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SCRUTINIZING THE EFFECT OF CORRUPTION ON NIGERIA'S GROWTH POTENTIAL: A COMPREHENSIVE ANALYSIS OF GOVERNMENT EXPENDITURE

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Keywords: government expenditure, corruption, economic growth, Nigeria, autoregressive distributed lag model, fully modified ordinary least squares, dynamic ordinary least squares.

Abstract

This study investigates the impact of government expenditure and corruption on growth in Nigeria from 1990 to 2020. The study uses the autoregressive distributed lag model, fully modified ordinary least squares, and dynamic ordinary least squares as alternative techniques for estimation. The results indicate that an increase in government expenditure and a reduction in corruption have a significant positive effect on short-term and long-term growth. Furthermore, corruption reduction enhances the increasing effect of government expenditure on economic growth. However, corruption reduction beyond a threshold of 42.25 diminishes the increasing effect of government expenditure on economic growth. To achieve sustained growth in Nigeria, policymakers must raise government expenditure and minimize corruption.

1. Introduction

Developing economies strive to achieve sustained, long-term growth for improved standard of living, poverty reduction, better sanitation, more education and higher life expectancy (Azam, 2022; Benjamin & Myers, 2005; World Bank, 2017). One strand of literature suggests that an efficient government can complement private capital formation, facilitate better and efficient organization of production, consumption and trade, and boost the overall productivity of private economic agents (see Barro (1990); IMF (2015); Kneller, Bleaney, and Gemmell (1999); Olofin (2001)).

However, the literature on the growth–government expenditure nexus and the growth–corruption nexus is broadly contentious. For instance, there are substantial arguments on the positive and negative influences of government expenditure on growth at theoretical and empirical levels (Alesina, Ardagna, Perotti, & Schiantarelli, 2002; Barro, 1990; Devarajan, Swaroop, & Zou, 1996; Tanzi & Zee, 1997). In addition, at least four views exist on the causal relationship between government expenditure and growth. Kouassi (2018) and Nyasha and Odhiambo (2019) aptly summarized the views to include the "government size-led economic growth view" built on the basis of the Keynesian idea that government expenditure can generate growth; "growth-led government size" deduced from Wagner's law, which posits that growth in per capita income propels government expenditure; the "bidirectional

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causality view" (Abu-Bader & Abu-Qarn, 2003; Abu-Eideh, 2015)d and the "neutrality view" (Afxentiou & Serletis, 1996; Ansari, Gordon, & Akuamoah, 1997; Taban, 2010).

Moreover, corruption is adjudged to either be "sand in the wheels of commerce", meaning that corruption creates distortion and inefficiency that hinder growth and development (Alfada, 2019; Andvig & Moene, 1990; Blackburn, Bose, & Haque, 2010; Mauro, 1995; Murphy, Shleifer, & Vishny, 1993; Nur-Tegin & Jakee, 2020; Schleifer & Vishny, 1993) or "grease the wheels of commerce", that is, corruption in some instances helps entrepreneurs to overcome obstacles and foster innovation, growth and development (Beck & Maher, 1986; Egger & Winner, 2005; Kato & Sato, 2015; Leff, 1964; Lui, 1985; Méon & Weill, 2010).

Nigeria has experienced uneven growth in the last three decades, with average GDP growth rates of 2.3%, 7.8% and 3.2% in the 1990s, 2000s and 2010s, respectively. Correspondingly, the growth rate of GDP per capita in the same period was at -0.2; 4.9 and 0.5, respectively. Amid this unimpressive growth performance, the ratio of government expenditure to GDP and per capita government expenditure have fluctuated over the three decades, hovering at around an average of 8.6% and ₦170,246, respectively. But the nominal and real government expenditures have risen steadily by about 16,867.99% and 78.07%, respectively. In addition, many authors have posited that corruption in Africa, and Nigeria in particular, is systemic (Abu, Karim, & Aziz, 2015; Abu & Staniewski, 2019; Abu et al., 2022; Gyimah-Brempong, 2002; Rivi, Ogboru, & Rivi, 2020). These assertions are further corroborated by anecdotal evidence; for instance, the Economic and Financial Crime Commission (2019) investigated about 39,970 high profile corruption cases involving past governors and top government functionaries and secured about 2,544 convictions during the 2010–2019 period. Also, a recent corruption survey conducted by the National Bureau of Statistics (NBS) (2019) estimated that a total of around ₦675 billion in bribe money exchanged hands twelve months prior to the survey; this translates to about 0.52% of Nigeria's GDP for the year.

