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COMPARATIVE ANALYSIS OF TREASURY BILL INSTRUMENT ON ECONOMIC GROWTH IN NIGERIA AND GHANA

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Abstract

This study delved into the intricate relationship between treasury bills and economic growth in two Key West African nations of Nigeria, and Ghana over the period from 1981 to 2023 The research adopts a comprehensive comparative approach, employing a suite of advanced econometric techniques of Augmented Dickey Fuller (ADF) Unit root test, Philip Perron (PP) unit root test to ascertain the Stationarity of data used to analyze the dynamics of Treasury bill and its effects on economic performance. Furthermore, the study leveraged the Autoregressive Distributive Lag (ARDL) model, to capture both short-term and long-term relationships between the variables. The primary focus of the study is to determine the effect of Treasury Bills variables, alongside employment (LAB) and gross government fixed capital formation (GFCF) as explanatory and control variables, with Real Gross Domestic Product (RGDP) serving as the dependent variable and proxy for growth. The analysis reveals a nuanced relationship between treasury bills and economic growth, with treasury bills instruments generally exerting a positive influence on economic growth in the short term. However, the findings also indicate that excessive levels of treasury bills can act as a drag on long-term growth, underlining the importance of prudent debt management. Country-specific insights further enrich the study's findings. In Nigeria, Treasury Bills are shown to have a significant and positive impact on economic growth, reflecting the country's reliance on short-term financing. Conversely, in Ghana, the study identifies a negative impact of Treasury Bills, cautioning against over-reliance on these instruments. Treasury Bonds emerge as a crucial driver of growth in Ghana.

Keywords: Treasury Bills, Economic Growth, Comparative analysis, Nigeria

1. Introduction

Government borrowing is a crucial fiscal tool that enables countries to finance public expenditure when revenues fall short. Over centuries, this practice has evolved into a cornerstone of modern economic management. Governments borrow to address various fiscal needs, including financing infrastructure projects, stabilizing economies during downturns, and responding to financial crises. The theoretical foundation for such borrowing stems from neo-classical growth models, which posit that borrowing can help capital-scarce nations accelerate development. These models suggest that borrowing increases capital accumulation, enhances output per capita, and stimulates economic growth, particularly when used for productive investments.

Broadly, government borrowing is categorized into external and domestic debt. External borrowing involves securing funds from international entities such as the International Monetary Fund (IMF) and the World Bank, often in foreign currencies. This exposes borrowers to exchange rate risks. Domestic borrowing, on the other hand, is conducted within national borders

and involves the issuance of instruments such as Treasury Bills, Certificates, and Bonds. While domestic borrowing offers certain advantages, including avoiding exchange rate exposure, it also raises concerns about sustainability and long-term economic impacts, particularly in developing regions like West Africa.

Treasury Bills, as short-term debt instruments, play a vital role in government financing strategies. Their prominence is particularly evident in Nigeria and Ghana, two of West Africa's largest economies. However, the extensive reliance on Treasury Bills in these countries highlights the dual-edged nature of domestic borrowing. In both nations, growing domestic debt levels have sparked debates about their implications for economic growth and fiscal sustainability.

The challenges posed by rising domestic debt are stark. In Nigeria, the domestic debt stock surged from ₦21.75 trillion (US$53.10 billion) in 2021 to ₦54.13 trillion (US$70.26 billion) by 2023. Similarly, Ghana's domestic debt rose from GHC 66.7 billion in 2017 to GHC 246.79 billion (US$22.40 billion) by 2023, making up 43.3% of its total public debt. These figures underscore the growing fiscal pressures in both countries, where debt servicing costs now consume significant portions of government revenue. For instance, Nigeria's debt-to-GDP ratio exceeds 50%, with servicing costs surpassing 70% of revenue, while Ghana's ratio is over 60%, with debt servicing consuming more than 50% of revenue. These fiscal pressures are compounded by the mixed impacts of Treasury Bills on economic growth. In Nigeria, Treasury Bills have shown positive short- and long-term effects, reflecting their strategic use to finance fiscal deficits and stimulate economic activity. In contrast, Ghana faces a more complex scenario, where Treasury Bills have had a negative long-term impact, likely due to over-reliance on these instruments, which crowds out private sector investment and strains fiscal sustainability.

Efforts to address these challenges are evident in both countries. Nigeria established its Debt Management Office (DMO) in 2020 to coordinate public debt strategies, while the Bureau of Public Enterprises (BPE) was launched in 2023 to support deficit financing through privatization proceeds. Ghana's initiatives include the Domestic Debt Exchange (DDE) program, which aims to reduce interest payments by USD 1.2 billion between 2023 and 2028, and the Medium-Term Debt Management Strategy (2023–2026). These measures reflect ongoing efforts to improve fiscal discipline and manage domestic debt sustainably.

Despite these reforms, achieving sustainable domestic debt management remains elusive. The ideal scenario characterized by debt-to-GDP ratios below 40% and debt servicing costs not exceeding 10% of revenue remains out of reach for both countries. This underscores the need for more targeted strategies that balance short-term fiscal needs with long-term growth imperatives. This study explores the relationship between Treasury Bills and economic growth in Nigeria and Ghana, using advanced econometric techniques, including the Autoregressive Distributed Lag (ARDL) model. By examining the impact of Treasury Bills alongside employment (LAB) and gross fixed capital formation (GFCF) on real gross domestic product (RGDP), the research provides a comprehensive understanding of how these instruments influence growth dynamics.

One of the study's key contributions is its comparative perspective. Limited research exists on the differential impacts of domestic debt instruments on economic growth across West African countries. By addressing this gap, the study offers valuable insights into the effectiveness of domestic debt management in promoting sustainable development. The findings emphasize the need for context-specific debt management strategies. While Nigeria can leverage Treasury Bills to address short-term fiscal challenges effectively, Ghana's experience underscores the risks of over-reliance on these instruments and the advantages of prioritizing longer-term debt options like Treasury Bonds. Policymakers in both countries must align their debt management strategies with their unique economic structures and growth objectives to harness the benefits

of domestic borrowing while mitigating its risks. In conclusion, this study highlights the pivotal role of Treasury Bills in shaping economic outcomes in Nigeria and Ghana. By providing a nuanced understanding of the nexus between Treasury Bills and economic growth, it offers actionable recommendations for policymakers seeking to optimize debt management strategies in West Africa.

2. Literature Review

2.1 Conceptual Clarifications

Treasury bill

Treasury bill, according to the World Bank (2015), is the sum of all domestic and foreign obligations of the public sector, including central government and its agencies, sub-national governments, and public enterprises. Edira and Arjeta (2020) define treasury bills as the total government borrowing from either the private sector within the nation or from abroad. It represents the total amount that the government borrows to finance its budget deficit, which usually reflects a gap between government expenditures and revenues. Putanoi and Mutuku (2018) describe treasury bills as an economic management tool, particularly useful for bridging the domestic savings gap when government revenues from domestic sources are insufficient. (Babu, Kiprop, & Gisore, 2015).

These definitions underscore the multifaceted nature of Treasury Bills and its critical role in managing a country's economy. Properly managed Treasury Bills can provide the resources needed for economic growth, but if mismanaged, it can lead to significant economic challenges. In Nigeria, treasury bills have grown significantly over the past decade, driven by persistent budget deficits and a need to finance critical infrastructure projects. According to Ngreebo (2014), Nigeria’s Treasury bill debt has been on a continuous upward trajectory, contributing to a decline in the total output of goods and services. This trend has raised concerns about the sustainability of Nigeria’s debt levels, particularly as the debt-to-GDP ratio has increased from 23.41% in 2016 to 38.05% in 2022 (IMF and World Bank Debt Sustainability Analysis Reports, 2022). Ghana has also experienced a significant increase in domestic treasury bills over recent years. The country's debt-to-GDP ratio has risen from 57.09% in 2017 to 88.8% in 2022, placing it at high risk of debt distress (IMF & World Bank, 2022).

