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Asymmetric modeling of the public debt–economic growth nexus in Ghana

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Abstract

Purpose – The impact of debt on economic growth has attracted immense economic research necessitated by ballooning public debt stock among countries and most of the literature presume a symmetric relationship between debt and economic growth. However, this study contemplates an asymmetric relationship and thus relies on annual series from 1970 to 2019 to examine the asymmetric effects of public debt on economic growth in Ghana.

Design/methodology/approach – The nonlinear autoregressive distributed lag (NARDL) bounds approach was employed. Gross domestic product (GDP) growth is the dependent variable while public debt and other control variables each decomposed into their positive and negative shocks constitute the independent variables.

Findings – The results reveal that a positive shock to public debt insignificantly impacts the growth of the economy in the short and long runs. Also, a negative shock to public debt exerts significant short-run negative and insignificant long-run positive effects on the growth of the economy. The divergence in the short- and long-run effects on growth of a negative shock to public debt and the general insignificant effects of a positive shock to the same is a glitch that is attributed to overcapitalized loans and poor utilization of credit facilities.

Practical implications – The study recommends "*inter alia*" that the government of Ghana strengthens the short to medium-term debt management strategies achievable through the enforcement of the Public Financial Management Act (PFMA) Act-921 and the Public Procurement Act (PPA) Act-914 to deal with any adverse effects of debt on the growth of the economy.

Originality/value – The novelty of the current study lies not only in the fact that it captures recent public debt dynamics at a time Ghana faces extreme fiscal constraints and escalating cost of debt servicing but it also does so in an asymmetric environment which is unprecedented an assumption in the analysis of Ghana's public debt–economic growth nexus.

Keywords Public debt, Economic growth, NARDL, Ghana

Paper type Research paper

1. Introduction

In many countries (both developed and developing), the size of the public sector has been increasing regardless of whatever approach is used to measure it. The implication is that, governments' participation in the day-to-day running of the economy continues to surge. Governments participate in the economy through various ways, paramount among them is the mobilization of tax revenue and ensuring efficient use of those revenues. However, in most countries, there has always been a mismatch between these two important variables (tax revenue and government expenditure), with expenditures mostly swallowing revenues

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against the ideal situation of balance budget where the proposed government spending is equivalent to the proposed government revenue. With this situation and given that nations are interdependent, borrowing now becomes inevitable. Of course, borrowing can be done domestically but that could also be highly costly as it reduces funds available for private investment which could crowd-out the private sector. The corollary of this is that, many countries rely on borrowing to fill their fiscal space.

As a response to the financial crises and the recent COVID-19 pandemic, Ghana just like other African countries embarked on expansionary policies to revamp the economy. This is so because as an emerging economy, Ghana was also hit hard by the impact of the financial crises. With limited fiscal space to effectively embark on these expansionary policies, the corollary has been to resort to borrowing to cover the fiscal space in this regard.

In Ghana, the public debt profile has been on a sustained level by the year 2006 (26.2% of gross domestic product [GDP]) due to the Highly Indebted Poor Countries (HIPC) debt relief. Since then, the debt profile continued to increase over the years with no indication of a decline at least in the short to medium term. For example, in 2015, Ghana's public debt stock as a percentage of GDP stood at 71.6% and increased to 73.9% in 2016. Furthermore, available data from the Bank of Ghana (BOG) indicate that Ghana's public debt stock hit GHS122.36 bn representing 72.5% of GDP in the first quarter of 2017. This figure is GHS22 bn higher than the debt recorded in the same quarter of 2016 (GHS100.2 bn or 72.2% of GDP). Of the new figure, GHS53.4 bn (31.6%) was domestic, being facilities or loans secured from the country whiles GHS68.9 bn (40.8%) was from external borrowing. Comparing the current figures to the same period in 2016, Ghana recorded external debt of GHS59.9 bn representing 43.2% of GDP while domestic borrowing for the same period was GHS40.3 bn, which represents 29.0% of GDP. The rising public debt stock in recent times raises fears about the danger of a possible default. Indeed, the situation has locked Ghana out of the international credit market, a situation which is reflected in a rapid depreciation of the cedi. The International Monetary Fund has expressed deep concerns about the debt levels in Ghana, and the fund is currently conducting a debt sustainability analysis (DSA) to determine whether or not to grant a program the government is seeking. The discussions around DSA are raising issues of a possible "haircut" on the investment of domestic creditors leading to investment reversals, which is putting further pressure on the cedi.

Several studies have been conducted to ascertain the effect of debt on economic growth. The outcomes of these studies have been mixed. Whereas some proffer positive effects of external debt, others proffer negative effects with others showing no relationship at all. Many of the studies on developing and sub-Saharan Africa reveal a significant positive effect of external debt on growth. See for example Siddique *et al.* (2015), Stefanoudakis *et al.* (2009), Maier (2005), Curutchet (2005) and Elbadawi *et al.* (1997). However, few studies have demonstrated that there could be adverse effects of external debt on economic growth at least beyond a certain threshold, for example Babu *et al.* (2015), Chowdhury (2001), Fosu (1996) and Cunningham (1993) . It is important to note that most of these studies examined the debt–economic growth nexus in a symmetric environment. However, this study contends that there could be asymmetries as well in the relationship between debt and economic growth. Thus, this study contributes to the literature by examining this asymmetric relationship between debt and economic growth in the context of Ghana. The rest of the paper is organized as follows: section 2 reviews the related literature (both theoretical and empirical), Section 3 discusses the concept of debt sustainability, Section 4 covers the methods and sources of data, Section 5 covers the estimation strategy, Section 6 presents the empirical results and the key findings and policy recommendations are summarized in Section 7.