Existing empirical studies on direct, and especially indirect, links between growth, government expenditure and corruption remain shallow in Nigeria. Ngutsav (2018); Aigheyisi (2015); and Ovat and Bassey (2014) investigated the link among the three variables, none of them estimated the marginal effects of government expenditure on growth given the level of corruption. In addition, there are specific limitations related to these studies. For example, while Ngutsav (2018) covered the period from 1981 to 2015, he failed to state how he got the data on the corruption perception index prior to 1996; he claimed that the series were integrated of order I(1) without reporting the results, rendering his findings suspicious. Aigheyisi (2015) used a limited number of observations (19) that falls short of the minimum required (30) for robust time series analysis and failed to conduct unit root and post-estimation diagnostics tests. The study by Ovat and Bassey (2014) lacks empirical rigor, and its findings were derived from a mere descriptive analysis.

Giving the competing theoretical and empirical arguments on the nexus among growth, government expenditure and corruption, Nigeria's score card on the three variables over the study period, and the dearth of the extant literature in the country, the present paper aims to investigate the effect of government expenditure and corruption on growth in addition to their direct linear effects. This will allow us to determine whether the level of corruption moderates the effect of government expenditure on growth in Nigeria, since the former can distort the composition and productivity of the latter (Mauro, 1998; Schleifer & Vishny, 1993; Tanzi & Davoodi, 1997). The paper is structured in five sections. Section two provides a literature review; section three explains the data and methodology used; section four presents the results and discussion; and section five concludes the study and proffers some policy recommendations.

2. Literature Review

This section presents a brief review of selected studies on the interacting role of corruption on the growth–government expenditure relationship, many of which were based on cross-country and panel data regressions. For example, Del Monte and Papagni (2001) examined the indirect effect of corruption on growth in a panel of 20 Italian regions. Building on the basic growth regression and estimating a dynamic panel data regression, the study found that corruption reduced economic growth by lowering private investment and reducing public investment efficiency.

Blackburn, Bose, and Haque (2011) argued that corruption lowers public capital accumulation and changes the volume and quality of public expenditure in a manner that endangers growth. Similarly, D'Agostino, Dunne, and Pieroni (2016) examined the indirect channels through which corruption affects growth. The study employed an endogenous growth model to examine how corruption affects growth through military and investment spending. Findings from the study revealed that the interaction between the two components of expenditure and corruption has a strong adverse effect on growth. D'Agostino, Dunne, Lorusso, and Pieroni (2020) further explored the interactive role of military spending, corruption and institutional quality on growth. Balanced and unbalanced panel data ARDL results indicated that military spending and corruption have an important decreasing effect on growth and argued for the possibility of high military spending–high corruption trap.

Nirola and Sahu (2019) examined the links among government size, institution and state-level economic growth in India. The authors estimated an augmented Solow growth model with pooled OLS, random effects and generalized method of moments (GMM) panel estimation techniques. The results showed that a larger government size decreases state-level growth, and the decrease is higher in states with poor quality institutions and lower in states with better institutions. Nguyen and Bui (2022) examined the interacting role of corruption control in the growth–government expenditure nexus in Asia over a sample period from 2002–2019. A combination of the GMM estimation technique and the threshold model was employed. The findings showed a significant negative impact of government spending and corruption control on growth. In addition, the growth–corruption control interaction diminished the observed negative effect. In fact, when the threshold value of corruption control reached 0.01, the effect of government expenditure on growth turned positive. Tanzi and Davoodi (1997) investigated the link between corruption, public investment and growth based on a cross-country regression analysis and found a significant growth-diminishing effect of corruption through increasing the share of less productive public investment at the detriment of current expenditure, a decrease in government revenues, and a drop in the overall quality of existing public infrastructure.

The few country-level studies conducted in Nigeria include Ngutsav (2018), who examined the impact of corruption and government expenditure on growth from 1981 to 2015 using the vector error correction model and the impulse response function. The findings indicated that corruption has a significant adverse impact on growth and government expenditure has a stimulating effect on growth. In addition, corruption decreases the stimulating effect of government expenditure on growth. Aigheyisi (2015) studied the impact of corruption and government expenditure on the GDP growth rate in pre-democratic (1994–1998) and democratic (1999–2012) era sample splits using the ordinary least squares (OLS) estimation technique. The primary findings were that in both sample splits, corruption had an insignificant effect on growth and capital expenditure decreased growth. Also, recurrent expenditure had a significant growth-decreasing effect in the pre-democratic era sample, nonetheless, the effect turned positive in the democratic dispensation sample. Ovat and Bassey (2014) explored the aggregate effect of governance, corruption and public expenditure on growth in Nigeria using descriptive and content analyses of available data. The authors discerned a clear adverse aggregate effect of corruption on growth.