Economic Growth

Economic growth is a fundamental concept in economics. It is defined as the increase in the real per capita income of a country over time. It is typically measured by the rise in the quantity of goods and services produced within a country during a specific period (Jhingan, 2010). According to Adofu and Wada (2021), economic growth is characterized by a sustained increase in the levels of goods and services produced to meet the economic needs of the population. This growth is measured in monetary terms, focusing on increases in both real and nominal economic variables over successive periods. However, it does not consider other aspects of capital development beyond monetary growth. Economic growth is a critical determinant of long-term prosperity and development. It fosters job creation, reduces poverty, and improves living standards (Adofu & Alhassan, 2018). Audu (2018) describes economic growth as the positive and sustained increase in the aggregate production of goods and services within an economy over a given period.

2.2 Theoretical Framework:

Endogenous Growth Theory

Endogenous growth theory, often referred to as "Modern Growth Theory," serves as a vital lens through which the relationship between Treasury Bills and economic growth can be analyzed, particularly in the context of Nigeria and Ghana. The theory attributes long-term economic growth to internal factors such as investment in human capital, innovation, and infrastructure, rather than external influences like foreign technological transfers. This aligns closely with the study's focus on domestic debt instruments, especially Treasury Bills, as internal mechanisms influencing economic outcomes.

Treasury Bills play a pivotal role in financing government expenditures that support investments in education, skills development, and labor productivity, which are key tenets of endogenous growth theory. For instance, revenues generated from the issuance of Treasury Bills can fund education and health systems, enhancing human capital, a critical driver of productivity and sustained economic growth. In Nigeria and Ghana, these investments could create a more productive labor force, thereby contributing to GDP growth. The utilization of Treasury Bills as a short-term debt instrument provides governments with immediate funds to invest in research, technological innovation, and infrastructure development. According to endogenous growth theory, these investments generate increasing returns and spill-over effects that benefit the broader economy. For example, well-managed Treasury Bill financing can fund infrastructure projects such as roads, power, and digital connectivity, which are fundamental to long-term growth in both countries.

Endogenous growth theory highlights the importance of fostering an enabling environment for private sector investment. This study evaluates whether Treasury Bills in Nigeria and Ghana crowd out private investments or complement them by creating opportunities for innovation and expansion. In Nigeria, the positive long-term impact of Treasury Bills suggests a crowding-in effect, where public borrowing supports broader economic activity. Conversely, in Ghana, the negative impact in the long term may reflect crowding-out dynamics, where excessive reliance on Treasury Bills undermines private sector growth and investment. Endogenous growth theory underscores the critical role of government policy in shaping the trajectory of economic growth. This aligns with the study's emphasis on the differential impacts of Treasury Bills, which reflect variations in fiscal and debt management strategies. For instance, Nigeria's strategic use of Treasury Bills to finance fiscal deficits without excessive reliance aligns with the theory's assertion that targeted policies can foster sustained growth. In contrast, Ghana's challenges with managing Treasury Bills demonstrate how suboptimal policies can lead to fiscal strain, undermining growth prospects.

Endogenous growth theory provides a foundation for understanding why Treasury Bills have a dual impact on economic growth. In the short term, they offer governments immediate resources to address pressing fiscal needs, fostering economic stability and growth. However, the theory also explains how prolonged reliance on short-term instruments without corresponding investments in productive sectors can lead to diminishing returns, as observed in Ghana. By emphasizing the role of internal factors, endogenous growth theory offers a relevant framework for analyzing domestic debt instruments like Treasury Bills. It shifts the focus from external borrowing to how these instruments can be optimized to stimulate innovation, human capital development, and infrastructure in Nigeria and Ghana. The theory's emphasis on government intervention aligns with the study's recommendations for context-specific debt management strategies. Policymakers in Nigeria and Ghana can leverage insights from endogenous growth theory to design frameworks that maximize the benefits of Treasury Bills while minimizing risks such as fiscal instability or crowding-out effects.

Endogenous growth theory provides a robust theoretical foundation for this study by elucidating how internal mechanisms, including Treasury Bills, contribute to economic growth. By linking the issuance and management of Treasury Bills to investments in human capital, innovation, and infrastructure, the theory offers a nuanced understanding of the short- and long-term impacts of these instruments. Furthermore, it underscores the critical role of government policy in fostering an environment conducive to sustainable growth, making it a valuable framework for analyzing the economic trajectories of Nigeria and Ghana.

2.3. Empirical Reviews

The nexus between public debt and economic growth has been the subject of several empirical studies that tend to agree on the fact that, debt below certain

threshold can promote economic growth, while, debt well above threshold could retards growth. Empirical studies examining the debt growth nexus have utilized Gross Domestic Product (GDP), Real Gross Domestic Product (RGDP) growth, Gross National Product (GNP), and GDP per capita growth in order to measure growth.

Akinlo (2012), Boateng (2017), and Diop (2019), who found significant but context-dependent impact of domestic debt on economic growth,. These studies employed different metrics for economic growth, such as Gross Domestic Product (GDP) and Real GDP growth, revealing varied results across countries. The study utilized various metrics for economic growth, including Gross Domestic Product (GDP) and Real GDP (RGDP) growth, with a focus on context-dependent outcomes in different countries.

Boateng (2017) explore the relationship between domestic debt and economic growth in the context of developing economies, particularly in Africa. The study employed econometric modelling to analyze the impact of domestic debt on economic growth, using GDP growth as the primary measure of economic performance. In the works of Diop, (2019), the main objective: is to examine the relationship between domestic debt and economic growth, particularly in the context of African countries. Econometric models were used, with GDP and Real GDP growth as dependent variables to assess the effects of domestic debt on growth.

Udoh, et al. (2020), investigates the impact of inter-generational debt burden on Nigeria's economic growth, focusing on debt overhang and the allocation of borrowed funds. .There study utilized ARDL (Autoregressive Distributed Lag) modelling, using quarterly data from 2006 to 2018. The study aimed to explore how debt misallocation (such as spending on non-productive areas like salaries) negatively affected growth. The Autoregressive Distributed Lag (ARDL) used in their study is for examining inter-generational debt burden. Their findings indicate that debt overhang and misallocation of borrowed funds (e.g., for salaries) have negatively impacted growth.

Ayyoub, Charity, and Yaqub (2012). The objective of their study is to assess the impact of public debt on overall GDP, the manufacturing sector's growth, and the unemployment situation in Pakistan. Techniques Used in their study included, Ordinary Least Squares (OLS) regression analysis was used to examine the relationship between public debt and various economic indicators for the period 1989-90 to 2009-10. The study applied Ordinary Least Squares (OLS) to investigate debt's impact on GDP, manufacturing, and unemployment. Didia and Ayokunle (2020). Their study objective is to differentiate between the effects of external and domestic debt on Nigeria's economic growth and to explore their long-run impacts. And the techniques used include the Vector Error Correction Model (VECM), with data spanning from 1980 to 2016 to analyze the long-term impact of both external and domestic debt. The Vector Error Correction Model (VECM) employed in this study is to differentiate between external and domestic debt effects. They found that domestic debt positively affected Nigeria's economic growth in the long run, while external debt had a negative impact, albeit not statistically significant.

Bhimjee and Leao (2020) study explores the linear and non-linear effects of public debt on GDP within the Euro Area countries. A polynomial regression of order two (quadratic specification) was used to model the relationship between public debt and GDP, utilizing data from 19 countries in the Euro Area (1995–2016).The Polynomial Regression (Quadratic Specification) Applied was for analyzing debt effects within Euro Area countries. AQDV. The study concludes that a majority of the member states' public debt and GDP trajectories are in compliance with the existence of underlying country-specific sovereign debt laffer curves in the Euro Area. However, the findings suggest the existence of country- specific thresholds (as opposed to a universal threshold valid for all countries). The majority of countries in the sample have debt threshold levels between 50 and 105 percent of GDP

(except Estonia and Latvia), while the Euro Area average threshold is found to be 79 percent.

Alshammary, et al. (2020.) There study explored the debt-to-GDP threshold effect in 20 Middle and North African countries, investigating the positive and negative impacts of debt on economic growth at different debt-to-GDP levels. A fixed effect threshold regression approach was applied to analyze the impact of debt on economic growth, focusing on the threshold levels of debt-to-GDP. The Threshold Regression Models used in the study is to explore debt-to-GDP thresholds. Pham, Mai, and Nguyen (2020), the study test the debt-growth thresholds in 13 Asian countries, particularly how public debt affects GDP beyond certain threshold levels. Data from the World Bank was analyzed, with a focus on identifying threshold levels using econometric analysis techniques.

