THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND PUBLIC DEBT: A THRESHOLD REGRESSION APPROACH IN GHANA

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ABSTRACT

Purpose– Ghana's debt stock has been a subject of debate for a very long time. This study is to estimate the debt threshold level above which it will be detrimental to economic growth.
Methodology– The study used a threshold autoregressive model introduced by Tong (1978) and Hansen (1996). The study employed time-series data for thirty-one years from 1990 to 2020. Economic growth was measured by the Gross Domestic Product Per Capita (GDPPC). The study sought to answer the following question: What is Ghana's public debt threshold value?
Findings– The data reveal that Ghana has a single public debt threshold value (i.e., structural breakpoint), implying that public debt and growth are not linear. The derived threshold regression model indicates a public debt threshold of 57.09 per cent, above which the growth rate of GDPPC is considerably retarded. In addition, below the threshold level, there is a statistically significant positive association between public debt and growth.
Conclusion– This article concludes that low public debt is growth-enhancing, whereas public debt above the threshold value is detrimental to economic growth. Therefore, policymakers should focus on monetary policies that aid in maintaining public debt at a low level. However, this study makes the following recommendations to help sustain Ghana's expanding state debt:
To begin with, the government should halt the accumulation of external debt, which incurs additional costs during periods of currency depreciation. Second, policymakers with decision-making authority should exert severe restraint on the growing cedi. Thirdly, the government should eliminate all wasteful spending. Finally, the government of Ghana should allocate its external debt appropriately for economic investment and maintain a strong debt management policy.

Keywords: Ghana's debt stock, threshold, economic growth, policymakers.
JEL codes: F34, H63

1. INTRODUCTION

Borrowing allows governments, institutions, and individuals to meet their financial obligations. The government may be required to engage in public sector investments on occasion, for instance, constructing schools, hospitals, and enhancing roads. This investment later generates a return on investment, which contributes to the expansion of productive capacity and the acceleration of economic growth. However, most developing countries lack the financial resources to pursue this investment, forcing them to borrow. The national debt, often known as public sector debt, refers to the total amount of money borrowed by the government. Public debt, in the real sense, is not bad, but how sustainable can it be? Elmendorf and Mankiw (1999) argued that state debt is significant because of its effects on a country's economy, whether they are direct or indirect. Taking on public debt is a good way for governments to raise additional funds to invest in their economic growth in the short term.

First and foremost, state debt may have an impact on the conduct of monetary policy. Higher interest rates are more likely to occur in a country with a high level of government debt, and the monetary authorities may be under pressure to lower interest rates due to monetary policy. This strategy may have a short-term impact on interest rates, but the long-term impact will be an increase in nominal interest rates, inflation, and actual interest rates that remain unchanged. As a result of the rise

in these two indicators (i.e., interest rates and inflation), private investment will decline, resulting in a decline in Gross Domestic Product (GDP) and economic growth. Second, the state's debt may impact the political process by determining fiscal policy in the first instance. Some economists say that the possibility that the government will borrow money during the budgeting process weakens the budgetary discipline that is needed.

The latter is predicated on the assumption that if a government incurs additional costs unrelated to income tax, policymakers and the general public will be less concerned about whether or not these costs are justified. To add to the list of problems, when a country's economy is burdened with public debt, it becomes more vulnerable to a worldwide crisis of confidence. Due to its high level, increased state debt places pressure on the bank's balance sheet through various channels. For example, after financial institutions have increased their risk assets to a certain level, the cost of financing for the institutions in question rises. Suppose financial institutions hold a significant portion of the government debt of countries experiencing "economic stress," which is perceived to be risky. In that case, they may be required to pay higher interest rates and may have difficulty raising funds in all market circumstances. It's not certain that they will be forced to increase their capital and liquidity reserves, but it's possible.

In addition, all of these factors contribute to an increase in the cost of debt service, which is detrimental to economic growth. To summarize, financial institutions may experience capital outflows as well as asset replacements; according to Guraziu et al. (2012), as a result of all of the factors listed above, a high level of public debt has a negative impact on the country's international reputation, harms the business climate, and has a negative effect on investment and economic growth. In the context of Ghana's rising public debt, one of the most pressing issues in the country's capacity to comply with its obligations in the short and long term. When Ghana agreed to a three-year IMF Extended Credit Facility worth $918 million in 2015, the Fund's debt sustainability analysis determined that the country faced a "high risk of debt distress" due to its high level of government debt. For four years, the country's debt situation remained unchanged in any significant way. Following their latest debt sustainability analysis, which concluded that Ghana's external and overall debt distress risks remain elevated, the World Bank and the International Monetary Fund (IMF) have maintained Ghana's status as a high-risk debt distress country. However, the country's public debt level has exceeded the sustainability threshold.