Overall, substantial cross-country and panel regression evidence suggests that minimizing the level of corruption can increase government expenditure productivity and efficiency, thereby enhancing the growth effect of government expenditure. Nevertheless, the lack of country-specific studies, particularly in Nigeria, calls for further studies to determine the nature and extent of the growth, public expenditure and corruption nexus, both directly and indirectly.

3. Data and Methodology

3.1. Theoretical Framework and Model Specification

The workhorse growth equation, following Barro (1990); Barro and Sala-i-Martin (1992) and Barro (1991), provides the basic framework for the growth regression analysis. The equation arises from the idea that factors capable of increasing the stocks of physical and human capital tend to promote technological progress and overall economic growth, while those that reduce incentives to invest and decrease the efficiency of well-functioning markets tend to reduce growth. In line with the theoretical exposition of Blackburn et al. (2011), we modify the base line growth equation to suit the purpose of this study, and the model is specified as follows:

$$LGDP_t = \omega_1 + \omega_2 LGX_t + \omega_3 COR_t + \omega_4 (LGX * COR_t) + \varphi' Z_t + {}_t \quad (1)$$

Equation 1 presents the econometric model, where $LGDP_t$ is the log of real GDP; LGE_t is the log of government expenditure; COR_t is the transparency of the international corruption index; and Z_t is the set of control variables, such as logarithms of gross fixed capital formation ($LGFC_t$), inflation ($LINF_t$), and openness ($LOPEN_t$). The interaction term between government expenditure and the corruption index ($LGX * COR_t$) yields the marginal effects of the variables after differentiating the growth equation with respect to government expenditure in Equation 2.

$$\frac{\partial LGDP}{\partial LGX} = \omega 2 + \omega_4 COR_t \quad (2)$$

Five fundamental policy implications can be deduced from the respective signs of ω_2 and ω_4 related to the hypothesis testing. Firstly, if $\omega_2 > 0$ and $\omega_4 > 0$, this means that government expenditure raises growth, and corruption enhances that positive effect. Thus, policymakers should increase government expenditure as it, along with corruption, are desirable ingredients of the growth process. Secondly, if $\omega_2 > 0$ and $\omega_4 < 0$, it implies that government expenditure spurs growth, and corruption diminishes this effect. Therefore, policymakers should reduce the incidence of corruption in order to maximize the positive effect of government expenditure on long-term growth. Thirdly, if $\omega_2 < 0$ and $\omega_4 > 0$, it suggests that government expenditure reduces growth, and corruption moderates that reduction. Fourthly, if $\omega_2 < 0$ and $\omega_4 < 0$, it suggests that government expenditure reduces growth and corruption amplifies that reduction. Policymakers should devise a measure to ensure that government expenditure and corruption promote growth. Finally, if the marginal effect of government expenditure on growth ($\omega_2 + \omega_4 COR_t$) increases together with the incidences of corruption, this implies that additional government expenditure and incidences of corruption can spur growth. Contrarily, the reverse is the case if the marginal effect decreases as the incidences of corruption increases.

Table 1. Definitions and sources of the variables.

Series	Definition	A priori sign	Source
LGDP	Logarithm of gross domestic product used as a proxy for economic growth.		CBN
LGX	Logarithm of government outlays for the provision of current and capital goods and services plus transfer payment.	Positive	CBN

COR	The Transparency International corruption perception index, which measures corruption between 100 corruption-free and 0 highly corrupt countries.	Positive	TI
LGX*COR	Interaction term between the logarithm of total government outlay and the corruption perception index.		Constructed
LGFC	Log of gross fixed capital formation, which measures capital accumulation through land improvements (fences, ditches, drains, etc.); plant, machinery, and equipment purchases; and the construction of roads, railways, schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings as a share of GDP.	Positive	WDI
LINF	Logarithm of inflation, measured by the annual growth rate of GDP. The implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency.	Positive	WDI
LOPEN	Logarithm of the sum of exports and imports of goods and services measured as a share of GDP.	Positive	WDI

Note: GDP = gross domestic product, GX = government total expenditure, COR = corruption, GFC = gross fixed capital formation, INF = inflation, OPEN = trade openness, and L = natural logarithm of the variable.
* denotes multiplication that shows the interaction of government expenditure and corruption.

3.2. Data and Econometric Techniques

The analysis covers a sample period from 1990 to 2020. Data availability, particularly on corruption, informed the sample choice. The descriptions, measurements and sources of data for all the series are summarized in Table1.

