repartition**
1	2016Q1	2016Q1

Table 6. ARDL Bound Test Results

Dependent Variables	Alternative ARDL Models	(5%) Critical Values		F-Statistics	Outcome
		I(0)	I(1)		
Total Debt Ratio	F(DEBT,CORR, GX, REV, LYP, UNEM)	2.27	3.28	6.45**	Cointegration
- -	F(DEBT,CORR, GX, CORR_GX REV, LYP, UNEM)			5.36	Cointegration
Domestic Debt Ratio	F(DDEBT,CORR, GX, REV, LYP, UNEM)	-	-	17.51**	Cointegration
Foreign Debt Ratio	F(FDEBT,CORR, GX, REV, LYP, UNEM)	-	-	12.11**	Cointegration

Note: ***, ** and * indicates significance at 1% level, 5% level and 10% level respectively

are a combination of *I*(0) and *I*(1), justifying the application of bound test approach to cointegration.

Table 5 reported the Bai-Perron multiple structural breaks test results. The evidence confirmed one break in 2016Q1. Also, bounds cointegration test results are reported in Table 6. A dummy variable (d16) enters the model as a fixed regressor to account for the detected structural break. The end results show that the F-statistics in the four alternative models (6.45, 5.36, 17.51 and 12.11) are higher than the upper bound value (3.28) at a 5 percent significance level. Implying rejection of the null hypothesis of no cointegration and confirming the existence of a long-run relationship between debt ratios and corruption perception index alongside other control variables.

4.3. Main Results

4.3.1. Long and short run results

Table 7 presents the long-run results for our four models. In column (1) we regressed the total public debt ratio without the interaction term, in column (2) we introduced the interaction term. In (3) and (4) we separate the total debt into foreign and domestic debt ratios and compare the results. The baseline results in column (1) indicate that corruption has a significant positive effect on public debt in Nigeria. An increase in the corruption perception index (rise in the incidence of corruption) by one unit will on average increase the ratio of public debt to GDP by 12.95 percent at a 5 percent significant level.

Table 7. Long run Results

	Coefficients [Std. Errors]			
DV:	(1)	(2)	(3)	(4)
Regressor	Total Debt Ratio	Total Debt Ratio	Foreign Debt Ratio	Domestic Debt Ratio
C	-926.98 [342.72]	-1083.99 [361.77]	-538.21 [209.20]	35.70 [117.74]
CORR	12.95** [4.46]	14.88*** [4.94]	7.04** [2.84]	1.68 [1.73]
GX	13.83*** [2.18]	8.49*** [1.62]	9.15*** [0.75]	2.54*** [0.62]
CORR_GX		-0.35 [0.51]		
REV	-14.05*** [2.14]	-2.99* [1.69]	-10.08*** [1.15]	-1.19 [0.91]
LYP	0.22 [6.62]	-2.30 [3.99]	1.27 [2.48]	-10.20* [5.75]
GDPGR	-5.06* [2.02]	2.55 [1.78]	-3.53*** [0.90]	-2.37** [0.87]
UNEM	1.21 [0.91]	-1.27* [0.64]	0.95 [0.53]	0.63 [0.45]

Note: Dependent Variables are ratio of public debt stock to GDP in column (1) and (2); Ratio of Foreign Debt stock to GDP column (3) and Ratio of Domestic Debt Stock to GDP column (4). CORR is the corruption perception index; GX is government expenditure as a ratio of GDP; CORR_GX is the interaction term of corruption and government expenditure; REV is government revenue as a ratio of GDP; LYP is log Per capita GDP, GDPGR is growth rate of GDP; and UNEM is unemployment rate. ***, ** and * indicates significance at 1% level, 5% level and 10% level respectively.

By implication the ratio of public debt to GDP can be contained with a reduction in the level of corruption. This finding is in line with earlier cross-country evidence reported by Del Monte &Pennacchio (2020) "corruption increases public debt irrespective of the level of government expenditure"; Benfratello *et al*., (2018) "corruption strongly increased public debt in advanced economies" and Cooray *et al.,* (2017) "increased corruption and a larger shadow economy lead to an increase in public debt" as well as refutes the findings of Fagbemi & Olatunde (2019) who opined that "corruption index and control of corruption have an insignificant adverse effect on public debt in the long run".