Following the Fund's debt sustainability analysis, completed in October 2019, the country's medium-term debt path was high due to lower GDP growth, a higher fiscal deficit (primarily due to costs associated with the energy sector), and debt service over the medium term. Despite a significant improvement in solvency ratios due to the adjustment to current prices, the debt service ratios continue to fall short of their respective benchmarks, demonstrating the country's deep-seated financial vulnerabilities. Currently, Ghana is the only country in Sub-Saharan Africa classified as high risk of debt distress. The government is accruing a significant amount of debt that it may not be able to pay back.

According to the Bank of Ghana, Ghana's public debt is unsustainable. Analysis by the Central Bank indicates that the high proportion of foreign investors makes the country vulnerable to external shocks. Interestingly, the Economic Commission for Africa (ECA) came to the same conclusion as the International Monetary Fund and the World Bank when it included Ghana among 11 countries in the sub-region at high risk of debt distress, which was a surprising turn of events. As a high-debt troubled country, Ghana's ability to meet its debt obligations is the international community's grave concern, as evidenced by its designation as such. Currently, the country's total public debt stock has increased from GH336 billion in 2021 to GH344.8 billion as of January 2022. The government has allocated more than GH37.44 billion in the 2022 Budget to cover interest payments, while GH32 billion was used to pay interest in 2021.

Concerns have been raised that any further deterioration in the country's fiscal situation will have a negative impact on the country's debt dynamics, which will have profound implications for investors' confidence in the country's economic prospects. Apart from that, Ghana continues to be burdened by high financing costs in both the domestic and international markets due to interest rates in the global financial market remaining extremely sensitive to actions taken by the Bank of the United States (the Federal Reserve). It has had a significant impact on Ghana's fiscal management because the cost of servicing the country's rising public debt (amortization and interest payments) has increased significantly. As a result, over the 11 years ending in 2019, the cost of servicing the debt (amortization and interest payments) increased significantly, making Ghana one of the African countries with the highest debt service obligations and posing a severe challenge to fiscal management. Total debt servicing increased from GH1.1 billion (3.6 per cent of GDP) to GH107.6 billion (31.1 per cent of GDP) between 2008 and 2012, reaching a level equal to the country's total external debt at the time.

The majority of the amortization, amounting to GH13.5 billion (53.6 per cent), was completed during the 2017-2019 period. Interest payments on the government debt increased from GH6.5 billion in 2009-2012 to GH36 billion in 2013-2016, and then to GH39.9 billion in 2017-2019, representing a significant increase from previous years. Over eleven years ending in 2019, the Ghanaian government paid a total of GH82.5 billion in interest on the public debt (76.7 per cent of total debt servicing costs). Total debt servicing costs averaged 42.3 per cent of total tax revenue from 2009 to 2019. During this time, interest payments as a percentage of total tax revenue averaged 40.2 per cent. Thus, according to the World Bank, for every one cedi collected as tax revenue since 2009, 40.2 pesewas have been used to pay interest on the nation's debt. A further point to mention is that for every one cedi collected as to total revenue, 42.3 pesewas were used to service the national debt. According to

official figures, total interest payments on public debt exceeded total government capital expenditure for the sixth consecutive year in 2019. Suppose the government does not slow down the rate of borrowing. In that case, interest payments will almost certainly have to be financed by additional public debt or at the expense of other critical government expenditures.

The 2022 budget allocates over GH37.44 billion to pay interest on government debt, making it one of the essential items on the government's expenditure bill, even outspending the allocation for capital expenditure. Interest on government debt is one of the critical items on the government's expenditure bill, accounting for one-third of the total expenditure bill. There's also the issue of rising energy sector debts, for which the government declared a "state of emergency" in July 2019. Ghana's public debt profile and its associated servicing costs rise further as the country prepares for the crucial 2020 election cycle, marked by increased demand for improvements in living circumstances. The Minister of Finance stated that the 2019 Budget includes a provision for interest payments on loans and borrowings of GH18.6 billion. As projected in the 2020 Budget, interest payments totalled GH21.7 billion. According to the Minister, if the economy does not improve or grow to accommodate rising debt servicing costs, the debt-to-GDP ratio, which stood at 62.1 per cent in 2019, may suffer.