3.3. Unit Root Test Equations

The study examined the stationarity status of the data series prior to estimating and testing the effect of corruption on the growth–government expenditure nexus. This is required in order to avoid spurious or misleading results. The augmented Dicker–Fuller (ADF) (Dickey & Fuller, 1979) and Phillips–Perron (PP) (Phillips & Perron, 1988) tests were utilized to achieve the objective. Both the ADF and PP equations estimated are specified in Equations 3 and 4, respectively.

$$\Delta yt = \partial + \emptyset t + (\rho - 1)yt_{-1} + \sum_{i=1}^{k} \delta \, \Delta yt_{-i} + \mu_t \qquad (3)$$

$$\Delta yt = \partial + \emptyset t + \varphi \, y \, t_{-1} + \mu_t \qquad (4)$$

Where $y\,t$ is the series and u_t is the error term. The null hypothesis H0 states that $\rho = 0$ (unit root). The alternative hypothesis H1 states that $\rho < 0$ (series is stationary). The ADF and PP complement each other; the decision rule is to accept the null hypothesis if the test statistic is lower than the critical value at the 5% significance level and vice versa.

3.4. ARDL Bounds Test for Cointegration

To explore the long-run interacting effect of corruption on the growth–government expenditure nexus, the ARDL bounds test for cointegration technique was used (Pesaran & Shin, 1999; Pesaran, Shin, & Smith, 2001). The technique is most suitable for a combination of I(1) and I(0) series and has several advantages over the other competing techniques (e.g., Engle and Granger (1987); Johansen (1988); Johansen (1991) and Johansen and Juselius (1990)). These advantages include a varied lag length for each variable, a single reduced-form equation, and its adequacy in estimating relationships, even with a finite sample (Abu & Gamal, 2020). The estimated model is specified as follows:

$\Delta LGDP_t = \alpha_0 + \sum_{i=1}^{n} \alpha 1i\, \Delta LGDP_{t-i} + \sum_{i=0}^{n} \alpha 2i \Delta LGX_{t-i} + \sum_{i=0}^{n} \alpha 3i\, \Delta COR_{t-i} + \sum_{i=0}^{n} \alpha 4i\, \Delta LGX * COR_{t-i} +$
$\sum_{i=0}^{n} \alpha 5i \Delta LGFC + \sum_{i=0}^{n} \alpha 6i\, \Delta LINF_{t-i} + \sum_{i=0}^{n} \alpha 7i \Delta\, LOPEN_t + \emptyset 1 LGDP_{t-1} + \emptyset 2 LGX_{t-1} + \emptyset 3 COR_{t-1} +$
$\emptyset 4 LGX * COR_{t-1} + \emptyset 5 LGFC_{t-1} + \emptyset 6 LINF_{t-1} + \emptyset 7 LOPEN_{t-1} + \varepsilon 1_t$ (5)

Equation 5 presents the intertemporal dynamic model, which estimates the relationship between GDP and its lagged value, and the contemporaneous and lagged values of the regressor. The bounds test for cointegration was carried out by testing the null hypothesis of no cointegration (H0) against the alternative hypothesis (H1) using the following equations:

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

The computed F-statistic (Wald test) was used to test the combined significance of the parameters and its value compared with the lower and upper critical bounds values. The F-statistic has to be significantly higher than the upper critical bound for the null hypothesis of no cointegration to be rejected.

$LGDP_t = \emptyset 0 + \emptyset 1 LGX_t + \emptyset 2 COR_t + \emptyset 3 LGX * COR_t + \emptyset 4 LGFC_t + \emptyset 5 LINF_t + \emptyset 6 LOPEN_t + 1_t$ (6) And

$\Delta LGDP_t = \alpha_0 + \sum_{i=1}^{n} \alpha 1i\, \Delta LGDP_{t-i} + \sum_{i=0}^{n} \alpha 2i \Delta LGX_{t-i} + \sum_{i=0}^{n} \alpha 3i\, \Delta COR_{t-i} + \sum_{i=0}^{n} \alpha 4i\, \Delta LGX * COR_{t-i} +$
$\sum^{n} \alpha 5i \Delta LGFC \quad {}_{i=0}^{n} + \sum_{i=0} \alpha 6i\, \Delta LINF_{t-i} + \sum_{i=0}^{n} \alpha 7i \Delta\, LOPEN_t + \pi 1 ECT_{t-1} + \varepsilon_t$ (7)

Equations 6 and 7 argue for long-run and short-run relationships among the variables, respectively.

The error correction term lagged by one period (ECT_{t-1}) measures the speed of adjustment required to restore any deviation/shock from the long-run equilibrium through its coefficient (π 1) that is assumed to be less than one and significant.

3.5. Diagnostic and Stability Tests

In order to validate the estimated regression results, the study carried out serial correlation, heteroscedasticity and normality diagnostic tests on the error terms. Breusch–Godfrey serial correlation and Lagrange multiplier tests were used to check if the residuals are serially correlated. The Breusch–Pagan–Godfrey heteroscedasticity test was used to check if the residuals are homoscedastic or otherwise, and finally, the Jarque–Bera test was used to test if the residuals are normally distributed.