In column (2) where government expenditure is interacted with corruption, corruption has a positive and significant effect on public debt stock; the interaction effect is negative and statistically not significant. This may be due to a small level of government expenditure as ratio of GDP in Nigeria (15.49) compared to the global average (30%). In addition, the result is similar to that of Del Monte and Pennacchio (2020).

The results in columns (3) and (4) show the effect of corruption on domestic and foreign debt respectively. For instance, the results in column (3) show that a rise in the incidence of corruption increases the ratio of foreign debt to GDP by about 7.04% at a 5 % significant level in the long run. Albeit the magnitude of corruption coefficient is smaller compared to our baseline specification; the evidence conformed to earlier finding by Revi *et al*. (2020), also anecdotes evidence over the last decade show that several sets of acquired foreign loans contravene the provision of fiscal responsibility act (2007)[3]. The results in column (4) indicate that corruption has a positive but insignificant effect on the ratio of domestic debt to GDP.

Similarly, an increase in the ratio of government expenditure to GDP by 1 percent increases the ratio of public debt to GDP by 13.83 percent in the long run at 5 and 1 percent significant level respectively. Similar evidence was reported by Appiah-Kubi *et al*., (2022), Fagbemi and Olatunde, (2019**)** and Cooray *et al*., (2017). Also, a rise in the ratio of government revenue to GDP by 1 percent will help reduce the ratio of public debt to GDP by about 14.05 percent in the long run at a 1 percent level; this corroborates Appiah-Kubi *et al*., (2022). Also, in line with Fern´andez, and Gonz´alez-Velasco (2014) we found that an increase in the real gross domestic product by 1 percentage point will decrease the ratio of public debt to GDP by an average of 5.06 percent at a 5 percent significant level in the long-run. The coefficients of GDP per-capita and rate of unemployment are statistically insignificant in the long-run. However, they indicate that a 1 percent increase in per capita GDP and unemployment rate will raise the public Debt-to-GDP ratio by 0.22 and 1.21 percent respectively.

The short-run results presented in Table 8 indicate that in the baseline specification column (1) the Public Debt-to-GDP ratio lag 1 period increases the current period debt ratio by about 0.23 percent. However, at the second and third lags it reduced the current debt ratio by 0.35 and 0.28 percent respectively. These effects are all statistically significant at a 5 percent significant level.

[3] The Fiscal responsibility Act (2007) categorically provided that "Government at all tiers shall only borrow for capital expenditure and human development, provided that, such borrowing shall be on concessional terms with low interest rate and with a reasonable long amortization period. The purposed of the intended borrowing must be specified with explicit cost-benefit analysis, detailing the economic and social benefits of such borrowing"

Table 8. Short run Results

Regressor	Coefficients [Std. Errors]			
	(1)	(2)	(3)	(4)
Regressor	Total Debt Ratio	Total Debt Ratio	Foreign Debt Ratio	Domestic Debt Ratio
ΔDEBT-1	0.23*[0.09]	0.543***[0.08]	-0.07[0.08]	0.02[0.07]
ΔDEBT-2	-0.35*[0.075]		-0.55***[0.06]	-0.60***[0.08]
ΔDEBT-3	-0.28*[0.09]		-0.33**[0.10]	
ΔCORR	54.63*[7.61]	16.48***[3.79]	24.17***[2.19]	0.88[0.91]
ΔCORR-1	-85.32*[12.07]	-15.68***[3.61]	-37.99***[3.50]	
ΔCORR-2	42.43*[6.86]		22.29***[2.15]	
ΔGX	3.64*[0.33]	3.88***[0.68]	1.35***[0.09]	1.33***[0.45]
ΔGX-1	-6.33*[0.80]		-2.24***[0.21]	
ΔGX-2	-5.17*[0.71]		-1.91***[0.21]	
ΔGX-3	-2.46*[0.36]		-0.81***[0.13]	
CORR_GX		-0.16[0.22]		
ΔREV	-2.79*[0.33]	-1.36*[0.76]	-1.11***[0.09]	-0.62[0.48]
ΔREV-1	7.06*[0.82]		2.95***[0.27]	
ΔREV-2	6.02*[0.76]		2.49***[0.26]	
ΔREV-3	1.96[0.39]		0.88***[0.16]	
ΔLYP	3.01*[0.66]	-1.053[1.82]	0.73***[0.17]	0.54[0.68]
ΔLYP-1	3.53*[0.81]		0.64***[0.18]	4.01***[0.98]
ΔLYP-2	2.70*[0.88]			3.57***[0.83]
ΔGDPGR	-1.11*[0.28]	-1.57***[0.52]	-0.75***[0.09]	-1.24**[0.37]
ΔGDPGR-1	4.64*[0.60]	2.73***[0.67]	1.45***[0.11]	
ΔGDPGR-2	3.90*[0.60]		1.22***[0.13]	
ΔUNEM	-0.89*[0.16]	-0.58**[0.27]	-0.35***[0.04]	-0.002[0.16]
ΔUNEM-2	-2.12*[0.28]		-0.83***[0.09]	-0.38**[0.16]
ΔUNEM-2	-2.17*[0.24]		-0.74***[0.06]	-0.57***[0.16]
ΔUNEM-3	-1.25*[0.24]		-0.37***[0.07]	
D16	17.63*[1.21]	26.61***[2.84]		
ECT-1	-0.82*[0.08]	-0.46***[0.05]	-0.47**[0.04]	-0.52**[0.06]