Another cause for concern is that foreigners hold a more significant portion of Ghana's public debt is another cause for concern. It poses severe risks to the country's balance of payments and external vulnerability. At the end of 2018, foreign investors held a total of 30 per cent of the country's domestic bonds, and they held a total of 64.9 per cent of the country's total public debt, according to the IMF. By March 2019, the situation had deteriorated to 67.2 per cent, making Ghana the country with the highest external holding of public debt in Africa, according to the World Bank. With more foreign investors, the government has had to deal with more market sentiment changes and currency exchange rate risks.

Ghana's freshly contracted state debt is also mainly non-concessional external foreign-currency debt, a significant source of concern. In this context, there is the possibility of capital flight if non-resident holders of the country's debt find other economies more attractive for investment than the one in which they are currently located. Furthermore, as foreigners hold a more significant proportion of Ghana's local bonds, the country has become more susceptible to investor confidence shifts and foreign exchange risks. As a result, the Ghanaian economy has become more vulnerable to the sentiments of foreign investors. If a panic situation arises that causes a capital flight, non-resident investors will sell off their holdings in the country.

Public debt is one of the most important macroeconomic indicators determining how a country is perceived in international markets. It is one of the factors that influence the flow of inward foreign direct investment. Furthermore, given that governments borrow primarily through the issuance of securities, the duration, interest rates, and overall cost of debt financing have significant implications for the economy, the future of businesses, and the provision of social services to current and future generations of citizens. According to Karazijien and Sabonien (2009), public borrowing is an unavoidable and morally reprehensible economic development. For economic growth, money from foreign investors (external debt) is injected into the economy, and assets (internal debt) are distributed among those who have more support than they can use and those who lack assets for developing economic initiatives and other needs. Numerous empirical studies have been conducted to determine the relationship between public debt and economic growth in developed and developing countries. However, the findings of these researchers are inconclusive on the relationship between public debt and economic development. (Pattillo et al., 2002; Pattillo et al., 2004, Kumar and Woo, 2010; Lici and Dika, 2016; and Irfan Alan, 2019) are a few examples.

Furthermore, the focus of these studies is on the relationship between public debt and economic growth in developing countries. In contrast, studies on determining the debt threshold level on economic growth are scarce in the region, as previously mentioned. The current debate over Ghana's public debt and its long-term viability served as the impetus for this paper. The study's goal is to figure out how much debt Ghana can handle and how that affects its economy.

2. LITERATURE REVIEW

2.1. Theoretical Review

There are several schools of thought on public debt: the Classical school views it as a burden on society; the Neoclassical school views it as detrimental to investment and growth; the Ricardian school views the state as a future tax debt (Barro, 1974); modern economists view public debt as a driver of economic growth if the funds are used productively, and the Conventional school believes in a frugal society. Because they thought that balancing the government's annual budget was a good thing on its own, classical economists came up with the idea that a budget deficit was a sign that the state couldn't keep its finances in order.

In the event of a recession, Keynes advocated increased government borrowing. Keynes observed that during a recession, firms cut back on investment while households cut back on spending. This results in an increase in private sector savings as well as an increase in unused resources. In this situation, government borrowing will not crowd out but instead inject money into the economy's circular flow and serve to "kickstart" economic activity. Government borrowing will aid in the recovery of the economy as well as provide an increase in tax revenues. Monetarists are harsher on government borrowing, claiming it is frequently due to political pressures rather than economic necessity. According to Milton Friedman, "There is nothing so

permanent as a temporary government program." Friedman said that government borrowing happens because of political interests that make governments spend more on programs like social security, farm subsidies, and healthcare.

2.2. Empirical Review

There are several studies on the impact of public debt on economic growth. These studies are inconclusive on the direction of the impact of public debt on economic growth. A few of these studies that are on the impact of debt threshold levels are (Chudik et al., 2017; Alam, 2019; and Awadzie, 2020).

Egbe and Aganyi (2014) analysed the impact of external debt on economic growth in Nigeria. The study used the Vector Auto–Regression (VAR) model to test whether or not external debt, the ratio of external debt to exports, and other economic control variables such as inflation, real exchange rate, and public investment stimulate economic growth proxied by gross domestic product (GDP) growth rate. The result indicates that there is a causation between external debt and economic growth in the Nigerian contest. External debt could not be used to forecast improvement or slowdown in economic growth in Nigeria. Mohanty (2017) evaluates the impact of external debt on economic growth in Ethiopia for the period 1981 to 2014. The study employed time-series data, and the result suggests the existence of a long-run relationship between external debt and economic growth in Ethiopia. The results show that Ethiopia's economy grows better when it has more money from outside sources.