The stability of the estimated model parameters is paramount for policy prescription; the study therefore used the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of the recursive residuals (CUSUMSQ) to confirm the stability status of the model parameters. If the plots of either the CUSUM or the CUSUMSQ break at the 5% lower or upper bound, then the parameters and the model are unstable (Greene, 2003).

3.6. Alternative Estimation Techniques

The fully modified ordinary least squares (FMOLS) of Hansen and Phillips (1990) and the dynamic ordinary least squares (DOLS) of Saikkonen (1992) and Stock and Watson (1993) were utilized to check the robustness and consistency of the estimated ARDL results. These techniques are effective in resolving problems of endogeneity, serial correlation and small sample bias (Abu & Gamal, 2020; Abu, 2019). 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 (Abu & Gamal, 2020), and it was implemented with the long-run covariance estimate (Bartlett's kernel, Newey–West fixed bandwidth). The DOLS approach regresses one of I(1) variables on other I(1) variables and the I(0) variables, as well as the lags and leads of the first differences of the I(1) variables.

4. Results and Discussion

4.1. Preliminary Data Exploration

To understand the data, a summary of the statistics of the variables is presented in Table 2. The evidence indicates that the means and medians of all the series are slightly different, with the exception of the corruption perception index and the interaction term, which suggests that these variables are nearly symmetrical. In addition, the Jarque–Bera probability values across all the series indicate that the variables are normally distributed, so the alternative hypothesis of non-normality cannot be accepted. Generally, there is low variation in all the variables based on their respective standard deviations. However, comparatively, the corruption perception index has the highest volatility with a standard deviation value of 6.00, followed by the logarithms of GDP (1.75) and government expenditure (1.52).

Table 2. Descriptive statistics of the variables.

Variable/Statistic	LGDP	LGX	COR	LGX*COR	LGFC	LINF	LOPEN
Mean	9.70	7.20	21.1	155	3.24	3.58	4.51
Median	10.0	7.56	24.0	143	3.26	3.61	4.50
Maximum	11.9	9.23	28.0	242	3.97	3.98	4.63
Minimum	6.20	4.09	6.90	40.2	2.65	3.03	4.37
Std. dev.	1.75	1.52	6.00	64.6	0.42	0.24	0.06
Jarque–Bera (Statistic)	2.35 (0.31)	2.57 (0.28)	3.08 (0.21)	2.86 (0.24)	2.37 (0.31)	1.46 (0.48)	0.14 (0.93)
Observations	31	31	31	31	31	31	31

Notes: Figures in ( ) are the probability values. GDP = gross capital formation, GX = government total expenditure, COR = corruption, GFC = gross fixed capital formation, INF = inflation, OPEN = trade openness, and L = natural logarithm of the variable. Also, * shows the interaction between government expenditure and corruption.

The results of the correlation analysis reported in Table 3 indicate a strong positive association between the logarithm of GDP, the logarithm of government expenditure (0.99) and the interaction term (0.85), but a moderately positive correlation with the corruption perception index (0.45) and a weak association between the logarithms of GDP and openness (0.03). In addition, there is a strong negative association between the logarithms of GDP and gross fixed capital formation (-0.93) as well as a weak negative correlation between the logarithms of GDP and inflation. Moreover, the interaction term has a strong positive relationship with the logarithms of total government expenditure (0.83) and corruption (0.85) and a strong negative association between the logarithm of gross fixed capital formation (-0.848). Finally, the logarithms of government expenditure and gross fixed capital formation are strongly negatively associated (-0.91).

Table 3. Correlation analysis.

Variable	LGDP	LGX	COR	LGX*COR	LGFC	LINF	LOPEN
LGDP	1.00						
LGX	0.99	1.00					
COR	0.45	0.42	1.00				

LGX*COR	0.85	0.83	0.85	1.00			
LGFC	-0.93	-0.91	-0.52	-0.85	1.00		
LINF	-0.20	-0.16	-0.37	-0.35	0.22	1.00	
LOPEN	0.03	0.05	-0.30	-0.19	0.02	0.14	1.00

Note: GDP = gross capital formation, GX = government total expenditure, COR = corruption, GFC = gross fixed capital formation, INF = inflation, OPEN = trade openness, and L = natural logarithm of the variable. Also, * shows the interaction between government expenditure and corruption.

4.2. Stationarity and Bounds Tests for Cointegration

Table 4 reports the outcomes of stationarity tests. Overall, evidence from the ADF/PP test statistics unanimously suggest that all the series have a unit root, apart from the log of gross fixed capital formation. This means that the series are a combination of I(0) and I(1); the latter can be made stationary after first differencing. These results further justify the use of the ARDL bounds test for cointegration.