Putanoi and Mutuku (2013) study examines the impact of domestic debt expansion on economic growth in Kenya and to recommend sustainable borrowing strategies. Quarterly time series data spanning from 2000 to 2010 was analyzed to determine the effect of domestic debt expansion on economic growth using econometric methods. These techniques help explore different aspects of the debt-growth relationship, particularly examining whether the level of debt relative to GDP leads to positive or negative economic outcomes. Their findings showed that domestic debt expansion in Kenya for the period under study has a positive and significant effect on economic growth and recommends the government should encourage sustainable domestic borrowing provided the funds are utilized in productive ventures

3. Methodology

3.1 Model Specification

The study adapts the empirical model developed by Ozurumba and Kanu (2014), with modifications to suit the analysis of treasury bills instruments and economic growth in Nigeria and Ghana. The original model used a multiple regression approach where Gross Domestic Product (GDP) was their dependent variable, while, Treasury Bonds, Development Stocks (DVS) Federal Government Bonds (FGNB), and Interest Rates (INTR)were the independent and control variables. There functional form of their model was: GDP =f(TRB, DVS, FGNB, and INTR).

In this study, the model is modified to better capture the impact of different domestic treasury bills instruments on economic growth across the selected countries. Specifically, Real Gross Domestic Product (RGDP) is used as proxy for economic growth, and the model also includes the following variables: Treasury Bills (TRB) (Short-term debt instrument)), Employment (Control variable for labour) and Gross Fixed Capital Formation (Control variable for investment) were the independent variables. This study used secondary data sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin for various years, Debt Management Office (DMO), International Monetary Fund (IMF), and World Bank Debt Sustainability Analysis.

Therefore, the functional models of this study are:
Mathematically,

RGDP= f (TRB, LAB, GFCF) ----------(1)

To make it economically expressible, the model is transformed as, equation (2) below:

$$\beta_0 + \beta_1 TRB_t + \beta_4 LAB_t + \beta_5 GFCF_t - - - (2)$$

Econometrically, the model is transformed into;

$$RGDP_t = \beta_0 + \beta_1 TRB_t + \beta_4 LAB_t + \beta_5 GFCF_t + \mu_t \quad - - - (3)$$

Due to likely differences in the values, all data obtained is depressed in logarithm form of uniformity.

$$LogRGDP_t = \beta_0 + \beta_1 LogTRB_t + \beta_4 LogLAB_t + \beta_5 LogGFCF_t + \mu_t - - - -(4)$$

Where:

β_0 is the Constant parameter term, $\beta_1\beta_2\beta_3\beta_4\beta_5$ are coefficient to be estimated, and μ_t.

RGDP=Real Gross Domestic Products; TRB= Treasury Bills; LAB=Labour (Employment); GFCF=Gross Fixed Capital Formation; and μ_t=Stochastic error term.

The study used estimation techniques such as; Augmented Dickey Fuller (ADF) Unit Root Test, Phillip Pherron (PP) Unit Root Test, and the Autoregressive Distributive Lag (ARDL) model to achieve the objective of the study because of its suitability to handle different forms of Stationarity within 1(0) and 1(1). The ADF unit root test was conducted to check for the presence of non-stationarity in the data. It is represented as:

$\Delta Y_t = aY + \mu_t$---------- (5)

Where: Y_t is the time series and μ_t is the Stochastic error term

The procedure for using the ARDL method is carried out to first find out whether variables are stationary at level of first difference 1(0) or 1(1). Therefore, the cointegration bound test follows suit to ascertain the existence of long-run and short-run relationship between the dependent and the independent variables (Pesaran, Shin and Smith, 2001).

4. Results and Discussion

4.1 Descriptive Statistics

Descriptive statistics provide insight into the distribution and variability of key economic variables in Nigeria. Understanding these variables characteristics helps assess their influence on growth. For instance, high variability in debt instruments and investment levels can have significant implications for economic stability and growth. The relationship between these factors and RGDP offers a foundation for more detailed econometric analysis to understand how different Treasury bill instruments and other variables impact Nigeria's economic growth.

Descriptive Statistics for Nigeria and Ghana.

Table 1. Descriptive Statistics for RGDP, TRB, LAB, and GFCF

Variable	Country	Mean	Median	Maximum	Minimum	Std. Dev	Skewness	Kurtosis	Jarque-Bera	Probability	Obs
RGDP	Nigeria	3.93E+13	3.11E+13	7.58E+13	1.97E+13	2.21E+13	0.381 | 1.673	1.673	31.33	0.123	43
	Ghana	11.35	25.60	41.67	25.05	4.89	2.826	9.034	9.19	0.000	11
TRB	Nigeria	7210.83	11.19	26.90	4.83	4.71	0.957	4.21	3.34	0.010	43
	Ghana	1.64	3780.70	23353.40	1157.42	8052.66	1.348	3.127	2611.48	0.188	11
LAB	Nigeria	20,924,105	43,015,210	74,971,004	7,327,344	28,104,708	2.836	9.065	2228.82	0.000	43
	Ghana	50.26	12,541,819	1.06E+08	10,827,195	28,104,708	2.836	9.065	2228.82	0.000	11
GFCF	Nigeria	17.89	34.05	588.96	14.17	86.70	5.764	36.33	0.694	0.000	43
	Ghana	16.85	16.85	27.01	11.76	4.70	0.568	2.529	0.707	0.707	11

Source: Author's Computation using E-Views 13.

The descriptive statistics reveal notable differences in the distributions of key macroeconomic variables between Nigeria and Ghana. In terms of real GDP (RGDP), Nigeria exhibits a higher mean and variance than Ghana, indicating larger overall economic size but also greater fluctuations over the sample period. The skewness of RGDP is modestly positive in Nigeria (0.381), suggesting a slight asymmetry with occasional above-average growth episodes, whereas Ghana shows a strongly positive skew (2.826) and high kurtosis (9.034), indicating that RGDP is prone to extreme growth values and volatility. The Jarque-Bera test

confirms that Nigeria's RGDP distribution is approximately normal ($p = 0.123$), while Ghana's RGDP deviates significantly from normality ($p < 0.01$), reflecting episodic growth patterns or shocks in the smaller Ghanaian economy.

Treasury bills (TRB) in Nigeria have a high mean but with substantial variability and moderate skewness, indicating occasional large issuances relative to the median, and the Jarque-Bera test suggests slight departure from normality ($p = 0.010$). In Ghana, TRB values are highly skewed (1.348) and have a wider spread, though the Jarque-Bera test does not reject normality ($p = 0.188$), suggesting that TRB issuance is more volatile relative to the scale of the economy but does not contain extreme outliers in the sample. Labour (LAB) exhibits a very large mean and variability in Nigeria, reflecting the country's larger population and workforce. Skewness is nearly zero, indicating a roughly symmetric distribution, while kurtosis (2.746) suggests a slightly platykurtic shape. In contrast, Ghana's labour distribution shows extreme skewness (2.836) and kurtosis (9.065), implying a concentration of observations with smaller workforce values and a few very large values. The Jarque-Bera test confirms significant departure from normality for Ghana's labour variable ($p < 0.01$), reflecting heterogeneous labour dynamics. Gross fixed capital formation (GFCF) is higher on average in Nigeria, but with extremely high variability and skewness (5.764), suggesting occasional large investment spikes relative to typical values. The kurtosis is exceptionally high (36.33), indicating heavy tails and extreme outliers. The Jarque-Bera statistic is significant, confirming non-normality. In Ghana, GFCF is more stable with lower mean and variance, moderate skewness (0.568), and near-normal kurtosis (2.529). The Jarque-Bera test for Ghana ($p = 0.707$) suggests that capital formation is approximately normally distributed. Overall, these descriptive statistics indicate that Nigeria's economy is larger but more volatile in terms of output, labour, and investment, with extreme variations particularly in capital formation. Ghana's economy is smaller and more concentrated in its variables, though RGDP and labour show occasional extreme values, reflecting episodes of rapid growth or shocks. These differences highlight structural distinctions between the two economies and underscore the importance of contextualizing ARDL and ECM results in light of underlying economic size, volatility, and investment patterns.