Mumba and Hong Li (2020) examined the association between external debt and economic growth in nine Southern African nations from 2000 to 2018. They utilized a panel model to examine the relationship between external debt and economic growth. The empirical evidence shows that short-term external debt has a negative effect on economic growth over the long run, just like it does in the short run. Long-term external debt has a negative effect on economic growth in the short run and a negative significant effect on growth over the long run, which means that the funds gained from external sources are not used for economic activities like investment, capital formation, or technology.

Getinet and Erumo (2020) use the ARDL approach to examine the effects of public foreign debt on economic growth in Ethiopia, utilizing annual data from 1983 to 2018. The yearly GDP growth rate is a dependent variable in the model. Other macroeconomic variables such as trade openness (TRD), rate of inflation (INFL), and public expenditure to GDP ratio (NEXPGD) are explanatory variables, as are debt variables such as public external debt stock to GDP (PEDSGD), debt service stock to GDP (DSSGD), and debt service stock to export (DSSEXP). For long-run co-integration, bound testing was used, and ECM was used for short-run dynamics. The findings of this study revealed that the debt variables PEDSGD and DSSGD are major debt factors that have a negative long-term and short-term influence on Ethiopia's economic growth. Economic growth is hurt by another debt variable, DSSEXP. This one is only looked at in the short term.

On the other hand, Alam (2019) investigates the relationship between the debt threshold and GDP per capita growth by using Panel Threshold Regression. The study used G7 (advanced countries) from the period of 1995 to 2015. The results suggest that the scale of the debt threshold is ambiguous in this study because the debt threshold has no significant effect on GDP per capita growth at the threshold level of 62.47%. The magnitude of the debt effect is not the same below and above the threshold level. Awadzie (2020) investigates the relationship between debt and financial performance. The study employed the Panel Threshold Regression model introduced by Hansen (1999). The study used panel data covering a period of fifteen years from 2005 to 2019 for twenty-five listed companies on the Ghana Stock Exchange. Financial performance was measured by the return on assets. The study finds the threshold level of debt at 43.85%. The result of the study, however, indicates that the debt threshold level is positive in both low and high debt regimes, but the degree of debt impact on both regimes is not comparable. It has also been indicated that debt has a significant potential impact on financial performance in low debt regimes and a slightly lower impact in high debt regimes. The findings further suggest that more debts have been contracted by companies in low debt regimes than in high debt regimes.

3. DATA AND METHODOLOGY

This study's methodology is based on the threshold autoregressive (TAR) approach proposed by Tong (1983) and Hansen (1996). In this model, the dependent variable is a function of its lag. In the self-exciting threshold model, the lag dependent variable is used as the threshold variable. This model specifies that individual observations can fall into discrete classes based on the value of an observed (threshold) variable. In growth theory, the primary sources of growth power lie in accumulating production and promoting marginal and total factor productivity. The threshold level of inflation is based on the following equation:

$$Y_t = \beta_1' \times_t h(qt \geq y) + \beta_2' \times_t h(y < qt < y) + \varepsilon_t \tag{1}$$

Where γ_t is the dependent variable, $\times_t$ is a vector of covariates with dimensions 1 x k possibly containing lagged values of γ_t, β_1' is a k x 1 vector of regime-invariant parameters, ε_t is an iid error with mean 0 and variance σ^2, h is a vector of exogenous variables with regime-specific coefficient vectors β_1' and β_2', and q_t is a threshold variable that may also be one of the variables in $\times_t$. Regime 1 is defined as the subset of observations in which the value of being q_t less than the threshold γ. Similarly, Regime 2 is defined as the subset of observations in which the value of q_t is greater than γ.

$$\gamma_t = \beta'_1 \times_t h + \varepsilon_t \qquad \text{if } q_t \leq \gamma \tag{2}$$

$$\gamma_t = \beta'_2 \times_t h + \varepsilon_t \qquad \text{if } q_t > \gamma \tag{3}$$