2. The literature

This section reviews both theoretical and empirical literature on the effect of external debt on economic growth. The section begins by presenting a theoretical analysis of the effect of debt on growth with the help of the debt overhang hypothesis. The section ends with the presentation of empirical evidence on the effect of public debt on economic growth.

2.1 Theoretical framework

The theoretical foundation for this study is the debt overhang hypothesis proposed by Myers (1977) in his classic research "determinants of corporate borrowing" in which he made the case for a suitable option of corporate financing. Myers' proposal has since been extrapolated to cover the debt financing of an entire economy. For instance, economists such as Krugman (1988) applied the concept to a number of highly indebted least developed countries in his article titled "Financing vs Forgiving a Debt Overhang" and concluded that these countries are likely to reprofile or default their debt obligations once their capacity to pay is limited. Krugman (1988) further points out that debt reprofiling and defaulting options are not desirable for economic growth as it leads to hikes in interest rates and declines in investments. Overburdened debt also has the potential of crowding out the private sector and thereby further slowing economic growth. Therefore, the term debt overhang can appropriately be used for a country that expends a chunk of its income on debt repayment and servicing. If this is the case, perhaps, it is most appropriate to locate a study on debt–growth nexus of the Ghanaian economy within the ambit of the debt overhang hypothesis. This is because, Ghana has gone through several phases as far as debt management is concerned. Ranging from highly indebted poor country initiatives to debt reprofiling and to the present regime where the country commits huge amounts of national income to debt servicing.

2.2 Empirical reviews

The empirical literature on Ghana and elsewhere related to the relationship between debt and economic growth is summarized in Table 1.

From the empirical literature, it is apparent that most of the works done on Ghana and elsewhere makes the prior assumption that, the independent variables most especially public debt exerts symmetric effect on economic growth. Thus, the effect on growth of an increase or decrease in the debt levels is necessarily the same. The current study, however, argues that, the impact is not necessarily symmetrical at least not in qualitative terms and therefore there is no reason to assume that there are no asymmetries in the impacts of debt on growth (Shin *et al.*, 2014). It is this asymmetric effect that this study seeks to investigate using data on the Ghanaian economy.

3. Debt sustainability analysis and the case of Ghana

This section presents the modern framework of central government debt dynamics and the circumstances which could render the debt stock sustainable or unsustainable.

To begin with, it is important to point out the broad components of government expenditure and government revenues. Government expenditures involves (1) government purchases of goods and services (G_t) and (2) interest payment on previous debt (iB_{t-1}). The revenue side on the other hand comprises (1) taxes issued bonds and (3) borrowing from the public (ΔM_t), which mostly leads to a change in the money supply.

Having identified the main expenditure components and the revenue sources of the central government's budget, we proceed to express the budget identity of the government in nominal terms as follows;

Country	Authors	Period	Variables	Methodology	Conclusion
Ghana	Owusu-Nantwi and Erickson (2016)	1970–2012	– Public debt – Real GDP	– VECM – Johansen cointegration	Public debt → (+) GDP growth
Ghana	Frimpong and Oteng-Abayie (2007)	1970–1999	– External debt – Debt servicing – FDI – GDP growth	– VECM	External debt → (+) GDP growth
Ghana	Asafo and Matuka (2019)	1970–2017	– External debt – GDP growth	– VECM	External debt → (+)GDP (–) for both short and long runs
Lebanon	Saad (2012)	1970–2010	– Export – Debt servicing – Real GDP	– Johansen cointegration	External debt → (+) GDP growth
20 developed economies	Reinhart and Rogoff (2010)	1949–2009	– Public debt – GDP growth	– Panel analysis	Public debt → (+/–)GDP
55 developing economies	Nguyen *et al.* (2003)	1970–2009	– External debt – GDP growth	– Panel analysis	External debt → (–)GDP
24 industrialized economies	Curutchet (2005)	1970–2002	– Public debt – GDP growth	– Panel analysis	No relationship between PD and GDP was found
Nigeria	Ogunmuyiwa (2011)	1970–2007	– External debt – GDP growth	– VECM	No relationship was found
93 developing countries	Pattillo *et al.* (2011)	1969–1998	– External debt – GDP growth	– Threshold analysis	External debt negatively affects growth after 35–45% of GDP threshold
39 SSA countries	Senadza *et al.* (2018)	1990–2013	– External debt – GDP growth	– System GMM	External debt → (–) GDP growth