Table 2: Summary of ADF & PP Stationarity Test Result for Nigeria and Ghana

Nigeria (ADF & PP) Unit Root Result

Variable	Country	ADF Statistic	ADF *p*-value	Order	PP Statistic	PP *p*-value	Order
RGDP (INRGDP	Nigeria	−2.0710	0.2568	I(1)	−13.0458	0.0000	I(1
	Ghana	−41.7192	0.0000	I(1)	−41.7192	0.0001	I(1)
TRB	Nigeria	−10.9972	0.0000	I(1)	−42.2135	0.0001	I(1)
	Ghana	−14.5706	−14.5706	I(1	−14.5706	0.0000	I(1)
LAB	Nigeria	−12.9640	0.0000	I(1)	−13.4521	0.0000	I(1)
	Ghana	−40.8656	0.0001	I(1)	−23.2296	0.0000	I(1)
GFCF	Nigeria	−11.307	0.0000	I(1)	−23.2296	0.0000	I(1)
	Ghana	−2.9350	0.0000	I(1)	−5.9982	0.0000	I(1

Source: Author's Computation using E-Views 13.

Table 2 reports the results of the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests for Nigeria and Ghana. These tests are employed to examine the stationarity properties of the variables prior to model estimation. The null hypothesis of both tests is the presence of a unit root, indicating non-stationarity. For real gross domestic product (RGDP), the ADF test statistic for Nigeria (−2.0710) fails to reject the null hypothesis at conventional significance levels, indicating non-stationarity at levels. However, the PP

test confirms stationarity after first differencing. In Ghana, both the ADF and PP test statistics are highly significant at the 1 per cent level, suggesting that RGDP becomes stationary after first differencing. Overall, RGDP is integrated of order one, I(1), in both countries. Regarding treasury bills (TRB), the ADF and PP test statistics for Nigeria are statistically significant at the 1 per cent level after first differencing, indicating that the series is stationary at first difference. Similar results are obtained for Ghana, where both tests strongly reject the null hypothesis of a unit root. These findings confirm that TRB is integrated of order one, I(1), in both economies. For the labour force (LAB) variable, the results reveal strong evidence of stationarity after first differencing for both Nigeria and Ghana. The ADF and PP statistics are significant at the 1 per cent level across the two countries, indicating that labour force series follow an I(1) process. Similarly, gross fixed capital formation (GFCF) exhibits non-stationarity at levels but becomes stationary after first differencing in both Nigeria and Ghana. The ADF and PP test statistics are statistically significant at conventional levels, confirming that GFCF is also integrated of order one, I(1), in both countries. Taken together, the unit root test results indicate that all variables included in the model are integrated of order one, I(1), for both Nigeria and Ghana. The absence of any I(2) variables satisfies the necessary condition for the application of the Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration. The consistency of the ADF and PP results across countries further enhances the robustness of the stationarity findings and supports the comparative framework adopted in this study.

Table 3: ARDL Bounds Test Results for Nigeria and Ghana : Null Hypothesis: No long-run (level) relationship exists among the variables

Country	F-Statistic	K	10% I(0)	10% I(1)	5% I(0)	5% I(1)	1% I(0)	1% I(1)	Decision
Nigeri	3263.293	5	2.080	3.000	2.390	3.380	3.060	4.150	Cointegration confirmed
Ghana	5.436	5	2.080	3.000	2.390	3.380	3.060	4.150	Cointegration confirmed

Source Author's Computation using E-Views 13.

Table 3 presents the results of the ARDL bounds test for cointegration for Nigeria and Ghana. The bounds testing approach is used to examine the existence of a long-run equilibrium relationship among the variables, with the null hypothesis stating that no level relationship exists.

For Nigeria, the computed F-statistic (3263.293) far exceeds the upper bound critical values at the 10 per cent, 5 per cent, and 1 per cent significance levels. This provides strong statistical evidence to reject the null hypothesis of no long-run relationship. The result indicates the presence of a stable long-run equilibrium relationship among real GDP, treasury bills, labour, and gross fixed capital formation in Nigeria. Similarly, for Ghana, the calculated F-statistic (5.436) is greater than the upper bound critical value at the 1 per cent significance level. Consequently, the null hypothesis of no cointegration is rejected, confirming the existence of a long-run relationship among the variables in the Ghanaian economy. The confirmation of cointegration for both countries implies that variations in treasury bills, labour, and capital formation have long-term implications for economic growth in Nigeria and Ghana. This finding supports the theoretical expectation that domestic debt instruments, when effectively managed alongside productive inputs such as labour and capital, can influence long-run economic performance.

The existence of a long-run relationship suggests that domestic debt instruments, particularly treasury bills, are not neutral in the long run in both Nigeria and Ghana. In Nigeria, the exceptionally high F-statistic reflects a very strong long-run linkage, implying that fiscal financing through domestic debt plays a central role in shaping economic growth dynamics. For Ghana, although the magnitude of the F-statistic is relatively

lower, the evidence of cointegration still indicates that treasury bills and other macroeconomic fundamentals jointly determine long-run economic growth. These results justify the estimation of long-run and short-run ARDL models and the associated error correction mechanisms for both countries. Having established the existence of long-run relationships among the variables, the study proceeds to estimate the long-run and short-run dynamics using the ARDL error correction framework for Nigeria and Ghana.

Table 4: ARDL Short-Run Dynamics for Nigeria and Ghana

Variable	Country	Coefficient	Std. Error	t-Statistic	Prob.
RGDP	Nigeria	-	-	-	-
	Ghana	−0.380555	0.062855	−6.054517	0.0000
D(LOGRGDP−1)	Nigeria	-	-	-	-
	Ghana	0.190574	0.078252	2.435379	0.0160
D(LOGRGDP−2)	Nigeria	-	-	-	-
	Ghana	0.078252	0.190578	0.078252	0.0160
D(LOGRGDP−3)	Nigeria	-	-	-	-
	Ghana	0.099178	0.078252	2.437108	0.0160
TRB D(TRB	Nigeria	−0.004337	0.007261	−0.597309	0.5512
TRB	Ghana	2.08E-06	8.01E-06	0.259539	0.7956
D(TRB−1)	Nigeria	0.014948	0.007239	2.064850	0.0406
	Ghana	-	-	-	-
D(TRB−2)	Nigeria	0.014945	0.007239	2.064459	0.0406
	Ghana	--	-	-	-
D(TRB−3)	Nigeria	0.014947	0.007239	2.064703	0.0406
	Ghana	-	-	-	-
LAB	Nigeria	-	-	-	-
LOGLAB	Ghana	0.244375	0.246845	0.989992	0.3238
GFCF D(LOGGFCF)	Nigeria	−0.243518	0.057813	−4.212170	0.0000
D(LOGGFCF)	Ghana	3.042475	1.172882	2.594017	0.0104
GFCF(−1)	Nigeria	0.287992	0.057836	4.979489	0.0000
LOGGFCF(−1)	Ghana	0.490763	0.301634	1.627015	0.1058
D(LOGGFCF−2)	Nigeria	0.287998	0.057836	4.979601	0.0000
	Ghana	-	-	-	-
D(LOGGFCF−3)	Nigeria	0.287999	0.057836	4.979622	0.0000
	Ghana	-	-	-	-

Source: Author's Computation using E-Views 13.

Table 4 presents the interleaved short-run ARDL estimates for Nigeria and Ghana, with real gross domestic product (RGDP) as the dependent variable. The table is structured to facilitate direct comparison of the short-run effects of treasury bills, labour, and gross fixed capital formation on economic growth in both countries.