Table 4. Stationarity test results.

Series	ADF test statistics		PP test statistics		Remark
	Level	First difference	Level	First difference	
LGDP	1.29	-2.42*	1.54	-2.36*	I(1)
LGX	1.22	-2.10*	3.64	-4.83*	I(1)
COR	-0.57	-6.22*	-0.55	-6.20*	I(1)
LGX*COR	0.58	-6.47*	0.90	-6.46*	I(1)
LGFC	-1.71**	-4.60*	-1.89**	-4.58*	I(0)
LINF	-0.89	-7.68*	-0.37	-15.32*	I(1)
LOPEN	-0.23	-6.31*	-0.23	-6.31*	I(1)

Note: * and ** indicate significance at the 5% and 10% levels, respectively.

GDP = gross capital formation, GX = government total expenditure, COR = corruption, GFC = gross fixed capital formation, INF = inflation, OPEN = trade openness, and L = natural logarithm of the variable.

Table 5 presents the results from the bounds test for cointegration. The F-statistic value of (4.82) is higher than the upper critical values at the 5% and 1% levels, respectively. Thus, the evidence confirms the existence of a long-run equilibrium relationship between the logarithms of GDP and government expenditure together with the other control variables.

Table 5. Bounds test for cointegration results.

(5%) Critical values				
Explained variables	**I(0)**	**I(1)**	**F-statistic**	**Outcome**
F(LGDP, LGX, COR, LGX*COR, LGFC, LINF, LOPEN)	2.87	4.00	4.82*	Cointegration

Note: * signifies the existence of cointegration at the 5% level of significance.

GDP = gross capital formation, GX = government total expenditure, COR = corruption, GFC = gross fixed capital formation, INF = inflation, OPEN = trade openness, and L = natural logarithm of the variable.

4.3. Results of Long-term and Short-term ARDL Coefficient Estimates

The results of the selected ARDL model are reported in Table 6. The selected optimum lag length was based on the Akaike information criterion (AIC: 1,0,0,0,01,0). Evidence indicates that government expenditure is positively and significantly related to Nigeria's long-term economic growth, but not its short-term growth. Specifically, a 1% rise in government expenditure leads to increases of around 1.06% and 0.02% in GDP in the long run and the short run, respectively. However, these effects are statistically significant at 5% in the long run but insignificant in the short run. In addition, when government expenditure is lagged by one period, its effect on growth returns to negative and is statistically significant in the short run. Our evidence aligns with the bidirectional causality thesis running from government expenditure to growth and reenforces the earlier empirical evidence reported by Joshua (2019); Babatunde (2018); Arpaia and Turrini (2008); Gitana, Agnė, and Aušra (2018); Ram (1986); Bose, Haque, and Osborn (2007); and Ghose and Das (2013).

The level of corruption, proxied by the Transparency International corruption perception index, has a significant inverse relationship with economic growth in Nigeria. An increase of 100 basis points in the corruption index (a decrease in corruption level) will raise economic growth by 0.20% in the long run and 0.05% in the short run at the 1% level. This finding supports the hypothesis that corruption is "sand in the wheels" in Nigeria and corroborates existing empirical evidence in Nigeria and beyond (Blackburn, Bose, & Haque, 2006; Blackburn et al., 2010; Mauro, 1995; Ngutsav, 2018; Nur-Tegin & Jakee, 2020; Ovat & Bassey, 2014).

The interactive term is negative and statistically significant at the 5% level. The coefficient reveals that simultaneous increases in the corruption perception index (i.e., a decrease in corruption level) and government expenditure will reduce the growth rate of the economy by about 0.03% in the long run and 0.01% in the short run. Surprisingly, this contradicts the evidence on the direct effect of corruption on growth reported above and supports the "corruption greases the wheel" hypothesis. Overall, the evidence suggests that corruption is directly "sand in the wheels of commerce" and indirectly "greases the wheels of commerce" through government expenditure in Nigeria. A similar argument, that corruption helps entrepreneurs to overcome bureaucratic inefficiency and facilitates innovation and growth, received support from Kato and Sato (2015); Méon and Weill (2010); and Egger and Winner (2005).

The rests of the results show that inflation, measured by the GDP deflator, shows a significant positive link with economic growth. A 1% increase in the rate of inflation raises the rate of economic growth by about 0.70% in the long run and 0.46% in the short run at the 5% level. The significant short-run positive effect of inflation on growth persists even when the rate of inflation is lagged by one period. Gross fixed capital formation shows an insignificant negative relation with economic growth in the long run. The negative effect, however, appears to be statistically significant in the short term. Openness seems to be insignificant in explaining long-term and shortterm economic growth over the sample period. The error correction term lagged by one period (ECT_{-1}) is negative and statistically significant; it shows that about 0.56% of the deviation from the long-run equilibrium is corrected over a period of one year. The R^2 value suggests that a 0.91% variation in the dependent variables is explained by the explanatory variables. The Durbin–Watson (DW) value of 2.00 is preliminary evidence that the error term is free of serial correlation.