Table 1.
Summary of empirical reviews

$$G_t + iB_{t-1} \equiv T_t + \Delta B_t + \Delta M_t \tag{1}$$

However, in an environment where the central bank is autonomous and there is close to zero Central Bank (CB) financing of central government budget, $\Delta M_t = 0$ and the budget identity relation becomes $G_t + iB_{t-1} \equiv T_t + \Delta B_t$, and with the primary deficit expressed as $G - T$, the actual budget deficit can be written from the budget identity relation as follows:

$$\text{Actual budget deficit}: \ \Delta B_t = (G_t - T_t) + iB_{t-1} \tag{2}$$

$$\text{Debt} - \text{GDP ratio}: \ b_t = \frac{B_{t-1}}{P_t Y_t} \tag{3}$$

$$\text{Primary deficit to GDP} - \text{ratio}: \ d_t = \frac{G_t - T_t}{P_t Y_t} \tag{4}$$

Note. $\Delta b_t \neq \frac{\Delta B_{t-1}}{P_t Y_t}$

With these identities and non-identities in mind, the actual budget deficit can then be written in real terms as follows:

$$\frac{\Delta B_t}{P_t Y_t} = \frac{(G_t - T_t)}{P_t Y_t} + \frac{iB_{t-1}}{P_t Y_t} \tag{5}$$

$$\frac{\Delta B_t}{P_t Y_t} = d_t + ib_t \tag{6}$$

$$b_t = \frac{B_t}{P_t Y_t} \rightarrow B_t = b_t P_t Y_t \tag{7}$$

$$\frac{\Delta B_t}{P_t Y_t} = \frac{P_t Y_t \Delta b_t}{P_t Y_t} + \frac{b_t Y_t \Delta P_t}{P_t Y_t} + \frac{b_t P_t \Delta Y_t}{P_t Y_t} \tag{8}$$

$$\frac{\Delta B_t}{P_t Y_t} = \Delta b_t + b_t \pi_t + b_t \gamma_y \tag{9}$$

Substituting equation (6) into (9), we have

$$d_t + ib_t = \Delta b_t + b_t \pi_t + b_t \gamma_y \tag{10}$$

$$\Delta b_t = d_t + (i - \pi_t - \gamma_y) b_t \tag{11}$$

Making use of the Fisher relation, the key expression for the change in debt is given in (12).

$$\Delta b_t = d_t + (r_t - \gamma_y) b_t \tag{12}$$

From (12), the following can be identified as the main factors determining the change in the debt stock (Δb_t) of a country.

(1) Primary deficit as a ratio of GDP (d_t) ↑ +,

(2) Change in real interest rate (r) ↑ +,

(3) Real GDP growth rate (γ_y) ↑ -,

(4) Current debt to GDP ratio (b_t) ↑ + and

Note. d_t is negative when the country is running a primary surplus.

From equation (12), when $\Delta b_t = 0$, then

$$b_t = \frac{-d_t}{r - \gamma_y} \tag{13}$$

Equation (13) is a key expression for analyzing the sustainability of the debt stock of an economy running a budget deficit or surplus given the various relationships between the real interest rate (r) and the growth rate (γ_y) of the economy (Carlin and Soskice, 2014). Figure 1 depicts the time path of the debt stock of an economy for an instance where the real interest rate (r) is higher than the growth rate (γ_y) of an economy running a deficit or surplus, i.e. $r > \gamma_y$ and d_t is either positive or negative. Similarly, Figure 2 depicts the time path of the debt stock when the growth rate (γ_y) of the economy is higher than the real interest rate (r) in the face of a primary deficit or surplus, i.e. $r < \gamma_y$ and d_t is either positive or negative. Notice that a positive d_t (primary deficit) renders the entire expression in (13) negative and vice versa.

Figure 3 presents the relationship between Ghana's real GDP growth rate and the real interest payments on external debt for the period 1970–2019. From the graph, it can be seen

that from the 90s to the early 2000s, the real interest rate is clearly above the growth rate of the economy. It is interesting to note that consistent with the debt dynamic analysis presented in Figures 1 and 2, it was around the same period (90s to early 2000s) that the debt stock of Ghana became unsustainable that the country had to accept the highly indebted poor country (HIPC) initiative. Under this program, Ghana achieved a significant debt reduction which could have resulted in the situation where the growth rate of the economy exceeded the interest rate payments on external debt as shown in Figure 3.