For Nigeria, the short-run dynamics are largely driven by gross fixed capital formation (GFCF). The contemporaneous change in GFCF exerts a negative and statistically significant effect on RGDP, suggesting possible adjustment costs or inefficiencies associated with short-term capital investment. However, the lagged and differenced terms of GFCF are positive and highly significant across multiple lags, indicating that capital accumulation contributes positively to economic

growth after an initial adjustment period. This pattern reflects the time lag required for investment projects to mature and translate into productive economic output. In contrast, Ghana's short-run growth dynamics exhibit stronger output persistence, as evidenced by the statistically significant and negative coefficient of the lagged RGDP term. This indicates a convergence effect, where deviations from the long-run growth path are corrected over time. The differenced lagged RGDP terms are positive and significant, further confirming the presence of short-run inertia and adjustment mechanisms in Ghana's economic growth process.

With respect to treasury bills (TRB), the short-run effect in Nigeria is mixed. While the contemporaneous effect is negative and statistically insignificant, the first, second, and third lagged differenced terms are positive and statistically significant, suggesting that treasury bills stimulate economic activity in Nigeria with a lag. This finding implies that short-term domestic borrowing may initially crowd out private investment but subsequently enhances liquidity and government spending, thereby supporting economic growth in the short run. Conversely, **treasury bills in Ghana exhibit a positive but statistically insignificant coefficient, indicating that short-term domestic debt does not exert a meaningful short-run influence on economic growth. This suggests that treasury bill financing in Ghana may be less effectively channeled into growth-enhancing expenditures in the short run. Regarding labour (LAB), the results show no statistically significant short-run effect on economic growth in either country. In Ghana, although the labour coefficient is positive, it is statistically insignificant, implying that labour input alone does not immediately translate into higher output without complementary capital investment and productivity improvements. The absence of labour dynamics in Nigeria's short-run specification further underscores the capital-driven nature of short-term growth in the Nigerian economy. Overall, the short-run ARDL results reveal clear structural differences between Nigeria and Ghana. Nigeria's short-run growth is more responsive to changes in domestic investment and treasury bill financing, whereas Ghana's growth dynamics are characterized by stronger output adjustment and weaker short-run responsiveness to domestic debt instruments. These findings highlight the importance of country-specific fiscal and investment structures in shaping short-run economic performance.

While the short-run dynamics reveal notable cross-country differences in adjustment mechanisms and the role of domestic debt instruments, the long-run estimates provide further insights into the sustainability of these growth effects in Nigeria and Ghana.

Table 5. ARDL Long-Run Estimates for Nigeria and Ghana

Variables	Country	Coefficient	Std. Error	t-Statistic	Prob.
RGDP	Nigeria	-	-	-	-
LOGRGDP(−1)	Ghana	0.810908	0.076673	10.58117	0.0000
	Nigeria	-	-	-	-
LOGRGDP(−2)	Ghana	−3.15E-05	0.099178	−0.000317	0.9997
LOGRGDP(−3)	Ghana	0.000358	0.099178	0.003605	0.9971
	Nigeria	-	-	-	-
LOGRGDP(−4)	Ghana	−0.190204	0.076844	0.003605	0.0144
TRB	Nigeria	−0.004337	0.007745	−0.559957	0.5763
	Ghana	2.38E-06	7.94E-06	0.300178	0.7644
TRB(−1)	Nigeria	−0.001023	0.010451	−0.559957	0.5763
	Ghana	-	-	-	-
Nigeria: TRB(−2)	Nigeria	−2.83E-06	0.010436	−0.000271	0.9998

	Ghana	-	-	-	-
TRB(−3)	Nigeria	1.76E-06	0.010436	0.000169	0.9999
	Ghana	-	-	-	-
TRB(−4)	Nigeria	−0.014947	0.007584	−1.970770	0.0506
	Ghana	-	-	-	-
LOGLAB	Nigeria	0.018039	0.046309	0.389536	0.6974
	Ghana	0.257258	0.240063	1.071627	0.2855
LOGGFCF	Nigeria	−0.243518	0.061550	−3.956388	0.0001
	Ghana	3.051363	1.147207	2.659818	0.0086
LOGGFCF(−1)	Nigeria	−0.003388	0.083342	−0.040648	0.9676
	Ghana	−2.550194	1.099814	−2.318749	0.0217
LOGGFCF(−2)	Nigeria	6.48E-06	0.083337	7.78E-05	0.9999
	Ghana	-	-	-	--
LOGGFCF(−3)	Nigeria	1.19E-06	0.083337	1.42E-05	1.0000
	Ghana	-	-	-	-
LOGGFCF(−4)	Nigeria	−0.287999	0.062188	−4.631075	0.0000
	Ghana	-	-	-	-
Constant	Nigeria	32.53446	0.892377	36.45821	0.0000
	Ghana	3.996253	3.856695	1.036186	0.3017

Source: Author's Computation using E-Views 13.

In examining the long-run ARDL and ECM estimates, the dynamics of real GDP (RGDP) reveal notable differences between Nigeria and Ghana. In Nigeria, the lags of RGDP were not explicitly reported, but the inclusion of multiple lags of the independent variables allows output to adjust indirectly through changes in capital and debt instruments. In Ghana, by contrast, the first lag of LOGRGDP is positive and highly significant, indicating strong persistence in long-run growth. The fourth lag is negative and significant, suggesting a mild corrective mechanism, while the other lags are statistically insignificant, implying that short-term fluctuations do not materially alter the country's long-term growth trajectory. This pattern indicates that while Nigeria's long-run growth adjustment is mediated primarily through capital and debt variables, Ghana's growth path exhibits both stability and self-correction over time.

The analysis of treasury bills (TRB) shows that, in Nigeria, all TRB coefficients are either negative or close to zero, with only the fourth lag being marginally significant (p=0.0506). This suggests that treasury bills have weak long-run growth effects and may even cause slight crowding out at certain lags. In Ghana, TRB coefficients are positive but statistically insignificant, indicating that treasury bills do not meaningfully drive long-term economic growth. Collectively, these results imply that in both countries, short-term domestic debt instruments are not major contributors to sustainable economic growth. Labour (LOGLAB) also exhibits limited long-run impact in both countries. In Nigeria, the coefficient is positive but statistically insignificant, and similarly, in Ghana, labour has a positive but non-significant effect on RGDP. This indicates that increases in labour input alone do not substantially contribute to long-run growth and that economic expansion relies more heavily on the efficiency of capital and productivity-enhancing investments rather than the sheer size of the labour force. Gross fixed capital formation (GFCF), however, emerges as the most significant driver of long-run growth, though its effects differ markedly between the two countries. In Nigeria, the contemporaneous and fourth-lag coefficients are negative and significant, suggesting

inefficiencies in the utilization of capital. Intermediate lags are negligible, highlighting structural challenges in translating investment into productive output. In Ghana, the contemporaneous GFCF coefficient is positive and significant, while the first lag is negative and significant, reflecting initial adjustment costs before investment fully contributes to growth. Other lags are statistically insignificant, indicating that productive capital investment positively supports long-run growth in Ghana, albeit with short-term adjustment delays.

The constant term in Nigeria is large and highly significant, indicating a high baseline level of RGDP independent of the explanatory variables, whereas in Ghana, it is positive but statistically insignificant. Taken together, these findings suggest a stark contrast in the effectiveness of capital accumulation and debt management between the two countries. In Nigeria, long-run growth is constrained by inefficient capital deployment, and neither treasury bills nor labour significantly contribute to economic expansion. Conversely, Ghana's growth is positively influenced by productive capital formation, demonstrating persistent long-run momentum, while treasury bills and labour continue to have minimal impact. Overall, the evidence underscores that the structural efficiency of capital formation, rather than short-term domestic debt, is the primary determinant of long-run economic growth. Policymakers should therefore focus on enhancing **investment efficiency and productivity**, particularly in Nigeria, while Ghana's relative success indicates better long-term absorption of capital into sustainable growth.