Where q_t signifies the threshold variable, dividing all the observed values into two groups or "regimes". Term γ_t signifies the variable to be explained, whereas ε_t is a matrix that denotes the explanatory variable. The error term ε_t is white-noise iid, and γ represents the threshold value, which is unknown but can be estimated. The model implies that when the threshold variable is smaller than the threshold parameter, the regression Equation (2) is applicable. Let $h_t(\gamma) = \{qt \leq \gamma\}$, and $\{.\}$ as an indicator function with $h =1$ if $q_t \leq \gamma$ occurs, or $h = 0$ otherwise. In addition, when $\times_t (\gamma) = \times_t h_t(\gamma)$, the equations (2) and (3) are revised as follows:

$$\gamma_t = \theta'x_t + \rho' x_t(\gamma) + e_{t,}e_t \sim iid(0,\sigma_t^2). \tag{4}$$

Therein, $\theta = \theta_2, \rho = \theta_1 - \theta_2, e_t = [e_{1t}\ e_{2t}]'\ \theta, \rho,$ and γ are the parameters to be estimated. Equation (4) allows all the regression coefficients to differ between sample groups. The resulting sum of squared error as a result of estimating these parameters $\theta, \rho,$ and γ can be expressed as follows:

$$S_1(\gamma) = \hat{e}(\gamma)'\ \hat{e}(\gamma) \tag{5}$$

The least-squares method for estimating γ was introduced by Hansen (1996). This can be achieved by minimizing the sum of squared errors in (5). The estimated threshold value is given as:

$$\hat{\gamma} = \text{argmin } S_1(\gamma) \tag{6}$$

And the variance of the residual is expressed as:

$$\hat{\sigma}^2 = \frac{1}{n}\ \hat{e}_t(\gamma)'\ \hat{e}_t(\gamma) = \frac{1}{n}s_1(\hat{\gamma}) \tag{7}$$

Once $\hat{\gamma}$ is obtained, the vector of parameter estimates is $\theta = \theta\ (\hat{\gamma})$ and $\hat{\rho} = \hat{\rho}\ (\hat{\gamma})$. The regression equation for a two-regime TAR model can be expressed as:

GDPPC $_{t=}$ β_{10} + β_{11} PDGDP. + β_{12} INFRATE + β_{13} TIGDP + β_{14} GEGDP. + ε_t if $\leq \gamma$ \qquad\qquad (8)

GDPPC $_{t=}$ β_{20} + β_{21} PDGDP. + β_{22} INFRATE + β_{23} TIGDP + β_{24} GEGDP. + ε_t if $\leq \gamma$ \qquad\qquad (9)

In assessing the model above, the threshold value is determined by obtaining the threshold value that limits the entirety of the squared error given by Equation (5). Since this paper aims to examine the inflationary threshold impacts on the connection between valuation and capital market performance, the quarterly growth rate of inflation is utilized as the core threshold variable in the examination. We have to test for the threshold impacts before applying the two-regime Threshold Autoregression (TAR) model. In this situation, it is undifferentiated from testing the null hypothesis of the linear model against the alternative view of the two-regime model for the Equation. Standard techniques for theory testing can't be applied in light of the trouble with the threshold boundary γ being unidentified under the null hypothesis. For this situation, the necessary appropriation of a vast example isn't dispersed by Chi-square dissemination.

Hansen (2000) proposed an answer to this issue and recommended that necessary tests be led using a Lagrange Multiplier (*LM*) bootstrap technique. For γ isn't distinguished under the invalid speculation of the no-threshold impact, a fixed bootstrap technique registers the p-values. To analyze by testing whether the coefficients in the two regimes are equivalent or not, the null hypothesis of no threshold impact to Equation is.

$$H_0 = \beta_{1i} = \beta_{2i}i = 0 \ldots\ldots \tag{10}$$

Let S_0 and S_1 be the residual sum of squares under the null hypothesis and alternative of (9). As such, the *F*-test is based on:

$$F_1 = \frac{S_0 - S_1(\gamma)}{\hat{\sigma}^2} \tag{11}$$

Once the threshold effect exists, the next question is whether or not the threshold value can be known. The null hypothesis of the threshold value is $H_0: \gamma = \gamma_0$ and the likelihood ratio statistics are:

$$LR_1(\gamma) = \frac{s_1(\gamma) - s_1(\gamma)}{\hat{\sigma}^2} \tag{12}$$

Where $S_1(\gamma)$ and $S_1(\gamma)$ are the residual sums of squares from Equation (7) given the actual and estimated value, respectively. The asymptotic distribution of $LR_1(\gamma_0)$ can be used to form a valid asymptotic confidence interval about the estimated threshold values. The statistics of $LR_1(\gamma_0)$ are generally not distributed, and Hansen（2000）computed their no-rejection region, $c(\alpha), \alpha$ is a given asymptotic level. That is if $LR_1(\gamma_0) \leq c(\alpha)$, where $c(\alpha) = -2\ln(1 - \sqrt{1-a})$, the null hypothesis of $H_0: \gamma = \gamma_0$ cannot be rejected. Aside from testing the existence of one threshold value, to further investigate whether there are two or more threshold values that exist, we first employ the F_1 test to assess the null hypothesis of no threshold. If this