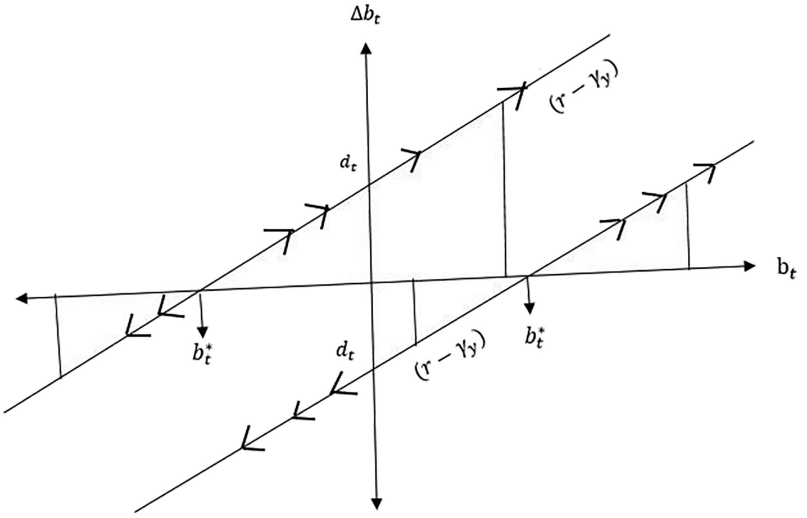

Figure 1.
Time path of debt stock when interest rate is greater than growth rate

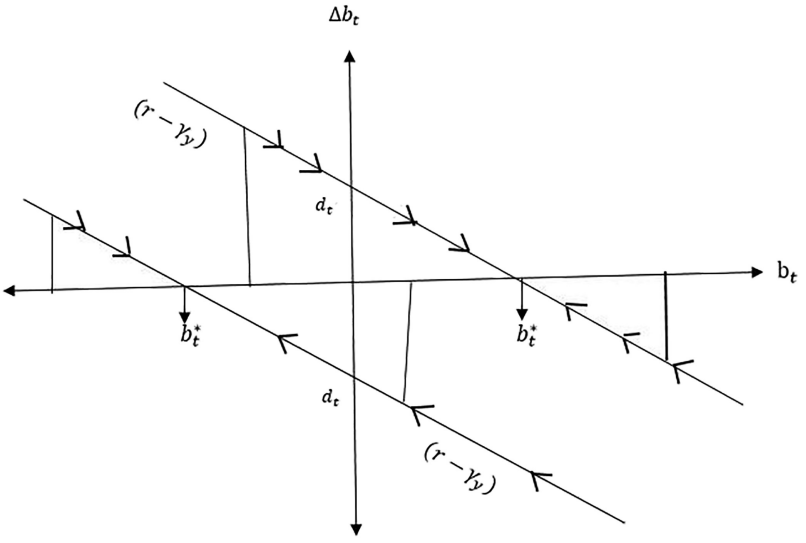

Figure 2.
Time path of debt stock when interest rate is less than growth rate

4. Methods and sources of data

This study employs annual time series data from 1970 to 2019 to analyze the impact of external debt on the growth of the Ghanaian economy. The natural logarithm of GDP (Current US$) constitutes the dependent variable, and the regressors are the natural logarithm of central government debt as a percent of GDP, interest payment on debt as a percent of GDP and net inflows of foreign direct investment as percent of GDP. Data on all variables except the central government debt are sourced from the World Bank's World Development Indicators (WDI) database. The data on the central government debt were obtained from Knoema site. Table 2 summarizes the independent variables and their expected sign both in the short and long runs.

5. Estimation technique

Most of the empirical works on Ghana relating to public debt and or external debt assumes that the relationship between debt and growth is necessarily symmetric. However, this study argues that there could be asymmetric relationships; therefore, to analyze the effect of central government debt including the other independent variables on the growth of the Ghanaian economy, this study follows the formulation of Shin *et al.* (2014) and fits a non-linear auto-regressive distributed lag (NARDL (p, q)) model. The functional form of which is specified in equation (14):

$$Y = f\left(Y_{t-1}, X_{1t}^{+}, X_{1t}^{-}, \ldots, X_{nt}^{+}, X_{nt}^{-}\right) \tag{14}$$

Equation (14) expresses the dependent variable as a function of its lagged values and the independent variables decomposed into their positive and negative shocks to reflect their asymmetric effects. The reparameterized error correction short and long-run cointegrated and operational representations of equation (14) are specified in equation (15) and (16), respectively:

$$\Delta Y_t = \alpha_0 + \sum_{i=0}^{p} a_1 \Delta Y_{t-1} + \sum_{i=0}^{q} \alpha_2 \Delta X_{t-1}^{+} + \sum_{i=0}^{q} \alpha_3 \Delta X_{t-1}^{-} + \rho Y_{t-1} + \varphi_1^{+} X_{t-1}^{+} + \varphi_2^{-} X_{t-1}^{-} + \varepsilon_t \tag{15}$$

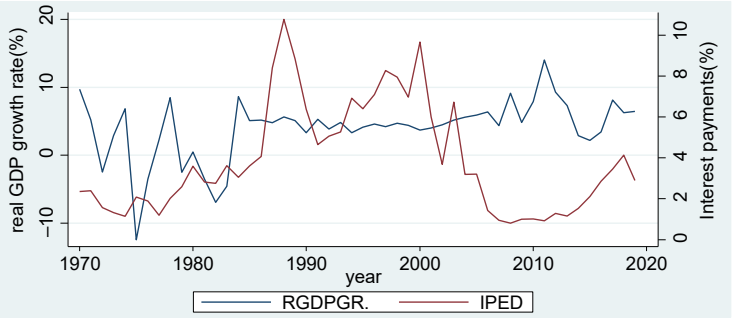

Figure 3.
Trends in Ghana's economic growth and interest payments on external debt

Variables	Expected signs	
	Short run	Long run
GDP (lagged) (IPED)	+/−	
Central gov. debt (CGD)	+	+/−
Interest payment on external debt (IPED)	−	−
FDI inflows (net) (NFDI)	+	+