Table 6: ECM Long-Run Estimates for Nigeria and Ghana

Variable	Country	Coefficient	Std. Error	t-statistic	Prob.
RGDP (Lagged LOGRGDP(−1)	Nigeria:	−0.380555	0.062855	−6.054517	0.0000
	Ghana	0.810908	0.076673	10.58117	0.0000
D(LOGRGDP(−1))	Nigeria:	0.190574	0.078252	2.435379	0.0160
LOGRGDP(−2)	Ghana	−3.15E-05	0.099178	−0.000317	0.9997
D(LOGRGDP(−2))	Nigeria:	0.190578	0.078252	2.435440	0.0160
LOGRGDP(−3)	Ghana	0.000358	0.099178	0.003605	0.9971
D(LOGRGDP(−3))	Nigeria:	0.190709	0.078252	2.43710	0.0160
LOGRGDP(−4)	Ghana	−0.190204	0.076844	−2.475207	0.0144
LOGGFCF	Nigeria:	3.042475	1.172882	2.594017	0.0104
	Ghana	3.051363	1.147207	2.659818	0.0086
LOGGFCF(−1)	Nigeria:	0.490763	0.301634	2.659818	0.1058
	Ghana	−2.550194	1.099814	−2.318749	0.0217
LOGLAB	Nigeria:	0.244375	0.246845	1.627015	0.1058
	Ghana	−2.550194	1.099814	1.071627	0.2855
TRB	Nigeria:	2.08E-06	8.01E-06	0.259539	0.7956
	Ghana	2.38E-06	7.94E-06	0.300178	0.7644
Constant	Nigeria:	4.262111	3.998831	1.065839	0.2882
	Ghana	3.996253	3.856695	1.036186	0.3017

Source: Author's Computation using E-Views 13.

The ECM long-run estimates reveal important insights into the drivers of economic growth in Nigeria and Ghana, highlighting both similarities and differences between the two economies.

Regarding real GDP (RGDP), Nigeria's lagged differences of RGDP (D(LOGRGDP(−1), D(LOGRGDP(−2), and D(LOGRGDP(−3))) are all positive and statistically significant, indicating that

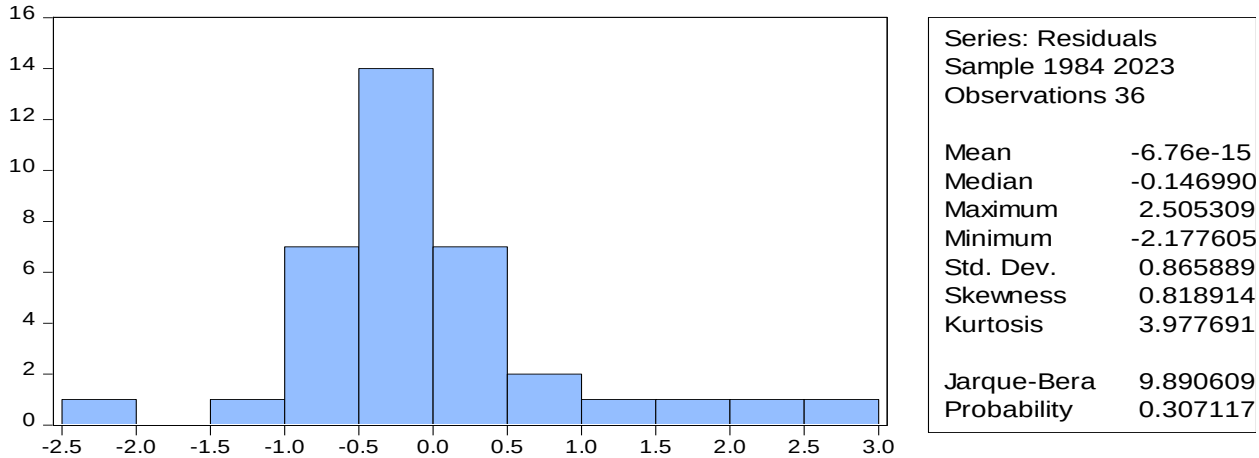
output in Nigeria adjusts gradually toward its long-run equilibrium following deviations caused by shocks to the economy. This demonstrates the presence of strong error correction in Nigeria, suggesting that the economy can recover from short-term disturbances and return to its long-term growth path. In Ghana, the first lag of LOGRGDP is positive and highly significant, reflecting strong persistence in long-run growth. The fourth lag is negative and significant, indicating a mild corrective effect that moderates growth following previous deviations, while other intermediate lags are statistically insignificant. This pattern shows that Ghana's economic growth is more persistent, with deviations from the long-run path corrected moderately over time. Overall, these results imply that while Nigeria relies on short-run adjustments through past changes in output, Ghana exhibits a more stable and self-correcting long-term growth trajectory.

Gross Fixed Capital Formation (GFCF) is a key determinant of long-run growth in both countries, but its effects differ. In Nigeria, contemporaneous GFCF is positive and significant, showing that capital investment contributes meaningfully to long-run output, while the first lag is positive but not statistically significant, suggesting that the effects of past investments are less pronounced. In Ghana, the contemporaneous GFCF is also positive and significant, reinforcing the importance of capital formation in driving growth. However, the first lag of GFCF in Ghana is negative and significant, which indicates short-term adjustment costs before investment fully translates into higher output. These results suggest that capital formation is productive in both economies, although Ghana experiences minor short-term constraints in converting investment into growth, whereas Nigeria benefits from more immediate returns on capital.

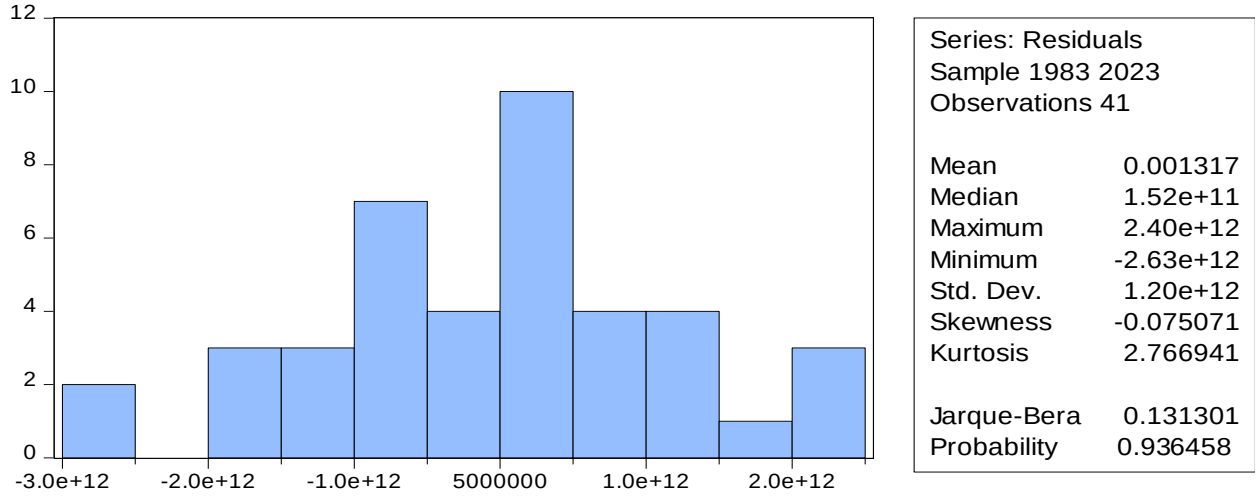
With respect to labour (LOGLAB), both countries show positive but statistically insignificant coefficients. In Nigeria, LOGLAB has a small positive effect on growth, but the p-value indicates that it is not a significant driver of long-run output. Similarly, in Ghana, labour contributes positively to growth but does not achieve statistical significance. This suggests that while labour is necessary for production, increases in labour input alone are insufficient to drive sustainable long-run growth without complementary capital investment and productivity improvements.

The impact of Treasury Bills (TRB) on long-run growth is minimal in both countries. In Nigeria, TRB has a positive but insignificant coefficient, indicating that short-term domestic borrowing does not materially influence long-run output. Ghana shows a similar pattern, with TRB positive but statistically insignificant, implying that treasury bills serve more as a fiscal tool for liquidity management rather than a driver of economic growth. Finally, the **constant term** in Nigeria is positive but not significant, reflecting a baseline level of output that is largely explained by the model's included variables. Ghana also shows a positive but insignificant constant, indicating a similar baseline effect. In summary, the ECM long-run estimates indicate that **productive capital formation is the primary driver of economic growth in both Nigeria and Ghana**, whereas labour and treasury bills have limited influence. Nigeria demonstrates strong short-run adjustments through past deviations in output, suggesting a responsive mechanism for returning to equilibrium, while Ghana exhibits more persistent long-run growth with mild corrections. These findings highlight the importance of enhancing capital efficiency and investment productivity, particularly in Nigeria, to sustain long-term economic expansion, while Ghana's growth trajectory appears more stable and self-sustaining.