Notes: Dependent Variables are ratio of public debt stock to GDP in column (1) and (2); Ratio of Foreign Debt stock to GDP column (3) and Ratio of Domestic Debt Stock to GDP column (4). Δ is the first difference operator; ***, ** and * indicates significance at 1% level, 5% level and 10% level respectively.

Interestingly, increase in the corruption perception index by one unit (i.e. rise in the level of corruption) and when the corruption perception index is lag two period will enlarge the ratio of public debt to GDP in the short run by 54.63 and 42.43 percent at a 1 percent significant level. Similarly, across all the alternatives specification the short-run positive effect of corruption on public debt was preserved. The results from the interaction specification in column (2) show a smaller magnitude of a short-run positive effect of corruption compared to base line specification. Also, column (4) provides replica evidence on the positive but insignificant effect of corruption on domestic debt in the short run. This result reinforced the long-run evidence reported earlier.

Additionally, a rise in the ratio of government expenditure to GDP by 1 percent increases the ratio of public debt to GDP by 3.64 percent in the short run at a 5 percent significant level. This effect, however, becomes negative when the ratio of government expenditure to GDP is from lags 1 to 3 periods. Likewise, increase in the ratio of revenue to GDP by 1 percentage point will on average reduce the ratio of public debt to GDP by about 2.79 percent at a 5 percent significant level, although for lags 1 to 3 the ratio of revenue to GDP has an increasing effect on public debt ratio. Similarly, increasing the growth rate of real GDP by 1 percentage point reduces the ratio of public debt to GDP in the short run by 1.11 percent at a 5 percent significant level, though this effect turned out to be positive when the growth rate of real GDP is lag 1-2 period.

Furthermore, the logarithm of per capita GDP is positively and significantly related to the ratio of public debt to GDP in the short run. An increase in the per-capita GDP by 1 percent will on average raise the level of public debt ratio by about 3.01 percent, this effect is sustained when per-capita GDP is lag1-2 period. Furthermore, a negative and statistically significant effect is observed between the rate of unemployment and the ratio of public debt to GDP in the short run, an increase in the rate of unemployment by 1 percentage point will reduce the ratio of public debt to GDP by about 0.89 percent, this effect is sustained even when the rate of unemployment is lag 1-3 period. It is worth noting that our structural break dummy (d16) is statistically significant which confirmed the significance of the structural break date detected from the Bai-Perron model parameter instability test. The coefficient of the error correction term lagged by one period (ECT-1) is negative and statistically significant at a 1 and 5 percent level. This suggests that about 0.82 percent of the deviation from equilibrium will be corrected in the following quarter of the year.

4.3. Models Diagnostics and Stability Tests

Table 9 reports the diagnostic tests results across the four models. The evidence affirmed that the estimated models are well specified, free from serial-correlation and heteroscedasticity. Therefore, the findings can be used to support policy formulations.

Figures 3 show that the plots of CUSUM and CUSUMS tests for the baseline model[4] lie within the boundaries at a 5 percent significant level, hence confirming the stability of the model parameters estimates.

4.4. Additional Results

The results of alternative cointegration estimation techniques reported in Table 10 and 11 consistently affirm the positive and statistically significant long-run effect of the corruption perception index on the ratio of public debt to GDP.