Thus far, our results provide evidence that government expenditure and its interaction with the corruption perception index have significant increasing effects on GDP growth. Nonetheless, we proceed to calculate the marginal effect in order to ascertain the threshold level at which reduction in corruption will decrease the GDP growth rate. Using the calculated long-run parameters of government expenditure and the interaction term, the marginal effects can be computed as follows:

$\partial LGDP$

$$\partial LGX = 1.056 - 0.0250COR_t \qquad (8)$$

Table 6. ARDL model estimates.

Short-term parameters (the explained variable is ΔLGDP)			**Long-term parameters (the explained variable is LGDP)**		
Regressor	**Coefficient [Standard errors]**	**P-value**	**Regressor**	**Coefficient [Standard errors]**	**P-value**
ΔLGX	0.02 [0.06]	0.71	LGX	1.06* [0.18]	0.00
ΔLGX_{-1}	-0.23* [0.07]	0.01	COR	0.20* [0.03]	0.00
ΔCOR	0.05* [0.01]	0.00	LGX*COR	-0.03* [0.01]	0.00
ΔLGX*COR	-0.01** [0.00]	0.05	LGFC	-0.12 [0.13]	0.37
ΔLGFC	-0.20* [0.06]	0.00	LINF	0.70* [0.24]	0.01
ΔLINF	0.46* [0.10]	0.00	LOPEN	-0.10 [0.13]	0.45
$\Delta LINF_{-1}$	0.89* [0.16]	0.00			
ΔLOPEN	0.03 [0.03]	0.36			
ECT_{-1}	-0.56* [0.08]	0.00	R^2 2.00		0.91 DW

Note: GDP = gross capital formation, GX = government total expenditure, COR = corruption, GFC = gross fixed capital formation, INF = inflation, OPEN = trade openness, and L = natural logarithm of the variable. DW = Durbin–Watson.

* And **indicate that the coefficient is significant at the 5% and 10% levels, respectively; L denotes the logarithms; and Δ denotes first differences.

The marginal effects estimated at the zero, minimum, mean and maximum levels of corruption with respect to the growth rate of GDP are 1.056, 0.8835, 0.528875, and 0.356, respectively. This suggests that an increase in the corruption perception index (i.e., a decrease in corruption) has a growth-decreasing effect through government expenditure; the more stringent the measure in reducing corruption, the higher the growth-reducing effect. Moreover, the threshold level of the corruption perception index to the growth rate of GDP is calculated at about 42.25; below this level, the marginal effect of government expenditure on the GDP growth rate is positive, but at this threshold level and beyond, the marginal effect turns negative. The implication of this threshold is that, at the current level of development (i.e., current institutional setting), an element of corruption is needed to overcome obstacles resulting from weak institutions and inefficient bureaucrats. Thus, the hypothesis that "corruption greases the wheels of commerce" can be confirmed in this instance.

4.4. Results of Diagnostic Tests and Stability Tests

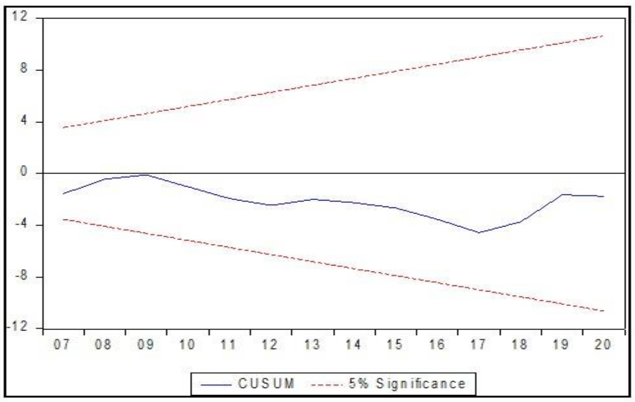
Table 7 presents the results of the diagnostic tests. In the Breusch–Godfrey serial correlation LM test, the Fstatistic and corresponding p-value (0.78 [0.48]) indicate that the null hypothesis of no serial correlation is accepted, and we can conclude that the model is free from serial correlation. The Breusch–Pagan–Godfrey heteroscedasticity test F-statistic and the corresponding p-value of (1.30 [0.32]) suggest that the model is homoscedastic. Also, the

Jarque–Bera normality test F-statistic and corresponding p-value (1.38 [0.50]) confirm that the model's error term is normally distributed.

Table 7. Post-estimation diagnostic tests.