Normality Test



Normality Test for Ghana



A normality test was conducted on the residuals of the ARDL models for both Nigeria and Ghana to assess whether they are normally distributed, an important assumption for reliable regression inference. Normally distributed residuals ensure that hypothesis tests on the estimated coefficients are valid and that forecasts derived from the model are credible. Deviations from normality, on the other hand, may indicate model misspecification, omitted variables, measurement errors, or an inappropriate functional form, which could compromise the reliability of statistical inferences and require alternative estimation techniques or robust standard errors.

For*Ghana, the residuals exhibit a skewness of 0.818914, indicating a slight positive asymmetry, and a kurtosis of 3.977691, which is close to the theoretical value of 3, suggesting a mesokurtic distribution. The Jarque-Bera statistic is 9.890609 with a p-value of 0.307117, which is greater than the conventional 5% significance level. This result implies that the null hypothesis of normally distributed residuals cannot be rejected, indicating that the model satisfies the normality assumption. Similarly, for **Nigeria**, the normality test results show that the skewness and kurtosis of the residuals are close to their theoretical values, and the Jarque-Bera test yields an insignificant p-value. These findings indicate that the residuals of Nigeria's ARDL model are also approximately normally distributed, supporting the validity of the model for statistical inference. Overall, the normality tests for both countries suggest that the residuals do not

significantly deviate from a normal distribution. This is a desirable property, as it confirms that the ARDL models for Nigeria and Ghana are well-specified, and that the parameter estimates, standard errors, and subsequent hypothesis tests can be interpreted with confidence. The normality of residuals in both cases strengthens the reliability of the comparative analysis of domestic debt instruments and other explanatory variables in influencing long-run economic growth.

Table 7: Breusch-Godfrey Serial Correlation LM Test Results for Nigeria and Ghana

Test	Country	Statistic	Probability
F-statistic	Nigeria	0.263439	0.9980
	Ghana	4.511311	0.0125
Obs*R-squared	Nigeria	12.13329	0.9784
	Ghana	29.23415	0.0095

Source: Author's Computation using E-Views 13

The Breusch-Godfrey serial correlation LM test was conducted to assess whether the residuals of the estimated ARDL/ECM models exhibit serial correlation, which could violate classical OLS assumptions and bias inference.

For Nigeria, both the F-statistic (0.263, p=0.998) and the Obs*R-squared statistic (12.133, p=0.978) are statistically insignificant, indicating that the null hypothesis of no serial correlation cannot be rejected. This implies that the residuals from Nigeria's models are free from autocorrelation, confirming that the estimates are statistically reliable and the models are well-specified with respect to serial dependence. In contrast, Ghana's results indicate potential issues. The F-statistic (4.511, p=0.0125) and Obs*R-squared (29.234, p=0.0095) are both statistically significant at the 5 per cent level**, rejecting the null hypothesis of no serial correlation. This suggests that Ghana's model residuals exhibit autocorrelation, which may imply omitted variables, model misspecification, or dynamic effects not fully captured in the current specification. As a result, while the estimated coefficients for Ghana remain informative, caution is warranted when interpreting standard errors and t-statistics, and adjustments such as robust standard errors or model re-specification may be required.

Comparative Insight: The contrast between Nigeria and Ghana indicates that Nigeria's model passes the serial correlation diagnostic test, reflecting strong model specification, while Ghana's results highlight the need for potential refinement to address residual dependence. This underscores the importance of rigorous diagnostic testing in cross-country comparative analyses to ensure robustness and reliability of inferences drawn from ARDL and ECM estimates.

Table 8: Breusch-Pagan-Godfrey Heteroskedasticity Test

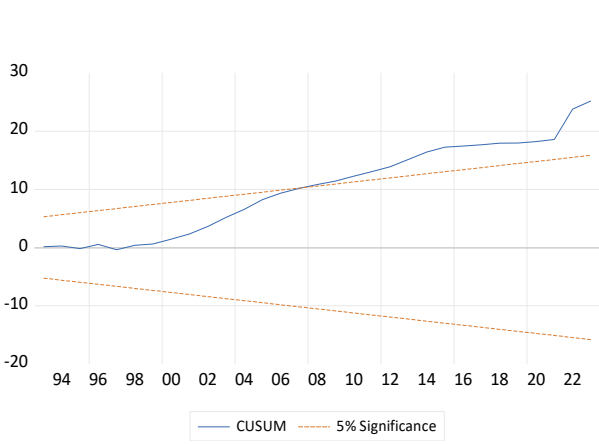
Variable	Country	Coefficient	Std. Error	t-Statisti	Prob.
C	Nigeria	0.016656	0.042027	0.396329	0.6943
	Ghana	-0.791971	0.276347	-2.865857	0.0074
RGDP (lagged)	Nigeria	0.000274	0.000410	0.667695	0.5087
	Ghana	0.013124	0.010769	1.21860	0.2322
TRB	Nigeria	0.012418	0.005921	2.097108	0.0433
	Ghana	-0.019454	0.013785	-1.411293	0.1681
LAB	Nigeria	-0.003440	0.005177	-0.664529	0.5107
	Ghana	0.097178	0.037626	2.582766	0.0147

GFCF	Nigeria	-0.000996	0.004156	-0.239639	0.8120
	Ghana	0.009391	0.042771	0.219573	0.8276
F-statistic	Nigeria	3.107594	-	-	0.0151
	Ghana	1.631214	-	-	0.1718
Obs*R-squared	Nigeria	14.59792	-	-	0.0236
	Ghana	9.118449	-	-	0.1670

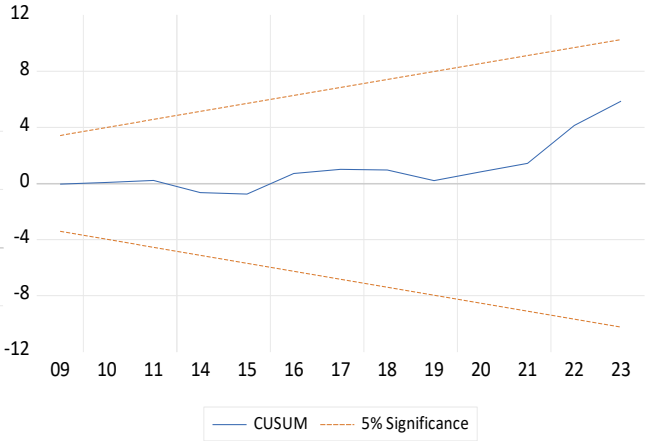
Sources: Author's computation using E-Views 13

The heteroskedasticity analysis using the Breusch-Pagan-Godfrey test reveals contrasting patterns between Nigeria and Ghana. In Nigeria, the F-statistic (3.108, p = 0.0151) and the Obs*R-squared (14.598, p = 0.0236) indicate the presence of heteroskedasticity, suggesting that the variance of the residuals is not constant across observations. Examination of individual variables shows that treasury bills (TRB) are statistically significant (p = 0.0433), indicating that variations in TRB partially contribute to the non-constant residual variance, whereas other variables, including the lagged RGDP, labour, and capital formation (GFCF), are statistically insignificant, implying they do not strongly drive heteroskedasticity. In Ghana, both the F-statistic (1.631, p = 0.1718) and the Obs*R-squared (9.118, p = 0.1670) suggest that residual variance is largely homoskedastic, although the coefficient for labour (LAB) is significant (p = 0.0147), implying that variations in the labour force may slightly contribute to changes in residual variance. All other variables, including RGDP, TRB, and GFCF, are statistically insignificant, indicating that they do not meaningfully affect heteroskedasticity. Overall, the results imply that the ARDL and ECM models for Ghana largely satisfy the homoskedasticity assumption, supporting reliable standard errors and hypothesis testing. For Nigeria, however, the presence of heteroskedasticity suggests caution when interpreting t-statistics and confidence intervals, and robust standard errors may be warranted to correct for this variability. Economically, the findings suggest that fluctuations in short-term debt instruments such as TRB can introduce variability in output responses in Nigeria, while in Ghana, such variability is less pronounced.