Table 2.
Expected signs of the regressors

$$\Delta \ln GDP = \alpha_0 + \sum_{i=0}^{p} a_1 \Delta \ln GDP_{t-1} + \sum_{i=0}^{q} \alpha_2 \Delta \ln CGD^{+}_{t-1} + \sum_{i=0}^{q} \alpha_3 \Delta \ln CGD^{-}_{t-1} + \sum_{i=0}^{q} \alpha_4 \Delta IPED^{+}_{t-1} + \sum_{i=0}^{q} \alpha_4 \Delta IPED^{-}_{t-1} + \sum_{i=0}^{q} \alpha_5 \Delta FDI^{+}_{t-1} + \sum_{i=0}^{q} \alpha_6 \Delta FDI^{-}_{t-1} + \rho \ln GDP_{t-1} + \varphi_1^{+} CGD^{+}_{t-1} + \varphi_2^{-} CGD^{-}_{t-1} + \varphi_3^{+} IPED_{t-1} + \varphi_4^{-} IPED_{t-1} + \varphi_5^{+} FDI_{t-1} + \varphi_5^{-} FDI_{t-1} + \varepsilon_t \quad (16)$$

where lnGDP = natural logarithm of GDP (Current US$), CGD = central government debt (% GDP), IPED = interest payments on debt (%GDP), NFDI = net inflows of foreign direct investment (%GDP), $\alpha_1 - \alpha_6 =$ are the short-run coefficients, $\varphi_1 = \varphi_5 =$ are the long-run coefficients and ρ is the error correction component. $\varepsilon_t =$ is the stochastic error term which is assumed to be id i.e. $\sim N(0, \delta^2)$.

Note. The central government debt (CGD), interest payments on debt (IPED) and the foreign direct investment (FDI) variables are not log-transformed again for the analysis.

Following Pesaran *et al.* (2001) the long-run bounds test can be conducted from equation (16) on the basis of the following underlying hypothesis statements. A rejection of the null indicates the presence of long-run relationships among the variables.

$$H_0 : \rho = \varphi_1^{+} = \varphi_2^{-} = 0 \text{ as against } H_1 : \rho = \varphi_1^{+} = \varphi_2^{-} \neq 0$$

The long-run asymmetric effects (positive and negative) of the regressors on the regressand can be calculated as negative ratio of the long-run asymmetric coefficients of the regressors to the long-run cointegrating coefficient of the lagged regressand as follows:

$$LM_{+} = \frac{-\varphi_1^{+}}{\rho} \text{ and } LM_{-} = \frac{-\varphi_2^{-}}{\rho} \quad (17)$$

The presence or otherwise of long- and short-run asymmetric effects in the model are then tested on the basis of the following hypothesis statements as proposed by Shin *et al.* (2014). Again a rejection of the null in each case indicates the presence of long and short-run asymmetric effects.

$$H_0 : \frac{-\varphi_1^{+}}{\rho} = \frac{-\varphi_2^{-}}{\rho} \text{ as against } H_1 : \frac{-\varphi_1^{+}}{\rho} \neq \frac{-\varphi_2^{-}}{\rho} \text{ for long run and}$$

$$H_0 : \sum_{i=0}^{q} \alpha_2^{+} = \sum_{i=0}^{q} \alpha_3^{-} \text{ as against } H_0 : \sum_{i=0}^{q} \alpha_2^{+} \neq \sum_{i=0}^{q} \alpha_3^{-} \text{ for the short run.}$$

6. Empirical results and discussions

This section presents the empirical findings from the analysis based on the model specified in the previous section. Because the NARDL proposed by Shin *et al.* (2014) is similar in spirit to the ARDL model of Pesaran *et al.* (2001), it is critical to ensure that none of the variables under consideration is integrated of order two, i.e. I(2). Against this background, the empirical section of this study begins with a unit root test on all the variables using both the Augmented Dicky–Fuller (ADF) test for unit root proposed by Dickey and Fuller (1979) and the Phillips–Peron (PP) test for unit roots put forward by Phillips and Perron (1988). The motivation for using both tests is to ascertain with much certainty the unit root properties of

the variables under consideration. The null hypothesis underlying both tests is that the series have a unit root. The results of the ADF and the PP tests for unit root are reported in Table 3.

As it is obvious from Table 3, the null hypothesis of the presence of unit root is rejected for all the variables after the first difference for both ADF and PP. This implies that all the variables to be used for the estimation are at most integrated of order one, i.e. I(1). This is an indication that estimating the underlying model with the NARDL model will not produce spurious results.

Integral to the NARDL system is the test for the existence of long run relationships among the variables. This is important for determining if the explanatory variables are important factors for predicting the dependent variable in the model even in the long run. In this study, this is achieved with the familiar ARDL test for long-run cointegration proposed by Pesaran *et al.* (2001). The results of this test are reported in Table 4.

From Table 4, it can be seen that, the *F*-statistic value of the asymmetric bounds test of 3.918 is at least greater than the 10% and the 5% upper critical bounds. This leads to the rejection of the null hypothesis of nonexistence of long-run relationships among the variables at the 10 and 5% levels. The outcome of the bounds test provides credence to the cointegrated specification of the NARDL model specified in the previous section.