Test statistic	Estimate
Serial correlation: F(2,12)	0.78 [0.48]
Normality: Jarque–Bera	1.38 [0.50]
Heteroscedasticity: F[15;13]	1.30 [0.32]

The stability of the model is attested by the plots in Figure 1. The plots of the sum of the recursive residuals test (CUSUM) and the sum of the recursive squared residuals test (CUSUM of squares) lie within the boundaries at the 5% level.



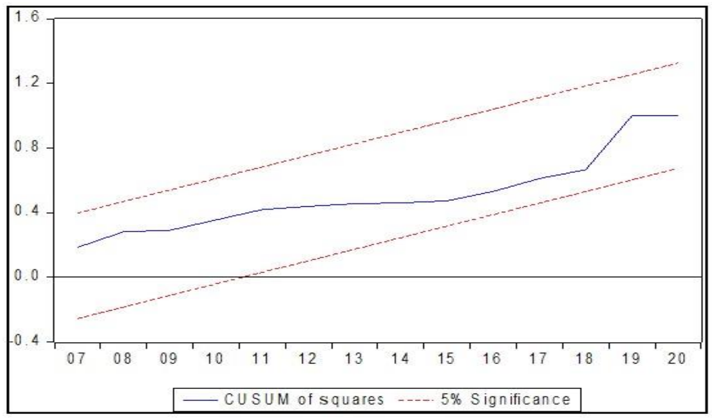


Figure 1. Plots of CUSUM and CUSUM of squares.

4.5. Results of Alternatives Cointegration Estimation Techniques: FMOLS and DOLS

Table 8 presents the estimates from the fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS). The long-run increasing effect of government expenditure on growth is consistent across the FMOLS estimated results. A 1% rise in government expenditure will increase the GDP growth rate by 0.80% and 1.48% in long-run for the FMOLS and DOLS models at the 1% level, respectively. Similarly, an increase of 100 basis points in the corruption perception index (i.e., a decrease in corruption level) will raise the growth of GDP by 0.04% and 0.03% in the long-run in the FMOLS and DOLS models at the 5% level, respectively. Furthermore, the coefficient of the interactive term confirms the negative and significant ARDL results, implying that simultaneous increases in government expenditure and the corruption perception index (i.e., a decrease in corruption) will reduce the growth rate of GDP.

Interestingly, the logarithms of gross fixed capital formation, inflation and openness are in line with our *a priori* expectation and are statistically significant. A 1% increase in capital formation will increase the growth rate of GDP by 0.31% and 0.38% in the FMOLS and DOLS models, respectively. Also, a rise in the rate of inflation by 1% will accelerate the growth rate of GDP by 0.65% and 0.40% in the FMOLS and DOLS models, respectively. Finally, opening up the economy by 1% will raise the GDP growth rate by 0.22% and 0.54% in the FMOLS and DOLS models, respectively.

Table 8. FMOLS and DOLS estimations.

FMOLS: D.V. = LGDP			DOLS: D.V. = LGDP	
Regressor	**Coefficient [Standard error]**	**P-value**	**Coefficient [Standard error]**	**P-value**
LGX	0.80*[0.09]	0.00	1.48* [0.08]	0.00

COR	0.04* [0.00]	0.00	0.03* [0.002]	0.00
LGX*COR	-0.05** [0.03]	0.05	-0.07* [0.01]	0.00
LGFC	0.31* [0.06]	0.00	0.38* [0.04]	0.00
LINF	0.65* [0.10]	0.00	0.40* [0.09]	0.01
LOPEN	0.22* [0.07]	0.00	0.54* [0.08]	0.00

Note: * and ** denote significance at 5% and 10%, respectively; L denotes logarithms; D.V. = dependent variable GDP = gross capital formation, GX = government total expenditure, COR = corruption, GFC = gross fixed capital formation, INF = inflation, OPEN = trade openness, and L = natural logarithm of the variable.

5. Conclusion and Recommendations

This study examined the interactive effect of corruption on the government expenditure–growth nexus in Nigeria over the 1990–2020 period. The objective was to investigate how the level of corruption proxied by the Transparency International corruption perception index influences the relationship between government expenditure and growth. The analysis was carried out using the ARDL, FMOLS and DOLS estimation techniques. Our primary finding is that, directly, government expenditure and control of corruption are enhance growth in both the long-run and short-run, implying that corruption is “sand in the wheels of commerce” in Nigeria. But the results from the interactive term indicate that corruption indirectly “greases the wheels of commerce” below the 4.25 threshold level in the Nigerian growth processes through government expenditure. The plausible explanation is that certain elements of corruption are helpful in overcoming inefficiency resulting from weak institutions and bureaucratic bottlenecks.

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