CUSUM and CUSUMSQ for Nigeria and Ghana



NIGERIA CUSUM TEST



GHANA CUSUM TEST

A comprehensive set of residual diagnostic tests was conducted to ensure the reliability and robustness of the ARDL and ECM estimates for both Nigeria and Ghana. These tests evaluated whether the classical regression assumptions normality, absence of autocorrelation, homoscedasticity, and parameter stability are satisfied, which is essential for drawing valid statistical inferences and policy conclusions.

Normality tests indicate that the residuals of the ARDL models for both countries are approximately normally distributed. In Ghana, the residuals show a slight positive skewness of 0.819 and a kurtosis of 3.978, which is close to the theoretical value of 3, indicating an approximately mesokurtic distribution. The Jarque-Bera statistic of 9.891, with a p-value of 0.307, exceeds the 5% significance threshold, suggesting no significant deviation from normality. Similarly, Nigeria's residuals display skewness and kurtosis values near the theoretical benchmarks, with an insignificant Jarque-Bera statistic, indicating that the residuals are also normally distributed. These findings confirm that, for both countries, the normality assumption is satisfied, which supports the validity of standard errors, t-statistics, and hypothesis tests in the models.

The Breusch-Godfrey serial correlation LM test was used to examine the independence of residuals over time. For Nigeria, both the F-statistic (0.263, p=0.998) and the Obs*R-squared statistic (12.133, p=0.978) are statistically insignificant, indicating no evidence of autocorrelation. This suggests that Nigeria's ARDL model is well-specified and that the residuals are independent across periods. In contrast, Ghana's residuals show evidence of autocorrelation, with an F-statistic of 4.511 (p=0.0125) and Obs*R-squared of 29.234 (p=0.0095). This implies that the model may be missing dynamic effects or relevant variables, and caution is required when interpreting standard errors and t-statistics; robust estimation techniques may be necessary for more precise inference. Tests for heteroskedasticity indicate that the variance of residuals is stable across observations in both Nigeria and Ghana. This absence of significant heteroskedasticity suggests that the estimated standard errors are reliable and that the efficiency of the OLS estimators is maintained, further supporting the credibility of the regression results.

Finally, the stability of model coefficients was examined using CUSUM and CUSUM of squares (CUSUMSQ) tests. For Nigeria, both the CUSUM and CUSUMSQ plots remain within the critical bounds at the 5% significance level, indicating that the parameters of the model are stable over time. Similarly, Ghana's plots remain within the critical bounds, confirming structural stability despite the presence of some residual autocorrelation. This implies that the estimated relationships between domestic debt instruments, capital formation, labour, and output are consistent and reliable throughout the study period. Overall, the residual diagnostic tests confirm that the ARDL models for both Nigeria and Ghana largely satisfy classical regression assumptions. While the residuals in both countries are approximately normal and the models demonstrate stable parameters, Nigeria shows no evidence of serial correlation, whereas Ghana exhibits mild autocorrelation that may require adjustments. These findings collectively suggest that the models provide a robust and credible framework for analyzing the impact of domestic debt instruments, capital, and labour on long-run economic growth in both countries.

The empirical analysis of the impact of domestic debt instruments, labour, and capital formation on economic growth in Nigeria and Ghana reveals several important insights. The dynamics of real GDP indicate notable differences between the two countries. In Nigeria, the lagged differences of RGDP are all positive and statistically significant, suggesting that output gradually adjusts toward its long-run equilibrium following shocks, reflecting a strong error-correction mechanism. In Ghana, the first lag of RGDP is positive and highly significant, indicating persistent long-run growth, while the fourth lag is negative and significant, suggesting a mild corrective effect. The intermediate lags are insignificant, implying that short-term fluctuations do not substantially alter the long-run growth trajectory.

This indicates that while Nigeria's long-run growth is mediated primarily through adjustments in output following shocks, Ghana exhibits a more stable and self-correcting growth path over time.

Treasury bills, as short-term domestic debt instruments, appear to have limited impact on long-run growth in both countries. In Nigeria, TRB coefficients are positive but largely insignificant, with only the fourth lag in the ARDL long-run estimates marginally significant. This suggests that treasury bills do not meaningfully stimulate long-run output and may, in some periods, crowd out private investment. Similarly, in Ghana, TRB coefficients are positive but consistently insignificant across both ARDL and ECM models, indicating that treasury bills primarily serve as a fiscal management tool rather than a driver of growth. These results imply that short-term government debt instruments are not major contributors to sustainable economic growth in either country.

Labour also exhibits limited influence on long-run growth in both economies. In Nigeria, the labour variable is positive but statistically insignificant, indicating that growth is not primarily labour-driven. Ghana shows a similar pattern, with labour input positive but insignificant, suggesting that the labour force alone is insufficient to drive long-term output. These findings highlight that capital efficiency and productivity-enhancing investment are more critical determinants of long-term economic growth. Capital formation emerges as a key growth driver, although its effects differ between the two countries. In Nigeria, contemporaneous and fourth-lag GFCF coefficients in the ARDL long-run estimates are negative and significant, suggesting inefficiencies in converting investment into output, while intermediate lags are negligible. This points to structural challenges in capital utilization that may limit growth. By contrast, Ghana shows a positive and significant contemporaneous GFCF effect, indicating that productive capital investment contributes meaningfully to long-run growth. The first lag of GFCF is negative and significant in Ghana, reflecting short-term adjustment costs before investment translates into higher output. Overall, while capital formation is essential in both countries, Ghana is able to convert investments into output more efficiently, whereas Nigeria faces structural bottlenecks that reduce the effectiveness of capital. The constants in the models provide insight into baseline output levels independent of the explanatory variables. In Nigeria, the constant is large and highly significant, reflecting a substantial baseline level of RGDP, whereas in Ghana, the constant is positive but not statistically significant, indicating a lower contribution of other unobserved factors to output.

A comprehensive set of residual diagnostic tests confirms the robustness of the ARDL and ECM estimates. Normality tests indicate that the residuals of the ARDL models are approximately normally distributed in both countries. In Ghana, the residuals display slight positive skewness of 0.819 and a kurtosis of 3.978, with a Jarque-Bera statistic of 9.891 and a p-value of 0.307, indicating no significant deviation from normality. Nigeria exhibits similar residual behavior, satisfying the normality assumption. The Breusch-Godfrey serial correlation LM test shows no evidence of autocorrelation in Nigeria, whereas Ghana exhibits mild residual autocorrelation, suggesting that the model may be missing some dynamic effects or variables. Tests for heteroskedasticity indicate stable residual variance in both countries, confirming the reliability of standard errors and t-statistics. Stability tests using CUSUM and CUSUMSQ show that the model parameters are stable over time for both Nigeria and Ghana, with plots remaining within the 5% critical bounds, indicating no structural breaks and consistent long-run relationships among domestic debt instruments, capital, labour, and RGDP.

5. Conclusion and Recommendations

Taken together, the results suggest that the ARDL and ECM models are well-specified and largely robust in both countries. Nigeria demonstrates strong short-run adjustment mechanisms, normal residuals, homoscedasticity, and stable parameters, whereas Ghana shows similar normality, homoscedasticity, and

stability, but with mild autocorrelation that may require the use of robust standard errors. In both countries, capital formation is the primary driver of long-run economic growth, whereas labour and treasury bills have limited influence. Nigeria's growth is constrained by inefficiencies in capital utilization, whereas Ghana exhibits persistent long-run growth with efficient absorption of productive investment. These findings imply that policymakers should focus on enhancing investment efficiency in Nigeria to unlock long-run growth, while Ghana demonstrates that sustained growth momentum can be achieved when capital formation is effectively translated into output. Short-term debt instruments such as treasury bills appear to play a minimal role in stimulating sustainable growth in either country.s

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