The empirical results of the NARDL model specified in equation (3) are reported in Table 5. In particular, it reports the nonlinear impacts of central government debt, interest payments on debt and net inflows of foreign direct investment on the economic growth of Ghana.

From Table 5 and starting with the long-run impacts, it can be inferred that both the long-run positive and negative partial sums of central government debt are not statistically significant in impacting the growth of the Ghanaian economy. The long-run positive and negative partial sums of central government debt are found to be −0.004 and 0.025, respectively. This implies that, ceteris paribus, a percentage increase in the central government debt is associated with about −0.004% decline in the growth of the Ghanaian economy in the long run. Similarly, a percentage decline in the debt stock increases the long-run growth of the Ghanaian economy by about 0.03% ceteris paribus. The finding where changes in debt stock impacts economic growth is consistent with the findings of Frimpong and Oteng-Abayie (2007), Sulaiman and Azeez (2012), Adenusola *et al.* (2007) and Elbadawi *et al.* (1997) among others. These findings are consistent with the *a priori* expectations of this study.

Table 3.
Results of the Augmented Dicky–Fuller and Phillips–Peron unit root tests

	ADF				PP			
	I(0)		I(1)		I(0)		I(1)	
Variables	I.C.	I.C. and Tr.	I.C	I.C. and Tr.	I.C.	I.C. and Tr.	I.C.	I.C. and Tr.
LnGDP	0.50	−1.32	−6.12**	−6.23**	0.50	−1.40	−6.15**	−6.24**
CGD	−1.4	−1.5	−4.2***	−4.1**	−1.6	−1.7	−4.2***	−4.1**
IPED	−1.6	−2.1	−7.4***	−4.5***	−1.6	−2.1	−7.1***	−7.0***
FDI	−1.6	−2.5	−4.4**	−4.4**	−1.7	−2.1	−4.3**	−4.3**

Note(s): *, ** and *** denote the absence of unit root at 10, 5 and 1% levels, respectively

Table 4.
Asymmetric bounds test

		Critical bounds	
F-statistic	Significance	I(0)	I(1)
3.918	10%	2.12	3.23
$K = 6$	5%	2.45	3.61
	1%	3.15	4.43

Note(s): The null hypothesis underlying this test is that no long-run relationship exists among the variables, and it is based on the Pesaran *et al.* (2001) table

Dep. var: lnGDP		Coefficient		*t*-statistics
EC_{t-1}		-0.703^{***}		-3.148 (0.014)
$CGDt^{+}_{t-1}$		-0.004		-0.369 (0.722)
$CGDt^{-}_{t-1}$		0.025		1.695 (0.129)
$IPED^{+}_{t-1}$		-0.120^{*}		-1.970 (0.084)
$IPED^{-}_{t-1}$		-0.155^{**}		-2.838 (0.022)
$NFDI^{+}_{t-1}$		0.158^{**}		2.707 (0.027)
$NFDI^{-}_{t-1}$		-0.166^{**}		-3.316 (0.011)
C		13.119^{**}		2.744 (0.025)
$\Delta \ln GDP_{t-1}$		0.279		1.371 (0.208)
$\Delta CGDt^{+}_{t-1}$		0.004		0.849 (0.421)
L1		-0.009		-1.119 (0.296)
$\Delta CGDt^{-}_{t-1}$		-0.028^{**}		-2.612 (0.031)
L1		-0.027^{**}		-2.682 (0.028)
$\Delta IPED^{+}_{t-1}$		-0.084^{*}		-1.883 (0.097)
$\Delta IPED^{-}_{t-1}$		0.096^{***}		3.258 (0.012)
L1		0.125^{**}		2.701 (0.027)
$\Delta NFDI^{+}_{t-1}$		0.170^{***}		4.476 (0.002)
L1		-0.053^{*}		-2.280 (0.052)
$\Delta NFDI^{-}_{t-1}$		-0.174^{***}		-5.739 (0.000)
L1		0.087^{*}		2.146 (0.064)
Diagnostic tests				
R^2	0.96	χ^2_{het}	15.965 (0.316)	
$\chi^2_{s/corr}$	0.041 (0.840)	JB_{norm}	2.566 (0.277)	

Note(s): (+) and (−) denote the positive and negative partial sums of the NARDL model, and the *p*-values are in parenthesis. Diagnostic tests in the model are conducted using $\chi^2_{s/corr}$ for serial correlation, χ^2_{het} for heteroscedasticity and JB_{norm} for normality. The null hypothesis underlying the residual diagnostic tests are as follows: $H_0^{s/corr}$: no serial correlation, H_0^{hetro} : homoscedasticity and H_0^{norm} : $\varepsilon_t \sim N(0, \sigma^2)$. *, ** and *** denote statistical significance at the 10, 5 and 1% level, respectively. The estimation of the NARDL model is based on an automatic ARDL framework constructed using optimally chosen SIC- and AIC-based lags

Table 5.
Asymmetric coefficient estimates

The next variable is the interest payments on external debt as a percent of GDP whose positive and negative partial sums are statistically significant at least at the 10% level. It has positive and negative partial sum of −0.120 and −0.155, respectively. This means that all things equal, a percentage increase or decrease in the interest payment on external debt is associated with 0.12% and 0.16% decline in the long-run growth of the Ghanaian economy, respectively. Except for the findings regarding the decline in the interest payments which is counter intuitive, the finding of a negative correlation between the interest payments and growth is consistent with the *a priori* expectations of this study as well as economic theory. It is also consistent with a plethora of empirical works such as Adesola (2010), Frimpong and Oteng-Abayie (2007), Rahmon and State (2018), Abille and Mpuure (2020) among others. It is instructive to note that interest payments are a capital flight; therefore, when they become significant, economic growth can be negatively affected.