From Table 10 a unit increase in the corruption perception index (increase in the level of corruption), raise the ratio of Nigeria's public debt to GDP by 8.80, 15.40, and 8.48 percent in FMOLS, DOLS and CCR models, respectively. Importantly, the interaction term is still statistically not significant asserting the fact that government size does not influence the impact of corruption on public debt in Nigeria.

[4] To save space the other models CUSUM and CUSUMS plots were not reported, but can be made available on request

Table 9. ARDL-ECM Models Diagnostic Tests

Test Statistic/Models	(1)	(2)	(3)	(4)
Serial Correlation	2.16 [0.21]	0.96 [0.40]	2.91 [0.26]	1.48 [0.33]
Normality: J.B Stats	1.13 [0.21]	0.43 [0.81]	8.12 [0.01]	8.53 [0.01]
Heteroscedasticity	0.56 [0.87]	1.12 [0.40]	0.33 [0.97]	1.53 [0.31]
Ramsey RESET Test	1.17 [0.38]	3.38 [0.07]	0.48 [0.53]	3.13 [0.14]

NB: F-statistics and their associated P-values in [ ]

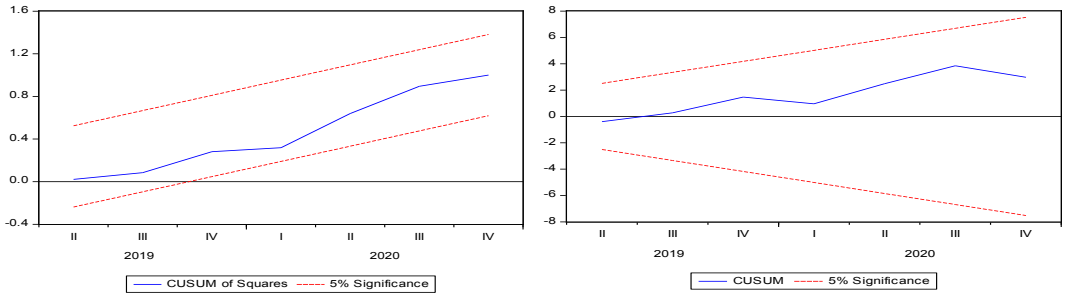

Figure 3. Plot of CUSUM and CUSUMS

Table 10. Results from FMOLS, DOLS and CCR Models

	FMOLS:DV=Debt Ratio		DOLS:DV=Debt Ratio		CCR: DV=Debt Ratio	
Regressors	Coefficient[Standard Errors]		Coefficient[Standard Errors]		Coefficient[Standard Errors]	
C	-658.92*** [167.97]	-560.9* [186.55]	-776.04* [434.22]	-375.1 [372.9]	-636.97*** [174.12]	-446.06 [2.09]
CORR	8.80*** [2.30]	8.70*** [2.49]	15.40*** [6.14]	16.21** [5.44]	8.48*** [2.39]	7.42*** [2.70]
GX	6.25*** [0.97]	5.96*** [1.05]	14.70*** [2.62]	16.33** [2.19]	5.92*** [1.30]	7.50*** [1.47]
CORR_GX		0.37 [0.34]		0.24 [0.41]		0.13 [0.34]
REV	-1.67 [1.35]	-2.47* [1.29]	-11.13*** [3.49]	-15.1** [3.08]	-1.26 [1.85]	-4.26** [1.87]
LYP	0.40 [3.18]	1.11 [3.19]	-28.93*** [8.502]	-43.0** [8.69]	0.69 [4.52]	1.49 [6.27]
GDPGR	-0.63 [1.03]	0.43 [0.93]	-0.70 [2.23]	2.00 [1.72]	-0.30 [0.98]	0.48 [1.04]
UNEM	-0.21 [0.41]	-0.11 [0.40]	-0.20 [0.88]	-0.74 [0.71]	-0.44 [0.46]	-0.12 [0.51]
D16	47.07*** [6.73]	53.09 [7.27]	30.00*** [10.62]	36.43 [8.70]	49.11*** [6.71]	44.80*** [8.53]

Note: ***, ** and * indicates significance at 1% level, 5% level and 10% level respectively

Other statistically significant consistent results in table 10 indicate that a 1 percent increase in the ratio of government expenditure to GDP will raise the ratio of public debt to GDP by 6.25, 14.70 and 5.95 percent in FMOLS, DOLS and CCR models, respectively. Also, the structural breaks dummy (d16) is statistically significant at 5 percent across all the FMOLS, DOLS and CCR models, justifying the importance of accounting for the detected structural breaks in our modeling process. Finally, the ratio of revenue to GDP has a decreasing effect on the ratio of public debt to GDP, though the effect is statistically significant in the DOLS model only.