null hypothesis is rejected, then at least one threshold value is ensured. We next proceed to test the null of one threshold against the two thresholds. We assume a known estimated $\hat{\gamma}_1$ and proceed to search the second threshold, γ_2. In this case, we obtain the following:

$$S_2^r(\gamma_2) = S(\hat{\gamma}_1, \gamma_2) \quad if \ \hat{\gamma}_1 < \gamma_2 \tag{13}$$

$$S(\gamma_2, \hat{\gamma}_1) \quad if \ \gamma_2 < \hat{\gamma}_1$$

The threshold value, the null hypothesis, and the F-test is respectively stated as follows:

$$\hat{\gamma}_2^r = \text{argmin} \ S_2^r(\gamma_2), \tag{14}$$

$$H_0 = \text{only one threshold} \tag{15}$$

$$F_2 = \frac{S_1(\hat{\gamma}_1) - S_2^r(\hat{\gamma}_2^r)}{\hat{\sigma}_2^2} \tag{16}$$

Where $S_1(\hat{\gamma}_1)$ is referred to as the sum of squared errors acquired from the previous threshold estimation. The residual variance is given as follows:

$$\hat{\sigma}_2^2 = \frac{1}{T} S_2^r(\hat{\gamma}_2^r) \tag{17}$$

The significance F_2 implies the rejection of the null of one threshold and two thresholds is expected. If the two thresholds cannot be rejected, then the confidence interval for two points (γ_1, γ_2) can be constructed in the same way. The procedures are carried out until the null in (17) can no longer be rejected.

4. FINDINGS AND DISCUSSIONS

This section focuses on the empirical estimation, presentation and economic interpretation of the regression results carried out using the methodology highlighted in the previous section.

4.1. Empirical Results

Table 1 presents a summary of the statistics for the variables that were used in the research paper. From 1990 to 2020, Ghana's average inflation rate was approximately 6.42 per cent, whereas the country's maximum and minimum inflation rates were 9.73 per cent and -0.46 per cent, respectively, during the same period. Ghana's average GDP growth over the same period was approximately 1.74 per cent, with a maximum of 6.13 per cent and a minimum of –6.13 per cent at various points in history.

Table 1: Descriptive Statistics

	GDPPC	PDGDP	INFRATE	TIGDP	GCGDP
Mean	1.737178	-4.680262	6.417439	8.089632	3.925201
Median	2.576422	-4.730551	7.878682	8.286252	3.892840
Maximum	6.130813	-2.409566	9.730751	10.38559	5.348060
Minimum	-6.151633	-6.924473	-0.460449	4.850936	3.167161
Std. Dev.	2.885501	0.969509	3.071229	1.394657	0.509607
Observations	117	117	117	117	117

The correlation matrix between the variables is shown in Table 2. The correlation coefficients for all of the explanatory variables range from -0.134 to 0.396, which is acceptable in order to avoid multicollinearity in the base regression model.

Table 2: Correlation Matrix

	GDPPC	PDGDP	INFRATE	TIGDP	GCGPD
GDPPC	1.000000				
PDGDP	0.231616	1.000000			
INFRATE	-0.551122	0.052602	1.000000		
TIGDP	-0.134096	-0.364883	-0.072072	1.000000	
GCGPD	0.232894	0.396211	-0.081464	-0.285789	1.000000

4.2. Test Statistics for Existence of Threshold Effects

Table 3 shows the threshold effects test results using the yearly public debt to GDP as the threshold variable. To correct the standard errors of the estimates, 1,000 bootstrap replications are used to produce the findings of the threshold test and asymptotic p-values in the endogenous threshold analysis.

The study first determines whether or not a threshold effect exists. F_1 statistics have a value of 13.23 per cent and a bootstrap p-value of 0.023. As a result, the F1 test strongly rejects the null hypothesis that there is no threshold at the 5% significant level, implying that there is at least one threshold. According to this variable, the projected ideal threshold value is 57.09 per cent, which separates the study's sample into two regimes (low public debt and high public debt regimes).