The final variable is the net inflows of foreign direct investment as a percent of GDP, which has statistically significant positive and negative partial sums of 0.158 and −0.166, respectively. This implies that, all things equal, a percentage increase or decrease in the net inflows of foreign direct investment is associated with about 0.16% increase and 0.16% decline in the long-run growth of the Ghanaian economy, respectively. These findings are consistent with the *a priori* expectations of the study and also in tandem with the findings of

Wang and Blomström (1992), Podrecca and Carmeci (2001), Abille *et al.* (2020) and Sokang (2018) among a host of others who found a positive and statistically significant effect of FDI on economic growth.

Turning to the short-run asymmetric coefficients, it can be seen from Table 4 that, although not statistically significant, the lag of GDP growth positively impacts the contemporaneous growth of the Ghanaian economy. In particular, a percentage change in the lagged value of GDP is associated with about 0.3% rise in the short-run growth of the Ghanaian economy.

The next variable is the central government debt as a percent of GDP which has positive and negative partial sums of 0.004 and −0.028, respectively. This implies that holding other factors constant, a percentage increase or decrease in the central government debt lead to about 0.004% increase and 0.028% decline in the short run growth of the Ghanaian economy respectively albeit the effect for the positive partial sum is not statistically significant. The findings are consistent with the *a priori* expectations of this study and in line with the findings of Rahmon and State (2018), Anning *et al.* (2016), Owusu-Nantwi and Erickson (2016) Hilton (2021) among others, who found a positive relationship between public debt and economic growth. It is important to note that public debt *per se* is not inimical to growth so far as it is utilized judiciously. It is rather the interest payments on external debt which constitutes capital flight that could negatively affect economic growth. Indeed, it is the excessive interest payments on the external debt component of public debt that leads to the "debt overhang" implications of excessive external debt financing of corporations or an economy as observed in the study of Frimpong and Oteng-Abayie (2007).

The next variable is the interest payments on debt expressed as a percent of GDP which has statistically significant positive and negative partial sums of −0.084 and 0.096, respectively. The implication is that ceteris paribus, a percentage rise or fall in the interest payments on external debt is associated with about 0.08% decline and 0.10% increase in the short-run growth of the Ghanaian economy, respectively. This finding is in line with the expectations of the study and just like the long-run results, empirically supported by the works of Adesola (2010), Frimpong and Oteng-Abayie (2007) and Rahmon and State (2018).

The final variable is the net flows of foreign direct investment as a percent of GDP, which has statistically significant positive and negative partial sums of 0.170 and −0.174, respectively. This implies that everything else equal, a percentage increase and decrease in the net flows of foreign direct investment lead to about 0.17% increase and 0.17% decrease, respectively, in the short-run growth of the Ghanaian economy. The findings are consistent with the expectations of the study and similar to the long-run findings, which are supported by the works of Wang and Blomström (1992), Podrecca and Carmeci (2001), and Sokang (2018).

The asymmetric error correction (EC_{t-1}) coefficient is −0.703. It is appropriately signed and highly significant in statistical terms. This reinvigorates the presence of cointegration in the model shown by the bounds test for cointegration. It further indicates the speed of adjustment from the short run towards long-run equilibrium. In other words, it shows that short-run shocks in the model are adjusted at a speed of about 70% per period towards long-run equilibrium. Therefore, short-run shocks in this model are expected to disappear in approximately one and half years' time.

The short- and long-run tests for asymmetries are reported in Table 6. From the table, it can be seen that there exist short- and long-run asymmetries shown by the significant Wald statistic. The finding of short- and long-run asymmetric effects of central government debt on the economic growth of Ghana further gives credence to the employment of the NARDL model in this study.

Stability analysis in the model is tested using the cumulative sum test of stability (CUSUM) and cumulative sum square tests, which are plotted in Figure 4 to determine the significance of course at the 95% confidence bounds based on the null hypothesis that parameters in the model are unstable (Brown *et al.*, 1975). To the extent that the cumulative sum and cumulative sum square tests of stability statistic lines lie within the 5% significance bounds, the null hypothesis is rejected, and its concluded that there is parameter stability in this model.

The cumulative dynamic multipliers of the asymmetric effects of central government debt, interest payments on external debt and the net inflows of foreign direct investment are reported in Figure 5. From Figure 5, it can be seen that economic growth in Ghana responds slowly to the positive shock in central government debt relative to the response to the negative shock of the same. Also, whiles the negative shocks initially increase growth sharply, its effect on growth dissipates over time in sharp fashion and takes a steady negative trajectory after the 5th year. The effect of a positive shock, on the other hand, starts as positive and declines slowly into a negative trajectory.