Furthermore, table 11 shows the obvious impact of corruption on foreign debt compared to domestic debt ratio. For example a unit increase in the corruption perception index (rise in the incidence of corruption) will increase the foreign debt ratio by an average of 3.18, 12.08 and 4.65 in FMOLS, DOLS and CCR model estimate at a 5 percent significant level. However, the impact of corruption on domestic debt ratio is statistically significant in FMOLS and CCR but not in the DOLS model estimate.

5. Conclusion and Recommendations

The study analysed the dynamic effect of corruption on Nigeria's public debt accumulation in the post debt-relief era. Quarterly data covering the 2010q1-2020q4 period and bound testing approach to cointegration were employed to estimate different alternative model specifications. Also, we accounted for structural breaks in the models. Overall, the results across ARDL, FMOLS, DOLS and CCR estimators indicate that the level of corruption (proxied by TI corruption perception index) has a significant

Table 11. Foreign and Domestic Debt Ratios Alternative Estimates

	Coefficient [Standard Errors]		Coefficient [Standard Errors]	Coefficient [Standard Errors]		
Regressors	DV= Foreign Debt Ratio			DV=Domestic Debt Ratio		
	FMOLS	DOLS	CCR	FMOLS	DOLS	CCR
C	-274.1***	-722.5***	-371.9*	-171.4**	-92.53	-176.6**
	[90.61]	[213.8]	[107.9]	[66.18]	[246.51]	[65.29]
CORR	3.18**	12.08***	4.64***	2.52***	3.87	2.61***
	[1.25]	[3.02]	[1.48]	[0.91]	[3.49]	[0.89]
GX	1.49**	8.89***	4.06***	2.94***	6.03***	3.21***
	[0.68]	[1.28]	[0.93]	[0.39]	[1.48]	[0.56]
REV	-1.86**	-7.71***	-3.07**	-0.41	-3.86*	-0.74
	[0.70]	[1.67]	[1.24]	[0.52]	[1.94]	[0.75]
LYP	1.13	-15.29***	0.40	0.63	-13.75**	0.44
	[1.72]	[4.19]	[3.41]	[1.29]	[4.83]	[2.07]
GDPGR	0.51	1.03	0.77	-0.45	-0.74	-0.30
	[0.48]	[1.00]	[0.69]	[0.36]	[1.16]	[0.43]
UNEM	0.72**	-0.28	0.32	-0.31*	-0.05	-0.30
	[0.24]	[0.43]	[0.33]	[0.16]	[0.50]	[0.20]
D16	10.07**	13.27**	21.81***	26.27***	19.79***	26.31***
	[4.56]	[5.08]	[4.93]	[2.62]	[5.85]	[2.97]

Note: ***, ** and * indicates significance at 1% level, 5% level and 10% level respectively

increasing effect on public debt-to-GDP ratio in the long and short run. Again, after disaggregating the debt stock into (foreign and domestic), the increasing effect of corruption on public debt was statistically significant in foreign debt, but not in domestic debt.

This means that reduction in corruption can assist Nigeria to contain its rising foreign and domestic public debt stock in the long and short run. However, the qualitative nature of corruption perception index data and the interpolation carried out may have posed a limitation to precision of our findings. Again, further studies on the asymmetric effect of corruption on public debt can strengthen the evidence on the relationship between corruption and public debt. The study recommends strengthening the capacity of existing anti-corruption institutions (EFCC, ICPC, etc.) to detect, prevent, and prosecute corrupt public servants and provision of severe penalty to corruption convicts. Despite the contribution of the paper on public debt- corruption literature there are certain limitations which future research should address. For example, the use of the bootstrap ARDL approach, threshold regression analysis and larger sample size can strengthen the evidence on public debt-corruption dynamics. Also, future studies can consider corruption and tax revenue interaction in order to ascertain the magnitude of increasing the effect of corruption on public debt via tax revenue reduction.

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