Table 3: Summary of Test Results of Debt Threshold Effect

| Hypothesis Test	F-Test	Bootstrap P-Value	Estimated Threshold (%)	95% Confidence Interval
Null of no Threshold	13.23**	0.033	57.09%	[55.76%, 57.09%]
Null of one Threshold	1.79	0.989		

Notes: The estimation period is 1990 to 2020. The threshold variable is denoted as PDGDP. The thresholds are obtained by the minimum sum of the squared residual. The F test is calculated based on (15). "**" is significant for 5%.

The F test is also used in the study to see if there is the potential for more than one threshold. The split results in insignificant bootstrap p-values of 0.989 (i.e., the null hypothesis of one threshold cannot be rejected). As a result of the test technique, there is just one threshold, which is 57.09 per cent, and two public debt regimes in Ghana's debt-growth relationship. As a comparison, Alam's (2019) study shows that there is a structural break in the data.

The estimated threshold value is quite different from the panel data studies when using time series data and an endogenous TAR model. However, there is an underlying assumption in these panel studies that for all nations in the sample, there is a unique and single structural break in the link between inflation and economic growth beyond which inflation becomes deleterious to economic growth (Munir & Mansur, 2009). Sepehri and Moshiri (2004, p. 192) believe that imposing a single "inverted U" connection across countries at different stages of development and with distinct institutions and social norms is inappropriate. Once the paper finds the threshold, the next step is to figure out what exactly it is. The confidence interval around the threshold estimate is examined using the LR test. The asymptotic confidence interval of 95 per cent [55.76%, 57.09%].

The normalized likelihood ratio sequence LR^*_n (γ) statistics as a function of the PDGDP threshold are shown in Figure 1. The least-squares estimate of the threshold (γ) is the number that minimizes the function LR^*_n (γ) and occurs at (γ̂)= 57.090 per cent, as previously stated. The dotted line depicts the asymptotic 95 per cent critical value of 9.25 (which is significant at 5 per cent levels) and the confidence interval [55.76 per cent, 57.09 per cent] where it crosses LR^*_n (γ). This indicates that the threshold estimates are extremely accurate. As a result, there is substantial evidence to support one of the model's thresholds. These findings show that a two-regime specification is quite likely. As a result, the findings show that Ghana has a PDGDP threshold, which means that the data can be broken up into two different regimes.

Figure 1: First Sample Split: Confidence Interval Constructions for Threshold
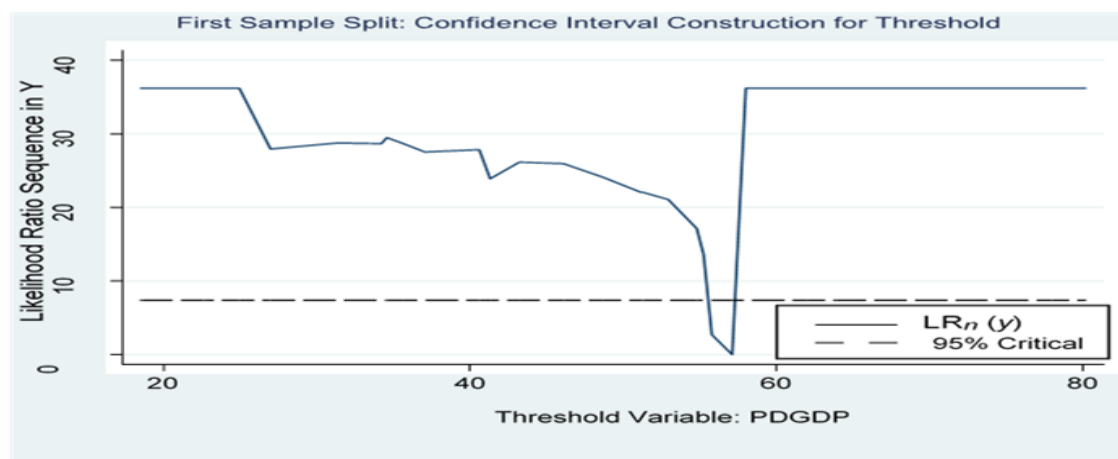
4.3. The Relationship between Inflation and Economic Growth