It can also be seen that economic growth in Ghana responds positively to decreases in interest payments and negatively to increases in interest payments as expected. Further, the growth of the Ghanaian economy responds positively to changes in the inflows of foreign direct investments.

Wald statistic	χ^2 statistic
W_{SR}	7.190^{***} (0.007)
W_{LR}	8.356^{***} (0.004)

Note(s): The null hypothesis underlying this test is that the coefficients are symmetric. W_{SR} and W_{LR}, respectively, denote the short- and long-run Wald statistic for symmetric coefficients in the model. The *p*-values are reported in parenthesis, and *** denotes significance at the 1% level

Table 6.
Test for asymmetries

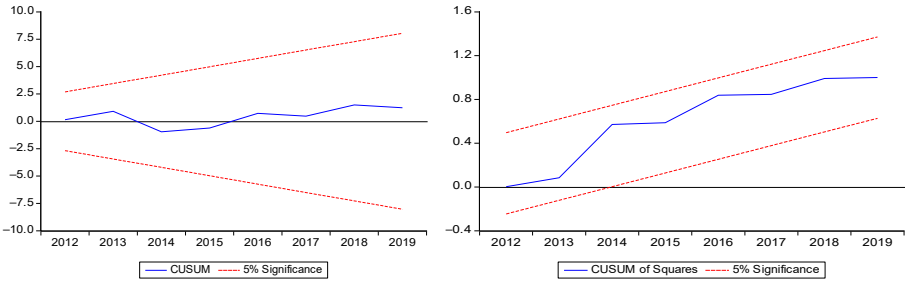

Figure 4.
CUSUM and CUSUM square tests of stability

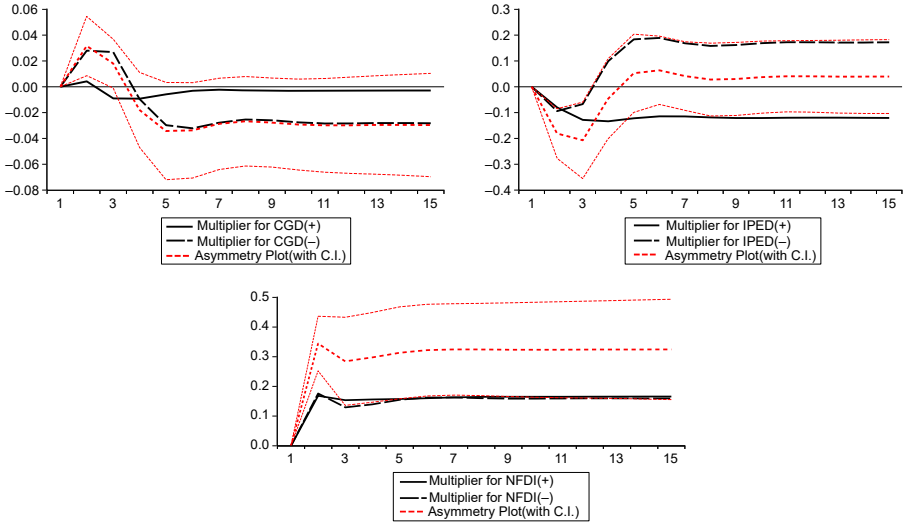

Figure 5.
Dynamic multipliers

7. Key findings and policy directions

This study examines the asymmetric effects of public debt on the economic growth of Ghana. By employing the NARDL technique, the study decomposed the effect of public debt into its positive and negative shocks. The findings reveal that there exist negative and positive impacts on growth of the Ghanaian economy as a result of long-run positive and negative shocks to central government debt, respectively. However, short-run positive and negative shocks to central government debt impact positively and negatively on the growth of the Ghanaian economy. Whereas the effect of the long-run shocks is not statistically significant, those of the short-run shocks are statistically significant at least at the 10% level. The glitch in the long-run effect of central government debt on economic growth in Ghana is attributed to a number of factors including overcapitalized loans, poor utilization of credit facilities and excessive corruption. Based on the findings, it is critical that the government of Ghana strengthens the short to medium term debt management strategies to deal with the adverse effects of public debt. This could be achieved by strictly enforcing legislative instruments such as the Public Financial Management Act (PFMA) Act-921 and Public Procurement Act (PPA) Act-914. Consistent with the *a priori* expectations, short-run positive shocks to interest payments on debt is found to have a negative effect on the growth of the Ghanaian economy. This revelation is particularly worrying especially at a time when Ghana devotes huge sums of government revenues to debt servicing. It is therefore critical that the governments explore options to reprofile the debt stock in order to minimize the interest risk and render the debt stock more sustainable. It is also important for the government to pay extra attention to the interest terms of future loans in order to relieve the country of interest payment burdens as excessive interest payments could be detrimental to the growth of the Ghanaian economy as established in this study. Since countries have different debt dynamics and are at different stages of development, the findings and policy recommendations of this study are limited to that of the Ghanaian economy and may not be generalized for other countries. Also, this study only examines the asymmetric effect of public debt on the aggregate rather than the sector specific growths of the economy. Thus, for sector specific policy formulation, it will be helpful if future studies examine the asymmetric effects of debt on the disaggregated growth (sectorial growth) of the economy.

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