Table 4 provides the estimation results of the relationship between public debt to GDP (PDGDP) and GDP per capita (i.e., GDP per capita growth) for Ghana from 1990 to 2020. For comparison purposes, the second column presents estimates for linear regression equation (2) that ignore the threshold effect. Columns (3) and (4) provide estimates of the two-regime TAR model. The empirical results obtained from the estimation of the linear model show that public debt to GDP (PDGDP) has no significant negative impact on GDP per capita growth. Under a low public debt regime, defined below 57.09 per cent, public debt has a significant positive impact on economic growth, where the significant coefficient is 0.674. Column (3) illustrates that, on average, a 1 per cent increase in public debt in Ghana leads to an increase in economic growth (GDPPC) by 0.67 per cent. However, in column (4), when public debt is higher than the threshold level of 57.09 per cent, public debt has a significant negative effect on economic growth, as the coefficient is –0.048. suggesting that, on average, a 1 per cent increase in public debt leads to a decline in the economic growth of 0.048 per cent.

This study's findings on the nonlinear relationship between public debt to GDP (PDGDP) and economic growth are consistent with the empirical and theoretical conclusions reached in previous studies by Sarels (1996), Bose (2002), Lee and Wong (2005), and Munir et al. (2009); that is, inflation has a negative effect on economic growth in a high-inflation regime (i.e., when inflation is high). Furthermore, in this study, both the linear model and the TAR model demonstrate that the calculated coefficients of public debt have a negative and statistically significant association with GDPPC (GDP per capita growth). Total investment in GDP (TIGDP) has a positive and insignificant influence on economic growth in the linear model and low public debt regimes, but it has a negative and significant effect on economic growth in the high public debt regime. Finally, according to the findings, the ratio of government expenditure to GDP has a statistically significant negative and positive effect on economic growth in both low and high public debt regimes. While in a linear model, the ratio of government expenditure to GDP has a positive but insignificant effect on economic growth.

Table 4: Regression Results of Public Debt and GDPPC (1990–2020)

Variables	Linear Model (OLS without Threshold)	Threshold Model	
		Regime 1 ≤ 57.090%	regime 2 > 57.090%
Constant	4.389**	5.079**	17.422**
	(1.954)	(1.903)	(3.293)
PDGDP	0.069	0.674**	-0.048**
	(0.306)	(0.251)	(1.074)
INFRATE	-0.534**	-0.706**	-0.181**
	(0.146)	(0.167)	(0.049)
TIGDP	0.185	0.384	-3.680**
	(0.319)	(0.338)	(0.623)
GEGDP	0.138	-1.463**	0.571*
	(0.495)	(0.478)	(0.290)
Observation	31	19	7
R^2	0.332	0.535	0.929

NOTES: The dependent variable is gross domestic product per capita from 1990 to 2020. Standard errors in parentheses are White corrected for heteroscedasticity. The estimation results correspond to a trimming percentage of 15 per cent. ***, **, and * represent significant at 1 per cent and 5 per cent and 10 per cent levels, respectively.

5. CONCLUSION AND IMPLICATIONS

Using new econometric approaches that provide appropriate procedures for estimation and inference, this research re-examines the topic of the existence of threshold effects in the relationship between public debt and economic growth. Estimates were made using annual data for the thirty-one-year period between 1990 and 2020. Empirical findings strongly show that there is a point beyond which public debt has a detrimental impact on economic growth. This means that the relationship between public debt and economic growth in Ghana is non-linear. The estimated results suggest that when public debt is below 57.09 per cent, it can encourage economic growth. Again, when public debt exceeds the threshold level of 57.09 per cent, it is harmful to economic growth.

Finally, the policy implication gained from this analysis is that keeping public debt below the threshold level in Ghana is desirable, as it may aid in ensuring sustainable growth. The structural break technique is used in this study to illustrate that the influence of public debt on economic growth is not just negative in a high-public debt regime, but can also be positive and more significant in a low-public debt regime. As a result, by focusing monetary policy on keeping public debt at a low level, a

significant rise in growth can be accomplished. Ghana's economy may be able to rebound and take off more quickly if the country's public debt is kept low and stable. In addition, given the current state of the Ghanaian economy, the findings of this research are critical for policymakers and other stakeholders involved in economic decision-making. In this situation, as the study's findings indicate, public debt levels above 57.09 per cent may have a negative impact on economic growth. To sustain Ghana's debt, this paper strongly recommends the following:

The government of Ghana should stop compiling the external debt, which comes with an additional cost when there is a disparity in the currency.

The policymakers who matter in decision making should strongly check the escalating cedis.

The government should cut down on all unproductive expenditures.

The government should use its external debt wisely and maintain a proper and efficient debt management policy.

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